TOTAL MAXIMUM DAILY LOADS FOR TOXIC POLLUTANTS IN BALLONA CREEK ESTUARY

PREPARED BY
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LOS ANGELES REGION
AND
U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 9

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LIST OF ACRONYMS

µg/g	Micrograms per Gram
µg/kg	Micrograms per Kilogram
µg/L	Micrograms per Liter
ATSDR	Agency for Toxic Substances and Disease Registry
BAT	Best Available Technology
BCT	Best Conventional Pollutant Control Technology
BMPs	Best Management Practices
BPTCP	Bay Protection and Toxic Cleanup Program
Caltrans	California Department of Transportation
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
COMM	Commercial and Sport Fishing
CSTF	Contaminated Sediments Task Force
CTR	California Toxics Rule
CWA	Clean Water Act
DL	Detection Limit
EMCs	Event Mean Concentrations
ERL	Effects Range-Low
ERM	Effects Range-Median
EST	Estuarine Habitat
FHWA	Federal Highway Administration
FR	Federal Register
HSPF	Hydrological Simulation Program FORTRAN
IPWP	Integrated Plan for the Wastewater Program
IRP	Integrated Resources Plan
kg	Kilograms
LACDPW	Los Angeles County Department of Public Works
LARWQCB	Los Angeles Regional Water Quality Control Board
M&N	Moffatt and Nichol Engineers
m^3	Cubic Meters
m^3/yr	Cubic Meters per Year
MAR	Marine Habitat
MCLs	Maximum Contaminant Levels
MdRH	Marina del Rey Harbor
MGD	Million Gallons per Day
mg/kg	Milligrams per Kilogram
MIGR	Migration of Aquatic Organisms
MS4	Municipal Separate Storm Sewer System
mt/m^3	Metric Tons per Cubic Meter
MTRL	Maximum Tissue Residue Level
MUN	Municipal and Domestic Water Supply
NAV	Navigation

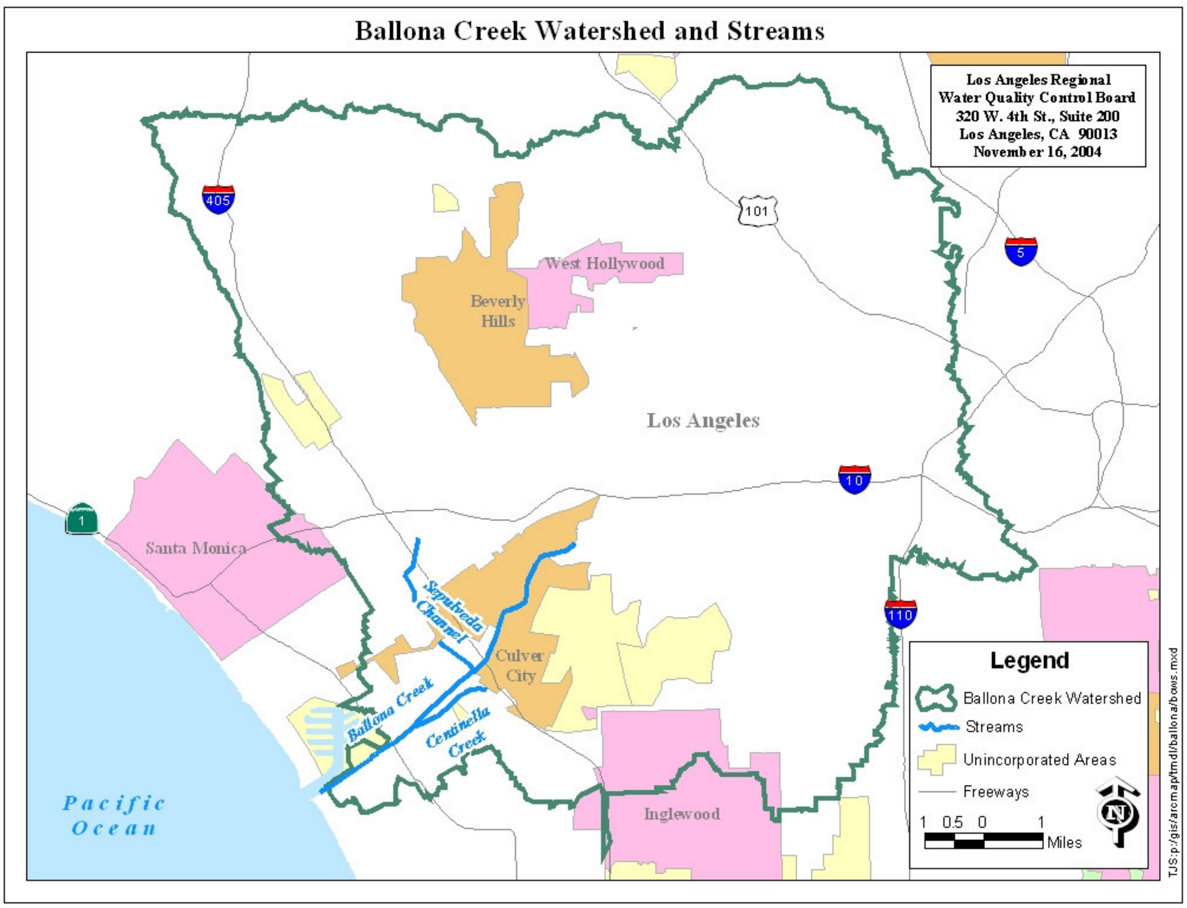
ND	Non Detect
ng/L	Nanograms per Liter
NHD	National Hydrography Data Set
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPTN	National Pesticide Telecommunications Network
O&M	Operation and Maintenance
OEHHA	Office of Environmental Heath Hazard Assessment
PAHs	Polynuclear Aromatic Hydrocarbons
PCBs	Polychlorinated biphenyls
PEL	Probable Effects Level
pg/L	Picograms per Liter
ppb	Parts per Billion
ppt	Parts per Thousand
RARE	Rare, Threatened, or Endangered Species
REC1	Water Contact Recreation
REC2	Non-Contact Water Recreation
SCCWRP	Southern California Coastal Water Research Project
SHELL	Shellfish Harvesting
SMBRP	Santa Monica Bay Restoration Project
SPWN	Spawning, Reproduction, and/or Early Development
SQGs	Sediment Quality Guidelines
SQOs	Sediment Quality Objectives
SWPPP	Storm Water Pollution Prevention Plan
TEL	Threshold Effects Level
TIE	Toxicity Identification Evaluation
TMDL	Total Maximum Daily Load
TSMP	Toxic Substances Monitoring Program
US	United States
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
WARM	Warm Freshwater Habitat
WDRs	Waste Discharge Requirements
WILD	Wildlife Habitat
WLAs	Waste Load Allocations
WQA	Water Quality Assessment
WQOs	Water Quality Objectives

1 INTRODUCTION

This report presents the required elements of the Total Maximum Daily Load (TMDL) for toxic pollutants in the sediments of Ballona Creek Estuary (Estuary) and summarizes the technical analyses performed by the United States Environmental Protection Agency, Region 9 (USEPA) and the California Regional Water Quality Control Board, Los Angeles Region (Regional Board or LARWQCB) to develop this TMDL.

Segments of Ballona Creek and Estuary are listed for a variety of toxic pollutants, including metals, historic pesticides, legacy organics, the analytical suite of organic pesticides referred to collectively as Chem A, and sediment toxicity. These segments (reaches) of Ballona Creek and Estuary were included on the 1996, 1998 and 2002 California 303(d) list of impaired waterbodies (LARWQCB, 1996, 1998, 2002). The Clean Water Act (CWA) requires a TMDL be developed to restore the impaired waterbodies to their full beneficial uses.

Figure 1. Ballona Creek Watershed



This TMDL complies with 40 CFR 130.2 and 130.7, Section 303(d) of the CWA and USEPA guidance for developing TMDLs in California (USEPA, 2000a). This document summarizes the information used by the USEPA and the Regional Board to develop TMDLs for toxic pollutants to the sediments of Ballona Creek Estuary. The TMDL also includes an implementation plan and cost estimate to achieve the waste load allocations (WLAs) and attain water quality objectives (WQOs) in Ballona Creek Estuary. The California Water Code (Porter-Cologne Water Quality Control Act) requires that an implementation plan be developed to achieve water quality objectives. The waterbodies addressed in this TMDL are shown in Figure 1.

1.1 REGULATORY BACKGROUND

Section 303(d) of the CWA requires that each State "shall identify those waters within its boundaries for which the effluent limitations are not stringent enough to implement any water quality objective applicable to such waters." The CWA also requires states to establish a priority ranking for waters on the 303(d) list of impaired waters and establish TMDLs for such waters.

The elements of a TMDL are described in 40 CFR 130.2 and 130.7 and Section 303(d) of the CWA, as well as in the USEPA guidance (USEPA, 2000a). A TMDL is defined as the "sum of the individual waste load allocations for point sources and load allocations for nonpoint sources and natural background" (40 CFR 130.2) such that the capacity of the waterbody to assimilate pollutant loads (the loading capacity) is not exceeded. A TMDL is also required to account for seasonal variations and include a margin of safety to address uncertainty in the analysis (40 CFR 130.7).

States must develop water quality management plans to implement the TMDL (40 CFR 130.6). The USEPA has oversight authority for the 303(d) program and is required to review and either approve or disapprove the TMDLs submitted by states. In California, the State Water Resources Control Board (State Board) and the nine Regional Water Quality Control Boards are responsible for preparing lists of impaired waterbodies under the 303(d) program and for preparing TMDLs, both subject to USEPA approval. If USEPA disapproves a TMDL submitted by a state, USEPA is required to establish a TMDL for that waterbody. The Regional Boards also hold regulatory authority for many of the instruments used to implement the TMDLs, such as the National Pollutant Discharge Elimination System (NPDES) permits and state-specified Waste Discharge Requirements (WDRs).

As part of its 1996 and 1998 regional water quality assessments (WQAs), the Regional Board identified over 700 waterbody-pollutant combinations in the Los Angeles Region where TMDLs would be required (LARWQCB, 1996, 1998). These are referred to as "listed" or "303(d) listed" waterbodies or waterbody segments. A 13-year schedule for development of TMDLs in the Los Angeles Region was established in a consent decree approved on March 22, 1999 (Heal the Bay Inc., et al. v. Browner, et al. C 98-4825 SBA).

For the purpose of scheduling TMDL development, the consent decree combined the more than 700 waterbody-pollutant combinations into 92 TMDL analytical units. Analytical Unit 55 addresses the impairments in Ballona Creek and Estuary associated with organic pollutants (ChemA, chlordane, dieldrin, DDT, PCBs, PAHs, and sediment toxicity) and Analytical Unit 57 addresses the impairments associated with metals (arsenic, cadmium, copper, lead, silver, and zinc) (Table 1-1). The consent decree also prescribed schedules for certain TMDLs, and according to this schedule, a TMDL for Analytical Units 55 and 57 was to be adopted by the Regional Board by March 22, 2004. Under the terms of the consent decree, USEPA was initially required to either approve a state TMDL or establish its own, by March 22, 2005. USEPA and the consent decree plaintiffs recently agreed to extend the completion deadline to December 22, 2005, in order to enable the State to complete its adoption process and USEPA to approve the State-adopted TMDLs for this water body.

Table 1-1. 1998 303(d) List of impairments identified in the Consent Decree for Ballona Creek and Estuary

TMDL Analytical Unit 55	**Ballona Creek**	**Ballona Creek Estuary**
Chem A	Tissue	
Chlordane	Tissue	Tissue, Sediment
Dieldrin	Tissue	
DDT	Tissue	Sediment
PCBs	Tissue	Tissue, Sediment
PAHs		Sediment
Toxicity	Sediment	Sediment
TMDL Analytical Unit 57	**Ballona Creek**	**Ballona Creek Estuary**
Arsenic	Tissue	
Cadmium	Sediment	
Copper	Tissue, Sediment	
Lead	Tissue, Sediment	Sediment
Silver	Tissue, Sediment	
Zinc		Sediment
Toxicity	Water	

Paragraph 8 of the consent decree provides that TMDLs need not be completed for specific waterbody by pollutant combinations if the State or EPA determines that TMDLs are not needed for these combinations, consistent with the requirements of Section 303(d). The consent decree provides that this determination may be made either through a formal decision to remove a combination from the State Section 303(d) list or through a separate determination that the specific TMDLs are not needed. Paragraph 9 of the consent decree describes procedures for giving notice that TMDLs are not needed.

On the 2002 303(d) list, the Regional Board delisted arsenic, copper, lead, and silver in fish tissue (Table 1-2). The tissue listing for arsenic in Ballona Creek was removed because the maximum tissue residue level upon which the 1998 listing was based does not exist for arsenic. The tissue listings for copper, lead, and silver in Ballona Creek were removed because the elevated data levels upon which the 1998 listings were based no longer reflect valid assessment guidelines. The 1998 sediment listings for copper and lead in Ballona Creek were not listed in the 2002 303(d) list. We believe that this was an oversight by the Regional Board as there is no documentation to support these delistings in the 2002 303(d) list. In addition, the Regional Board added new listings for dissolved copper, dissolved lead, dissolved zinc and total selenium in Ballona Creek.

Table 1-2. 2002 303(d) List of metal impairments in the Ballona Creek Watershed

Pollutant	Ballona Creek	Ballona Creek Estuary
Chem A	Tissue	
Chlordane	Tissue	Tissue, Sediment
Dieldrin	Tissue	
DDT	Tissue	Sediment
PCBs	Tissue	Tissue, Sediment
PAHs		Sediment
Cadmium	Sediment	
Copper	Water	
Lead	Water	Sediment
Selenium	Water	
Silver	Sediment	
Zinc	Water	Sediment
Toxicity	Water, Sediment	Sediment

Pursuant to paragraph 8, USEPA and the State have determined that the tissue data used to list Ballona Creek for organic contaminants were from Ballona Creek Estuary. There is no data to suggest that Ballona Creek is impaired by or should be listed for the organic contaminants identified under Analytical Unit #55. Therefore, USEPA and the State find that the Ballona Creek listings for organic were made in error and should be applied to the Estuary. Furthermore, USEPA and the State find that the fish and shellfish tissue data used by the Regional Board in 1996 and 1998 listing cycles is insufficient by itself for listing purposes under current listing procedures. Therefore, we find that a TMDL is not required for dieldrin, which was found solely in fish tissue. In addition, we find that the listing for Chem A[1] (an analytical suite of pesticides) is redundant. Since, chlordane and dieldrin were the only Chem A pesticides detected in the tissue data used by the Regional Board in the 1996 and 1998 listing cycles. Therefore, separate TMDL for Chem A is not required. Finally, USEPA and the State find that the Ballona Creek listings for all sediments (cadmium, copper, lead and silver) were made in error and should be applied to the Estuary. The basis for these findings are discussed in Section 2.2 Water Quality Data Review. This constitutes the notice as provided for in paragraph 9 of the consent decree.

On June 12, 2003, the Regional Board held a California Environmental Quality Act (CEQA) scoping meeting to solicit input from the public and interested stakeholders in determining the scope, content and implementation options of the proposed TMDL for toxic pollutants in Ballona Creek and Estuary. At the scoping meeting, the CEQA checklist of significant environmental issues and mitigation measures were discussed. This meeting fulfilled the requirements under CEQA (Public Resources Code, Section 21083.9).

This TMDL will address impairment of beneficial uses due to concentrations of chlordane, DDT, PCBs, PAHs, cadmium, copper, lead, silver and zinc in Ballona Creek Estuary sediments. The

[1] ChemA pesticides include aldrin, dieldrin, chlordane, endrin, endosulfan, heptachlor, heptachlor epoxide, hexachlorocyclohexane (including lindane), and toxaphene.

sediment toxicity listing will be addressed by the TMDLs, waste load allocations (WLAs) and load allocations (LAs) for these toxic pollutants. This TMDL was developed concurrently with the Ballona Creek Metals TMDL, which addresses impairments related to exceedances of water quality objectives for toxic metals in the water column. The TMDLs for nearby Marina del Rey Harbor required under Analytical Units # 54 and 56 are not addressed in this document.

1.2 ENVIRONMENTAL SETTING

Ballona Creek flows as an open channel for just under 10 miles from Los Angeles (South of Hancock Park) through Culver City, reaching the Pacific Ocean at Playa del Rey. North of Hancock Park, the channel continues in a network of underground storm drains. Ballona Creek and its tributaries drain a watershed with an area of approximately 128 square miles. Approximately 60% of the land use can be categorized as residential, 17% as recreation/open space, 16% as commercial, 5% as industrial, and 2% as other. The Ballona Creek watershed is comprised of the Cities of Beverly Hills and West Hollywood, and portions of the cities of Culver City, Inglewood, Los Angeles, Santa Monica, and unincorporated areas of Los Angeles County.

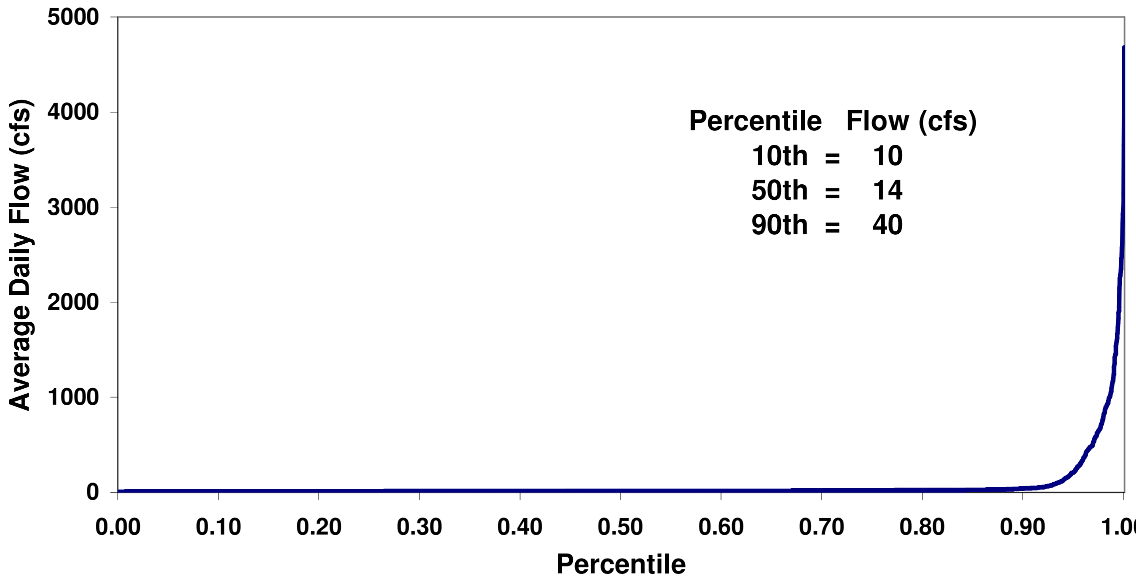
Channelization and construction of Marina del Rey Harbor altered the natural hydrology of Ballona Creek Estuary, Ballona Creek and its tributaries. Except for the estuarine section of the creek, which is composed of grouted rip-rap sloped sides and an earthen bottom, Ballona Creek is entirely lined in concrete and extends into a complex underground network of storm drains, which reaches north to Beverly Hills and West Hollywood. Tributaries of Ballona Creek include Centinela Creek, Sepulveda Canyon Channel, Benedict Canyon Channel, and numerous storm drains (Figure 1). All of these tributaries are concrete lined channels that lead to covered culverts upstream.

The Water Quality Control Plan for the Coastal Watersheds of Los Angeles and Ventura Counties (Basin Plan) defines three sections of the creek based on hydrologic units. The section referred to as "Ballona Creek" (Reach 1) is a 2-mile stretch from Cochran Avenue to National Boulevard. This area is characterized by vertical concrete walls, which line the creek from the point where it emerges from the underground network of drains at Cochran Avenue, in the City of Los Angeles, to National Boulevard in Culver City. "Ballona Creek to Estuary" (Reach 2) is the longest segment of the creek (approximately 4 miles) continuing on from National Boulevard and ending at Centinela Avenue where the Estuary begins. Sepulveda Canyon Channel discharges into Ballona Creek Reach 2. Centinela Creek drains directly to "Ballona Creek Estuary" just below the boundary with Reach 2. The Estuary continues to the Pacific Ocean for 3.5 miles and its lower portion runs parallel to the main channel of Marina del Rey Harbor (Figure 1).

The bike path along the creek provides opportunities for recreation in the area. This path extends almost seven miles from Ballona Creek at National Boulevard in Culver City to the end of Ballona Creek Estuary in Marina del Rey. The bike path is connected to another path along Dockweiler Beach by the Pacific Bridge, which links Marina del Rey to Playa del Rey.

Dry-weather flows are estimated at 14 cubic feet per second (cfs) (Ackerman et al., 2003) and can be up to 36,000 cfs for a 100-year storm event (SMBRP, 1997). As shown in Figure 2 the average daily flows during dry weather in Ballona Creek are very consistent. The 90th percentile flow is considered the inflection point between dry and wet weather. Ballona Creek was channeled to quickly convey storm water to the ocean. Therefore, the relationship between rain events in the watershed and increased flow in the creek is strong and immediate (Ackerman and Weisberg, 2003).

Figure 2. Flow in Ballona Creek at Sawtelle Avenue (1987 to 1998)



1.3 ORGANIZATION OF THIS DOCUMENT

Guidance from USEPA (1991) identifies seven elements of a TMDL. Sections 2 through 7 of this document present these elements, with the analysis and findings of this TMDL for that element. The required elements are as follows:

Section 2: Problem Identification. This section presents the data used to add the waterbody to the 303(d) list, and summarizes existing conditions using that evidence along with any new information acquired since the listing. This element identifies those reaches that fail to support all designated beneficial uses; the beneficial uses that are not supported for each reach; the WQOs designed to protect those beneficial uses; and, in summary, the evidence supporting the decision to list each reach, such as the number and severity of exceedances observed. This section also identifies the listed reaches and pollutants for which available data do not indicate water quality standards violations and for which TMDL development is not needed.

Section 3: Numeric Targets. This section identifies the numeric targets established for the TMDLs and representing attainment of water quality objectives (WQOs) and beneficial uses. For this TMDL, the numeric targets are based on narrative WQOs, interpreted through the use of sediment quality guidelines (SQGs).

Section 4: Source Assessment. This section identifies the potential point sources and nonpoint sources of organic pollutants and metals to Ballona Creek and Estuary.

Section 5: Linkage Analysis, TMDL and Pollutant Allocations. This section presents the analysis to evaluate the link between sources of toxic pollutants and the resulting conditions in the impaired waterbody. The pollutant loading capacity (i.e., assimilative capacity) and associated TMDL for each pollutant are identified. Each identifiable source is allocated a quantitative load or waste load allocations for the listed pollutants, representing the load that it can discharge while still ensuring that the receiving water meets the WQOs. Allocations are designed to protect the waterbody from conditions that exceed the applicable numeric target. The allocations are based on critical conditions to ensure protection of the waterbody under all conditions.

Section 6: Implementation. This section describes the regulatory tools, plans and other mechanisms available to achieve the WLAs. The TMDL provides cost estimates to implement best management practices (BMPs) required throughout the Ballona Creek watershed to meet water quality objectives in the Estuary.

Section 7: Monitoring. This TMDL describes the monitoring to ensure that the WQOs are attained. If the monitoring results demonstrate the TMDL has not resulted in attainment of WQOs, then revised allocations will be developed. It also describes special studies to address uncertainties in assumptions made in the development of this TMDL and the process by which new information may be used to refine the TMDL. While the TMDL identifies the goals for a monitoring program, the Executive Officer will issue subsequent orders to identify the specific requirements and the specific entities that will development and implement a monitoring program and submit technical reports.

2 PROBLEM IDENTIFICATION

The listings for Ballona Creek and Estuary are based on concentrations of chlordane, dieldrin, DDT and PCBs in fish tissue and concentrations of cadmium, copper, lead, silver, zinc, chlordane, DDT, PCBs and PAHs in sediments. This section provides an overview of water quality criteria and guidelines applicable to Ballona Creek and Estuary and reviews the water quality data used in the 1998 water quality assessment, the 2002 303(d) listing, and additional data gathered in preparation of this TMDL.

As a result of the data review conducted to prepare this section, USEPA and the State concluded that some of the 303(d) listing decisions were made in error. Section 2.2 describes the basis for these conclusions. Pursuant to the consent decree, TMDLs are not required to address these listings and are therefore not developed pursuant to the consent decree.

2.1 WATER QUALITY STANDARDS

California state water quality standards consist of the following elements: 1) beneficial uses; 2) narrative and/or numeric WQOs; and 3) an antidegradation policy. In California, beneficial uses are defined by the Regional Boards in the Water Quality Control Plans (Basin Plans). Numeric and narrative objectives are specified in each region's Basin Plan. The objectives are set to be protective of the beneficial uses in each waterbody in the region and/or to protect against degradation. Numeric objectives for toxics can be found in the California Toxics Rule (40 CFR §131.38).

2.1.1 Beneficial Uses

The Basin Plan for the Los Angeles Regional Board (1994) defines 13 existing (E), potential (P), or intermittent (I) beneficial uses for Ballona Creek, Sepulveda Canyon Channel, and Ballona Creek Estuary (Table 2-1).

Table 2-1. Beneficial Uses of Ballona Creek and Ballona Creek Estuary (LARWQCB, 1994)

Ballona Creek Watershed	Hydro Unit #	MUN	NAV	REC1	REC2	COMM	WARM	EST	MAR	WILD	RARE	MIGR	SPWN	SHELL
Ballona Creek Estuary	405.13		E	E	E	E		E	E	E	Ee	Ef	Ef	E
Ballona Creek to Estuary	405.13	P*		Ps	E		P			P				
Ballona Creek	405.15	P*		Ps	E		P			E				

Beneficial use designations apply to all tributaries to the indicated waterbody, if not listed separately.
E: Existing beneficial use
P: Potential beneficial use
e: One or more rare species utilize all oceans, bays, estuaries, and wetlands for foraging and/or nesting.
f: Aquatic organisms utilize all bays, estuaries, lagoons, and coastal wetlands, to a certain extent, for spawning and early development. This may include migration into areas that are heavily influenced by freshwater inputs.
s: Access prohibited by Los Angeles County Department of Public Works
* Conditional designation

The municipal and domestic supply (MUN) use designation is conditional, as noted by the asterisk in Table 2-1. Conditional designations are not recognized under federal law and are not subject to water quality objectives requiring TMDL development at this time. (Letter from Alexis Strauss [USEPA] to Celeste Cantú [State Board], February 15, 2002.)

Discharges of toxic pollutants to these waterbodies may result in impairments of beneficial uses associated with aquatic life (WARM, EST, MAR, WILD, RARE, MIGR, and SPWN), human use of these resources (COMM and SHELL), and recreational uses (REC1 and REC2).

Ballona Creek Estuary has existing designated uses to protect aquatic life that use the estuarine, marine, and wildlife habitat (EST, MAR and WILD). The RARE use designation is designed to protect rare, threatened or endangered species that may utilize the estuary and adjacent wetlands for foraging or nesting habitat. There are existing uses to protect aquatic organisms utilizing the estuary for migration (MIGR) or for spawning, reproduction, and/or early development (SPWN). There are also beneficial uses associated with human use of the estuary including navigation (NAV), commercial and sport fishing (COMM), and shellfish harvesting (SHELL). In the creek, there are potential designated beneficial uses to protect warm freshwater habitat (WARM) and wildlife habitat (WILD). The recreational use for water contact (REC1) applies as an existing use for the estuary and a potential use in the creek. The secondary non-contact water recreation (REC2) applies as an existing use in both the estuary and creek.

2.1.2 Water Quality Objectives (WQOs)

As stated in the Basin Plan, water quality objectives (WQOs) are intended to protect the public health and welfare and to maintain or enhance water quality in relation to the designated existing and potential beneficial uses of the water. The Basin Plan specifies both narrative and numeric water quality objectives. The following narrative water quality objectives are the most pertinent to this TMDL. These narrative WQOs may be applied to both the water column and the sediments.

> Chemical Constituents: *Surface waters shall not contain concentrations of chemical constituents in amounts that adversely affect any designated beneficial use.*
>
> Bioaccumulation: *Toxic pollutants shall not be present at levels that will bioaccumulate in aquatic life to levels, which are harmful to aquatic life or human health.*
>
> Pesticides: *No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses. There shall be no increase in pesticide concentrations found in bottom sediments or aquatic life.*
>
> Toxicity: *All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.*

The Regional Board's narrative toxicity objective reflects and implements national policy set by Congress. The Clean Water Act states that, "it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited." (33 U.S.C. 1251(a)(3).) In 2000, USEPA established numeric water quality objectives for several pollutants addressed in this TMDL in the California

Toxics Rule (CTR) (USEPA, 2000b). The CTR establishes numeric aquatic life criteria for 23 priority toxic pollutants and numeric human health criteria for 92 priority toxic pollutants. These criteria are established to protect human health and the environment and are applicable to inland surface waters, enclosed bays and estuaries.

For the protection of aquatic life, the CTR establishes short-term (acute) and long-term (chronic) criteria in both freshwater and saltwater. The acute criterion equals the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time without deleterious effects. The chronic criterion equals the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) without deleterious effects. Freshwater criteria apply to waters in which the salinity is equal to or less than 1 part per thousand (ppt) 95 percent or more of the time. Saltwater criteria apply to waters in which salinity is equal to or greater than 10 ppt 95 percent or more of the time. For waters in which the salinity is between 1 and 10 ppt, the more stringent of the two criteria apply.

The human health criteria are established to protect the general population from priority toxic pollutants regulated as carcinogens (cancer-causing substances) and are based on the consumption of water and aquatic organisms or aquatic organisms only, assuming a typical consumption of 6.5 grams per day of fish and shellfish and drinking 2.0 liters per day of water. Table 2-2 summarizes the CTR aquatic life criteria (freshwater and saltwater) and human health criteria for organic constituents covered under this TMDL (chlordane, dieldrin, DDT, and PCBs.) The CTR criteria for metals are addressed in the Ballona Creek Metals TMDL.

Table 2-2. Water quality objectives established in the CTR for organochlorine compounds

Pollutant	Criteria for the Protection of Aquatic Life				Criteria for the Protection of Human Health	
	Freshwater		Saltwater			
	Acute (µg/L)	Chronic (µg/L)	Acute (µg/L)	Chronic (µg/L)	Water & Organisms (µg/L)	Organisms only (µg/L)
Chlordane	2.4	0.0043	0.09	0.004	0.00057	0.00059
Dieldrin	0.24	0.056	0.71	0.0019	0.00014	0.00014
4,4'-DDT[1]	1.1	0.001	0.13	0.001	0.00059	0.00059
Total PCBs[2]		0.014		0.03	0.00017	0.00017

1 Based on a single isomer (4,4'-DDT).
2 Based on total PCBs, the sum of all congener or isomer or homolog or aroclor analyses.

For PCBs, the Basin Plan states that, "*Pass-through or uncontrollable discharges to waters of the Region, or at locations where the waste can subsequently reach water of the Region, are limited to 70 picograms per liter (pg/L) measured as a 30 day average for protection of human health and 14 nanograms per liter (ng/L) measured as a daily average and 30 ng/L measured as a daily average to protect aquatic life in inland fresh water and estuarine waters, respectively*." The aquatic life values in the Basin Plan are the same as in the CTR. The human health value in the Basin Plan of 70 pg/L is more stringent the CTR value of 170 pg/L.

There are no numeric standards for fish tissue in the Basin Plan. The human health criteria in the CTR were developed to ensure that bioaccumulative substances do not concentrate in fish tissue at levels that could impact human health.

There are no water quality objectives for sediment in the Basin Plan. The Regional Board applied best professional judgment to define elevated values for metals in sediment during the water quality assessments conducted in 1996, 1998, and 2002. The State Board is in the process of developing sediment quality objectives (SQOs) for enclosed bays and estuaries. Draft objectives are expected to be released for public review in August 2005, and State Board expects to adopt final sediment quality objectives and an implementation policy by March 2007. The final objectives and implementation policy would be subject to review by the Office of Administrative Law before becoming effective. The Regional Board will review the numeric targets in this TMDL for consistency with the final sediment quality objectives within six months after the effective date.

2.1.3 Antidegradation

State Board Resolution 68-16, "Statement of Policy with Respect to Maintaining High Quality Water" in California, known as the "Antidegradation Policy," protects surface and ground waters from degradation. Any actions that can adversely affect water quality in all surface and ground waters must be consistent with the maximum benefit to the people of the state, must not unreasonably affect present and anticipated beneficial use of such water, and must not result in water quality less than that prescribed in water quality plans and policies. Furthermore, any actions that can adversely affect surface waters are also subject to the federal Antidegradation Policy (40 CFR 131.12).

2.2 WATER QUALITY DATA REVIEW

This section summarizes the data for Ballona Creek and Estuary for the listed toxic pollutants in water, fish and sediments. The summary includes data considered by the Regional Board and USEPA in developing the 1998 and 2002 303(d) lists as well as subsequent data.

2.2.1 Water Column

There is very little information on the concentrations of organic pollutants in the waters of Ballona Creek and no data were available for assessing water column concentrations of organic pollutants in Ballona Creek Estuary.

Los Angeles County Department of Public Works (LACDPW) conducts storm water sampling for PAHs, PCBs and organochlorine pesticides in Ballona Creek at Sawtelle Boulevard as part of their Municipal Storm Water Permit. The data for 1995 to 2000 are summarized in Table 2-3. None of the samples collected had concentrations above the analytical detection limit. However, it should be noted that the detection limits were greater than the CTR standards for PCBs, DDTs and several of the PAHs.

Based on the limited data available, there is no indication that CTR standards are exceeded for any of the organic pollutants in Ballona Creek or the Estuary, however, additional water quality monitoring is recommended for both Ballona Creek and Estuary at detection limits that are below CTR standards. Please see the Ballona Creek Metals TMDL for a discussion of metals data in the water column.

Table 2-3. Summary of LACDPW water quality monitoring data

Pollutant	Human Health Criteria Organisms only (µg/L)	Detection Limit (µg/L)	Total No. of Samples	Total No. of Non-detected Samples
Acenaphthene	2,700	0.05	16	16
Acenaphthylene	---	0.05	16	16
Anthracene	110,000	0.05	16	16
Benzo(a)anthracene	0.049	0.1	16	16
Benzo(a)pyrene	0.049	0.1	16	16
Benzo(b)fluoranthene	0.049	0.1	16	16
Benzo(k)fluoranthene	0.049	0.1	16	16
Chrysene	0.049	0.1	16	16
Dibenzo(a,h)anthracene	0.049	0.1	16	16
Fluoranthene	370	0.1	16	16
Fluorene	14,000	0.1	16	16
Indeno (1,2,3-cd)pyrene	0.049	0.1	16	16
Naphthalene	---	0.05	16	16
Phenanthrene	---	0.05	16	16
Pyrene	11,000	0.05	16	16
Organochlorine Pesticides & PCBs	0.00014-0.00059	0.05-1.0	13	13

2.2.2 Fish and Shellfish Tissue

As discussed above, there is very little data on water column concentrations to address the potential for bioaccumulation in fish. Analysis of fish tissue for chemical contaminants provides a more direct means for assessing impacts.

Maximum tissue residue levels (MTRLs) were developed by State Board by multiplying the human health CTR water quality objectives by the bioconcentration factor for each substance as recommended by USEPA (USEPA, 1991). These objectives represent levels that protect human health from consumption of fish and shellfish. The MTRLs are an assessment tool and do not constitute enforceable regulatory limits. MTRLs have value as alert levels indicating water bodies with potential human health concerns. However, the MTRLs are no longer used by the State to evaluate fish or shellfish tissue data for 303(d) listing purposes.

Screening values have been developed by the Office of Environmental Health Hazard Assessment (OEHHA). These screening values relate human health endpoints to contaminant concentrations in fish based on an average consumption rate for fish and shellfish.

To assess potential impairments associated with contaminant concentrations in fish and shellfish tissue, we reviewed the 1996 WQA worksheets, which formed the basis for the 1998 303(d) list. Tissue data used in the assessment were from the State Mussel Watch Program in the mid-1980s and data collected as part of the Toxic Substances Monitoring Program (TSMP) in 1993 (Table 2-4). A review of the original data sets revealed that both sets of data were from locations in Ballona Creek Estuary. There is no data on fish tissue or mussel tissue for Ballona Creek. We conclude that the Ballona Creek listings for chlordane, dieldrin, DDT, and PCBs were made in error and should have been applied more properly to Ballona Creek Estuary.

Table 2-4. Summary of tissue data from State Mussel Watch Program and Toxic Substances Monitoring Program (ppb, wet weight). Station locations are in Ballona Creek Estuary

Program	Mussel Watch			TSMP	SWRCB	OEHHA
Date	1985	1986	1988	1993	Maximum Tissue Residue Level (MTRL)	Screening Value (µg/kg)
Species	Transplant California Mussel	Transplant California Mussel	Resident Bay Mussel	Striped Mullet		
Number of individuals	3	3	3	1		
Chlordane	17	13	15	119	8.3	30
Dieldrin	2	NA	ND	26	0.7	2.0
Total DDTs	16	18	16	182	--	100
Total PCBs	28	32	39	890	5.3	20

Both the Mussel Watch and the TSMP data indicate concentrations of chlordane, dieldrin, DDTs, and PCBs that are above the MTRLs or OEHHA screening values. The listing for the pesticide grouping known as Chem A is based entirely on chlordane and dieldrin. No other contaminants in the Chem A grouping were detected in either the TSMP or the Bay Protection and Toxic Cleanup Program (BPTCP) samples. Therefore, we find that the Chem A listing is redundant.

The Mussel Watch data represents three sampling events from a station labeled Marina del Rey/Ballona Creek located near the mouth of Ballona Creek Estuary. The TSMP data represents the results from a single fish (striped mullet) collected in Ballona Creek Estuary. These data sets are over 10-years old and may not reflect current conditions. Given the age of the data, the limited number of samples and the questions about the representativeness of the samples, we find that developing TMDLs based on fish or shellfish tissues is not warranted at this time. However, more fish tissue monitoring is recommended for both Ballona Creek and Estuary.

2.2.3 Sediment

To assess impacts to sediments, we reviewed the 1996 WQA worksheets, additional data reviewed by the Regional Board in the 2002 listing cycle (Table 2-5) and data compiled through the Contaminated Sediments Task Force (CSTF). The 1996 WQA worksheets, which formed the basis for the 1998 303(d) list, provide only summary information on the chemical concentrations in sediments. The original data are longer available, so we cannot confirm the sample locations. This is important because there is a discrepancy in the nomenclature used to define Ballona Creek and the Estuary. In the Basin Plan, the transition between Creek and Estuary is at Centinela Blvd. Ballona Creek (above Centinela) is concrete-lined. Ballona Creek Estuary (below Centinela) is soft-bottomed. Agencies unfamiliar with this regulatory distinction may have inadvertently attributed samples collected from Ballona Creek Estuary to Ballona Creek. Sediment data used in the 1996 WQA appear to have been collected from soft-bottomed Estuary sediments as opposed to the concrete-lined channel. Therefore, we believe that Ballona Creek was listed in error.

For Ballona Estuary, the sediment listings were based primarily on data collected as part of the BPTCP, which collected samples from a single station (Station 440240) at the mouth of the Estuary in January 1993 and February 1994. The CSTF database also contains sediment data from two studies in the bay near the mouth of the Ballona Creek Estuary. In one study, the US Army Corps of Engineers (USACE) analyzed chemical concentrations in sediments at six stations in March 1998. The other study performed by the LACDPW provides information on long-term trends (1990-1999) in sediment contaminant concentrations at two locations. Figure 3 presents the locations of the stations and the results of these studies are summarized in Table 2-5.

Figure 3. Sediment sampling locations in Ballona Estuary

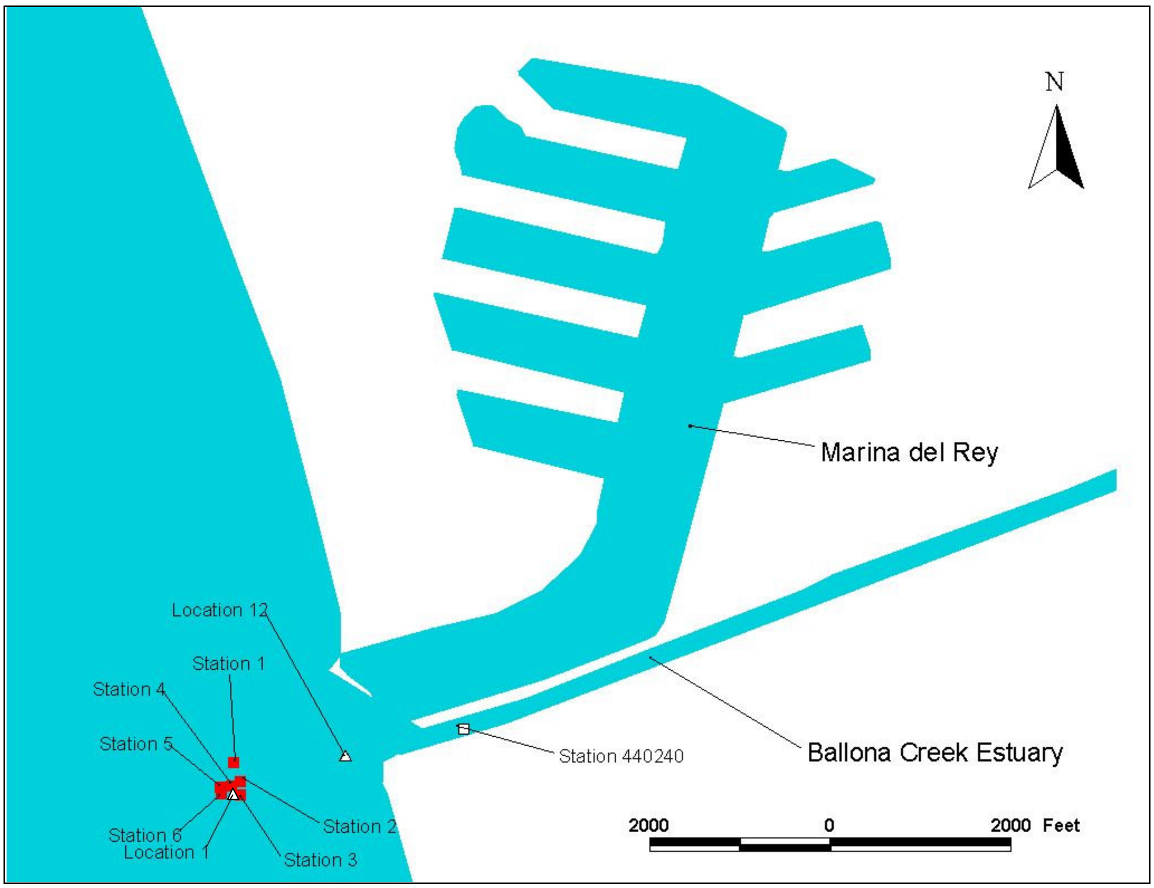


Table 2-5. Summary of available sediment quality data for the Estuary.

Station	Start date	End date	No. of samples	No > DL	Minimum (µg/kg)	Maximum (µg/kg)
Chlordane						
BPTCP (440240)	1/14/93	2/15/94	2	2	75	108
LACDPW (Location 1)	10/18/90	10/26/95	6	5	28	220
LACDPW (Location 12)	10/18/90	10/26/95	6	6	90	380
USACE (Stations 1-6)	3/1/98	3/2/98	6	5	36	92
Dieldrin						
BPTCP (440240)	1/14/93	2/15/94	2	2	9.7	27.6
LACDPW (Location 1)	10/21/92	10/13/99	7	0	0.5	1.0
LACDPW (Location 12)	10/21/92	10/13/99	7	3	1.0	30
USACE (Stations 1-6)	3/1/98	3/2/98	6	0	2.2	2.8
DDTs						
BPTCP (440240)	1/14/93	2/15/94	2	2	112	198
LACDPW (Location 1)	10/18/90	10/13/99	10	8	1.7	71
LACDPW (Location 12)	10/18/90	10/13/99	10	10	9.1	153
USACE (Stations 1-6)	3/1/98	3/2/98	6	0	6.6	8.4
PCBs						
BPTCP (440240)	1/14/93	2/15/94	2	2	236	431
LACDPW (Location 1)	10/18/90	10/13/99	10	2	10	350
LACDPW (Location 12)	10/18/90	10/13/99	10	6	10	390
USACE (Stations 1-6)	3/1/98	3/2/98	6	0	154	196
PAHs						
BPTCP (440240)	1/14/93	2/15/94	2	2	3910	6663
USACE (Stations 1-6)	3/1/98	3/2/98	6	6	407	2160

Table 2-5. Summary of available sediment quality data for the Estuary (continued).

Station	Start date	End date	No. of samples	No > DL	Minimum (mg/kg)	Maximum (mg/kg)
Cadmium						
BPTCP (440240)	1/14/93	2/15/94	2	2	0.48	2.15
LACDPW (Location 1)	10/18/90	10/13/99	10	9	0.13	1.0
LACDPW (Location 12)	10/18/90	10/13/99	10	10	0.64	1.49
USACE (Stations 1-6)	3/1/98	3/2/98	6	6	0.26	0.61
Copper						
BPTCP (440240)	1/14/93	2/15/94	2	2	100	120
LACDPW (Location 1)	10/18/90	10/13/99	10	9	6	40
LACDPW (Location 12)	10/18/90	10/13/99	10	10	16	98
USACE (Stations 1-6)	3/1/98	3/2/98	6	6	8	30
Lead						
BPTCP (440240)	1/14/93	2/15/94	2	2	34	113
LACDPW (Location 1)	10/18/90	10/13/99	10	10	23	97
LACDPW (Location 12)	10/18/90	10/13/99	10	10	112	427
USACE (Stations 1-6)	3/1/98	3/2/98	6	6	48	160
Silver						
BPTCP (440240)	1/14/93	2/15/94	2	2	0.3	3.55
LACDPW (Location 1)	10/26/95	10/13/99	5	4	0.16	0.47
LACDPW (Location 12)	10/26/95	10/13/99	5	4	0.52	1.32
USACE (Stations 1-6)	3/1/98	3/2/98	6	6	0.17	0.38
Zinc						
BPTCP (440240)	1/14/93	2/15/94	2	2	190	464
LACDPW (Location 1)	10/18/90	10/13/99	10	10	27	190
LACDPW (Location 12)	10/18/90	10/13/99	10	10	59	426
USACE (Stations 1-6)	3/1/98	3/2/98	6	6	54	170

In the 2002 listing cycle, the Regional Board evaluated sediment contaminants relative to sediment quality guidelines (SQGs), specifically the values for Effects Range-Low (ERL), Effects Range-Median (ERM) (Long et al., 1995), Threshold Effects Level (TEL), and Probable Effects Level (PEL) (MacDonald, 1994). These SQGs are based on empirical data compiled from numerous field and laboratory studies performed in North America.

The National Oceanic Atmospheric Administration (Long et al., 1995) assembled data from throughout the country that correlated chemical concentrations in sediments with effects. These data included spiked bioassay results and field data of matched biological effects and chemistry. The product of the analysis is the identification of two concentrations for each substance evaluated. The ERL values were set at the 10th percentile of the ranked data and represent the point below which adverse biological effects are not expected to occur. The ERM values were set at the 50th percentile and are interpreted as the point above which adverse effects are expected.

The TEL and PEL values were developed by the State of Florida and were based on a biological effects empirical approach similar to the ERLs/ERMs. The development of the TELs and PELs differ from the development of the ERLs and ERMs in that data showing no effects were incorporated into the analysis. In the Florida weight-of-evidence approach, two databases were assembled: a "no-effects" database and an "effects" database. The TEL values were generated by taking the geometric mean of the 15th percentile value in the effects database and the 50th percentile value of the no-effects database. The PEL values were generated by taking the geometric mean of the 50th percentile value in the effects database and the 85th percentile value of the no-effects database. By including the no-effect data in the analysis, a clearer picture of the chemical concentrations associated with the three ranges of concern (no effects, possible effects, and probable effects) can be established.

The ERLs and TELs are presumed to be non-toxic levels and pose with a high degree of confidence no potential threat. The ERMs and PELs identify pollutant concentrations that are more probably elevated to toxic levels. The SQGs used by the Regional Board during the 2002 WQA are summarized in Table 2-6.

Table 2-6. Summary of marine sediment quality guidelines used in WQAs

Organics	**ERL (µg/kg)**	**ERM (µg/kg)**	**TEL (µg/kg)**	**PEL (µg/kg)**
Chlordane	0.5	6	2.26	4.79
Dieldrin	0.02	8	0.715	4.3
Total DDTs	1.58	46.1	3.89	51.7
Total PCBs	22.7	180	21.6	189
Total PAHs	4,022	44,792	1,684	16,770
Metals	**ERL (mg/kg)**	**ERM (mg/kg)**	**TEL (mg/kg)**	**PEL (mg/kg)**
Cadmium	1.2	9.6	0.676	4.21
Copper	34	270	18.7	108
Lead	46.7	218	30.2	112
Silver	1	3.7	0.73	1.77
Zinc	150	410	124	271

The sediment data were compared to the SQGs to confirm and evaluate the impairment (Table 2-7). Several of the samples were non-detect, however, in some cases the detection limits were greater than the SQG. In Table 2-7, the detection limits were treated as the actual concentration when evaluating the sediment data.

Table 2-7. Evaluation of sediment data relative to detection limit (DL) and sediment quality guidelines

Chemical	Number of samples	# >DL	# > ERL	# > ERM	# > TEL	# > PEL
Chlordane	20	18	20	20	20	20
Dieldrin	22	5	22	3	20	3
DDTs	28	20	28	9	25	6
PCBs	28	10	20	10	20	10
PAHs	8	8	1	0	3	0
Cadmium	28	27	3	0	12	0
Copper	28	28	10	0	15	1
Lead	28	28	23	3	26	12
Silver	18	16	2	0	4	1
Zinc	28	28	9	2	11	3

2.2.3.1 Organics in Sediments

Chlordane was detected in 18 out of 20 sediment samples in the CSTF database. In the two samples, that were non-detect, the detection limit was above the SQGs. Therefore, all 20 samples exceeded the ERL, ERM, TEL and PEL values based on the assumption that the detection limit is the actual concentration.

Dieldrin was detected in 5 out of 22 sediment samples in the CSTF database. Three of the samples exceeded all of the SQGs. Concentrations at the BPTCP station 440240 ranged from 9.7 to 27.6 µg/kg. The maximum concentration of 30 µg/kg was detected by LACDPW at location 12. Samples from the other locations were below detection levels.

DDTs was detected in 20 out of 28 sediment samples in the CSTF database. DDT concentrations ranged from below detection limits to 198 µg/kg. All samples were above the ERL and nine samples were above the ERM. DDT appears to remain above concentrations of concern.

PCBs were detected in 10 out 28 sediment samples in the CSTF database. Total PCB concentrations from the BPTCP ranged from 236 to 431 µg/kg (calculated as the sum of the congeners). PCB concentrations measured by the LACDPW and the USACE were calculated as aroclor mixtures. PCBs were largely undetected in these studies, but the detection limits associated with these studies were relatively high. Summing up the detection limits for each of the aroclors, the range of values runs from 10 to 390 µg/l. Treating detection limits as true values, 20 out of the 28 measurements in CSTF database were greater than the lower level SQGs (ERL or TEL) and 10 out of 28 were greater than the highest SQG (PEL = 189 µg/kg).

PAHs were detected in 8 out of 8 sediment samples in the CSTF database. The BPTCP data indicated values ranging from 3,910 to 6,663 µg/kg. PAH values measured by the Army Corps ranged from 407 to 2,160 µg/kg. These concentrations are less than the ERM and PEL, but close to or greater than the ERL and TEL values.

In summary, the concentrations of legacy pollutants such as chlordane, DDTs, PCBs, and to a lesser extent dieldrin, remain at elevated concentration in sediments within the Ballona Creek Estuary. Concentrations of PAHs are also moderately elevated relative to sediment quality guidelines.

2.2.3.2 Metals in Sediments

Ballona Creek was listed for cadmium in 1998 303(d) list based on a maximum sediment concentration of 30 mg/kg reported in the 1996 WQA data summary. The maximum concentration in the CSTF data base is 2.15 mg/kg. Although, this value is lower, it is still greater than the low SQGs (ERL or TEL).

Ballona Creek was listed for copper in the 1998 303(d) list based on a maximum sediment concentration of 117 mg/kg reported in the 1996 WQA data summary. The maximum concentration in the CSTF data base is 120 mg/kg, which is elevated relative to many of the SQGs.

Ballona Creek was listed for lead in the 1998 303(d) list based on a maximum sediment concentration of 260 mg/kg reported in the 1996 WQA data summary. Ballona Creek Estuary was listed for lead in the 1998 303(d) list based on a maximum sediment concentration of 306 mg/kg reported in the 1996 WQA data summary. The maximum concentration in the CSTF database is 427 mg/kg. These concentrations are higher than any of the SQGs.

Ballona Creek was listed for silver in the 1998 303(d) list based on a maximum sediment concentration of 10 mg/kg reported in the 1996 WQA data summary. The maximum concentration in the CSTF database is 3.55 mg/kg, which is lower than previously reported values, but still higher than the SQGs.

Ballona Creek Estuary was listed for zinc in the 1998 303(d) list based on a maximum sediment concentration of 1310 mg/kg reported in the 1996 WQA data summary. The maximum concentration in the CSTF database is 464 mg/kg. This value is higher than any of the SQGs.

In summary, metals are elevated in the sediments of Ballona Creek Estuary and confirm the sediment listings, including copper, which should have been listed in 2002 but was inadvertently left off of the 303(d) list.

2.2.4 Summary and Findings concerning TMDLs Required

There is no evidence for water column impairment in Ballona Creek or Ballona Creek Estuary for any of the organic contaminants listed under Analytical Unit #55. The water column impairments for metals in Ballona Creek listed under Analytical Unit #57 are addressed in the Ballona Creek Metals TMDL.

There is no evidence of fish tissue problems in Ballona Creek. The fish tissue data and mussel watch data used in the listing was from Ballona Creek Estuary. Although these data indicate concentrations of chlordane, dieldrin DDT, and PCBs, that are elevated relative to screening levels, both sets of tissue data are over 10-years old and represent relatively small data sets, which may not reflect current conditions.

The site locations of the data attributed to sediments in Ballona Creek is no longer available. However, we believe these data were from the soft-bottomed Estuary rather than the concrete-lined portion of the Creek. We find that the listings for cadmium, copper, lead, and silver based on the sediment data attributed to Ballona Creek are more appropriately applied to the Estuary. There is clear evidence that chlordane, DDT, PCBs, PAHs, cadmium, copper, lead, silver and zinc are elevated in the sediments of Ballona Creek Estuary.

TMDLs will be developed to reduce sediment contamination in Ballona Creek Estuary for five metals (cadmium, copper, lead, silver, zinc) and four organic pollutants (chlordane, DDTs, PCBs, PAHs).

Table 2-8. Pollutants listed in the Consent Decree for Ballona Creek and Estuary

Pollutants in AU 55	**Ballona Creek**		**Ballona Creek Estuary**	
	Tissue	**Sediment**	**Tissue**	**Sediment**
Chem A	N[1]			
Chlordane	N[1]		N[1]	Y
Dieldrin	N[1]			
DDT	N[1]			Y
PCBs	N[1]		N[1]	Y
PAHs				Y
Toxicity		N[4]		Y[3]
Pollutants in AU 57	**Ballona Creek**		**Ballona Creek Estuary**	
	Tissue	**Sediment**	**Tissue**	**Sediment**
Arsenic	N[2]			
Cadmium		N[4]		Y[4]
Copper	N[2]	N[4]		Y[4]
Lead	N[2]	N[4]		Y
Silver	N[2]	N[4]		Y[4]
Zinc				Y

1. No TMDL required based on finding that fish tissue data inadequate for listing.
2. Delisted on the 2002 303(d) list.
3. Toxicity addressed indirectly through pollutant specific TMDLs.
4. These are modifications of the listings. This is based on the finding that the original listings for Ballona Creek sediments were made in error and are more appropriately applied to the sediments of Ballona Creek Estuary.

3 NUMERIC TARGETS

Numeric targets are developed for metals, organochlorine compounds and PAHs in sediments that are protective of aquatic life beneficial uses. As discussed in Section 2, the Basin Plan provides narrative objectives that can be applied to sediments but does not provide numeric WQOs for sediment quality. To develop the TMDLs, it is necessary to translate the narrative objectives into numeric targets that identify the measurable endpoint or goal of the TMDL and represent attainment of applicable numeric and narrative water quality standards.

Sediment quality guidelines compiled by National Oceanic and Atmospheric Administration (NOAA) are used in evaluating waterbodies within the Los Angeles Region for development of the 303(d) list. The sediment quality guidelines are applicable numeric targets because the impairments and the 303(d) listings are primarily based on sediment quality data. In addition, the pollutants being addressed have a high affinity for particles and the delivery of these pollutants is generally associated with the transport of suspended solids from the watershed or from sediments within the Estuary.

The ERLs (Long et al., 1995) guidelines are established as the numeric targets for sediments in Ballona Creek and Estuary as summarized in Table 3-1. The State Board listing policy recommends the use of ERMs along with other lines of evidence as a threshold for listing. The goal of the TMDL is to remove impairment and restore beneficial uses. Therefore, the numeric targets need to limit adverse effects to aquatic life. In addition, the selection of the ERLs as numeric targets over the ERMs provides an implicit margin of safety.

Table 3-1. Numeric targets for sediment quality in Ballona Creek and Estuary

Organics	Numeric Target for Sediment
Chlordane	0.5 µg/kg
Total DDT	1.58 µg/kg
Total PCBs	22.7 µg/kg
Total PAHs	4,022 µg/kg
Metals	**Numeric Target for Sediment**
Cadmium	1.2 mg/kg
Copper	34 mg/kg
Lead	46.7 mg/kg
Silver	1.0 mg/kg
Zinc	150 mg/kg

4 SOURCE ASSESSMENT

This section identifies the potential sources of metals and organochlorine compounds to Ballona Creek and Estuary. The toxic pollutants can enter surface waters from both point and nonpoint sources. Point sources typically include discharges from a discrete human-engineered point. These types of discharges are regulated through the federal National Pollutant Discharge Elimination System (NPDES) program, which the Regional Boards have been delegated to implement through the issuance of Waste Discharge Requirements (WDRs). Nonpoint sources, by definition, include pollutants that reach surface waters from a number of diffuse land uses and activities that are not regulated through NPDES permits. The Regional Board, under the authority of the Porter-Cologne Water Quality Control Act, issues WDRs for discharges to groundwater from nonpoint sources. In Los Angeles County urban runoff to Ballona Creek and Estuary is regulated under storm water NPDES permits, which are regulated as a point source discharge.

4.1 BACKGROUND ON TOXIC POLLUTANTS

The following sections provide background information on the toxic pollutants addressed in this TMDL, including their properties and uses.

4.1.1 Organic Pollutants

Chlordane was used as a pesticide to control insects on agricultural crops, residential lawns and gardens, and in buildings, particularly for termite control. In 1988, all chlordane uses, except for fire ant control, were voluntarily cancelled in the United States (NPTN, [undated]). Chlordane can still be legally manufactured in the United States for sale or use by foreign countries. Although it is no longer used in the US, chlordane persists in the environment, adhering strongly to soil particles. It is assumed that the only source of chlordane in the watershed is storm water runoff carrying historically deposited chlordane most likely attached to eroded sediment particles.

DDT is an organochlorine insecticide that was widely used on agricultural crops and to control disease-carrying insects. The use of DDT was banned in the United States in 1972, except for public health emergencies involving insect diseases and control of body lice. From 1947 to 1982, the Montrose Chemical Corporation of California, Inc. (Montrose) manufactured DDT at its plant on Normandie Avenue in Los Angeles, California. Wastewater containing significant concentrations of DDT was discharged from the Montrose plant into the sewers, flowed through the Los Angeles County Sanitation Districts wastewater treatment plant and was discharged to the ocean waters of the Palos Verdes Shelf through subsurface outfalls. Montrose's discharge of DDT reportedly stopped in about 1971, and the Montrose plant was shut down and dismantled in 1983. Although DDT is no longer used, it persists in the environment, adhering strongly to soil particles and moving slowly to groundwater. It is assumed that the only source of DDT in the watershed is historically deposited DDT transported through storm water runoff most likely attached to eroded sediment.

Polychlorinated biphenyls (PCBs) are mixtures of up to 209 individual chlorinated compounds (known as congeners). They were used in a wide variety of applications, including dielectric fluids in transformers and capacitors, heat transfer fluids, and lubricants. In 1976, the manufacture of PCBs was prohibited because of evidence they build up in the environment and can cause harmful health effects. Although it is now illegal to manufacture, distribute, or use PCBs, these synthetic oils were used for many years as insulating fluids in electrical transformers and in other products such as cutting oils. Products made before 1977, which may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, and old microscope and hydraulic oils. Historically, PCBs have been introduced into the environment through discharges from point sources and through spills and accidental releases. Although point source contributions are now controlled, nonpoint sources may still exist, for example, refuse sites and abandoned facilities may still contribute PCBs to the environment. Once in a waterbody, PCBs become associated with solid particles and typically enter sediments (USEPA, 2002).

Polynuclear aromatic hydrocarbons (PAHs) are a group of over 200 different chemicals. They are found in nature in coal and crude oil and in emissions from combustion of fossil fuels, forest fires and volcanoes. Most PAHs entering the environment are formed unintentionally during burning (coal, oil, wood, gasoline, garbage, tobacco and other organic material) or in certain industrial processes. Important sources of PAHs in surface waters include deposition of airborne PAHs, municipal waste water discharge, urban storm water runoff particularly from roads, runoff from coal storage areas, effluents from wood treatment plants and other industries, oil spills, and petroleum pressing (ATSDR, 1995). It is assumed that the primary source of PAHs to Ballona Creek and Estuary is urban storm water runoff. Although airborne PAHs may be a significant source to surface waters, most airborne PAHs are deposited on the land (e.g., through precipitation or indirect atmospheric deposition) and are transported to Ballona Creek through storm water runoff.

4.1.2 Metals

Cadmium is a trace element used in a wide variety of applications, including, electroplating, the manufacture of pigments, storage batteries, telephone wires, photographic supplies, glass, ceramics, some biocides, and as a stabilizer in plastics. The main anthropogenic sources of cadmium appear to be metal smelting, industries involved in the manufacture of alloys, paints, batteries, and plastics, agricultural uses of sludge, fertilizers and pesticides that contain cadmium, and the burning of fossil fuels (MacDonald, 1994).

Potential anthropogenic sources of copper include corrosion of brass and copper pipe be acidic waters, copper brake pads, the use of copper compounds as aquatic algaecides, sewage treatment plant effluents, runoff and groundwater contamination for agricultural uses of copper as fungicides and pesticides, and effluents from industrial sources. Major industrial sources include mining, smelting and refining industries, copper wire mills, coal burning industries and iron and steel producing industries (MacDonald, 1994).

The single largest use of lead is in the production of lead-zinc batteries. Lead and its compounds are used in electroplating, metallurgy, construction materials, coating and dyes, electronic equipment, plastics, veterinary medicines, fuels and radiation shielding. Lead is also used for ammunition, corrosive-liquid containers, paints, glassware, fabricating storage tank linings, transporting radioactive materials, solder, piping, cable sheathing, and roofing (MacDonald, 1994). Prior, to the phasing out of leaded gasoline, lead additives in gasoline was a significant source of lead in the environment. Since the phasing out of leaded gasoline, there has been a gradual decline of lead concentrations in the environment.

Silver is used extensively in photographic materials. Other uses of silver include the manufacture of sterling and plated ware, jewelry, coins and medallions, electrical and electronic products, brazing alloys and solders, catalysts, mirrors, fungicides, and dental and medical supplies. Potential sources of silver to surface waters include leachates from landfills, waste incineration, and effluents from the iron, steel and cement industries (MacDonald, 1994).

Zinc is primarily used as a coating on iron and steel to protect against corrosion, in alloys for die-casting, in brass, in dry batteries, in roofing and exterior fittings for buildings, and in some printing processes. The principal sources of zinc in the environment include smelting and refining activities, wood combustion, waste incineration, iron and steel production, and tire wear (MacDonald, 1994). A tire contains about half a pound of zinc, which is needed to cure the rubber (America Zinc Association).

4.2 POINT SOURCES

A point source, according to 40 CFR 122.3, is defined as "any discernable, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel, or other floating craft from which pollutants are or may be discharged." The NPDES Program, under CWA sections 318, 402, and 405, requires permits for the discharge of pollutants from point sources.

The NPDES permits in the Ballona Creek Watershed include the MS4 and Caltrans Storm Water Permits, general construction storm water permits, general industrial storm water permits, minor NPDES permits, and general NPDES permits (Table 4-1).

Table 4-1. NPDES Permits in the Ballona Creek Watershed

Type of NPDES Permit	Number of Permits
Municipal Storm Water	1
California Department of Transportation Storm Water	1
General Construction Storm Water	17
General Industrial Storm Water	14
Individual NPDES Permits (Minors)	12
General NPDES Permits:	
Construction and Project Dewatering	92
Petroleum Fuel Cleanup Sites	15
VOCs Cleanup Sites	7
Potable Water	7
Non-Process Wastewater	5
Hydrostatic Test Water	1
Total	**172**

4.2.1 Storm Water Permits

Storm water runoff in the Ballona Creek watershed is regulated through a number of permits. The first is the municipal separate storm sewer system (MS4) permit issued to the County of Los Angeles. The second is a separate statewide storm water permit specifically for the California Department of Transportation (Caltrans). The third is the statewide Construction Activities Storm Water General Permit and the fourth is the statewide Industrial Activities Storm Water General Permit. The permitting process defines these discharges as point sources because the storm water discharges from the end of a storm water conveyance system. Since, the industrial and construction storm water discharges are enrolled under NPDES permits, these discharges are treated as point sources in this TMDL.

4.2.1.1 MS4 Storm Water Permits

In 1990, USEPA developed rules establishing Phase I of the NPDES storm water program, designed to prevent harmful pollutants from being washed by storm water runoff into MS4s (or from being discharged directly into the MS4s) and then discharged from the MS4s into local waterbodies. Phase I of the program required operators of medium and large MS4s (those generally serving populations of 100,000 or more) to implement a storm water management program as a means to control polluted discharges from MS4s. Approved storm water management programs for medium and large MS4s are required to address a variety of water quality-related issues, including roadway runoff management, municipally owned operations, and hazardous waste treatment. Large and medium MS4 operators are required to develop and implement Storm Water Management Plans that address, at a minimum, the following elements:

- Structural control maintenance
- Areas of significant development or redevelopment
- Roadway runoff management
- Flood control related to water quality issues
- Municipally owned operations such as landfills, wastewater treatment plants, etc.
- Municipally owned hazardous waste treatment, storage, or disposal sites, etc.
- Application of pesticides, herbicides, and fertilizers
- Illicit discharge detection and elimination
- Regulation of sites classified as associated with industrial activity
- Construction site and post-construction site runoff control
- Public education and outreach

The MS4 Permit was renewed in December 2001 (Regional Board Order No. 01-182) and is on a five-year renewal cycle. There are 85 co-permittees covered under this permit including 84 cities and the County of Los Angeles.

4.2.1.2 Caltrans Storm Water Permit

As stated previously, Caltrans is regulated by a statewide storm water discharge permit that covers all municipal storm water activities and construction activities (State Board Order No. 99-06-DWQ). The Caltrans storm water permit authorizes storm water discharges from Caltrans properties such as the state highway system, park and ride facilities, and maintenance yards.

The storm water discharges from most of these Caltrans properties and facilities eventually end up in either a city or county storm drain. The metals or pesticides loading specifically from Caltrans properties have not been determined in the Ballona Creek watershed. A conservative estimate of the percentage of the Ballona Creek watershed covered by state highways is 1.3% (approximately 1080 acres). This area represents Caltrans' right-of-way that drains to Ballona Creek (Caltrans comment letter dated 8/26/04). This percentage does not represent all the watershed area that Caltrans is responsible for under the storm water permit. For example, the park and ride facilities and the maintenance yards were not included in the estimate.

4.2.1.3 General Storm Water Permits

Federal regulations for controlling pollutants in storm water discharges were issued by the USEPA on November 16, 1990 (40 Code of Federal Regulations [CFR] Parts 122, 123, and 124). The regulations require operators of specific categories of facilities where discharges of storm water associated with industrial activity occur to obtain an NPDES permit and to implement Best Available Technology Economically Achievable (BAT) to reduce or prevent non-conventional and toxic pollutants associated with industrial activity in storm water discharges and authorized non-storm discharges. The regulations also require discharges of storm water to surface waters associated with construction activity including clearing, grading, and excavation activities (except operations that result in disturbance of less than five acres of total land area) to obtain an NPDES permit and to implement BAT to reduce or eliminate storm water pollution. On December 8, 1999, federal regulations promulgated by USEPA (40CFR Parts 122, 123, and 124) expanded the NPDES storm water program to include storm water discharges from construction sites that resulted in land disturbances equal to or greater than one acre but less then five acres. Now under Phase II, any construction site that is greater than one acre must obtain a storm water permit.

On April 17, 1997, State Board issued a statewide general NPDES permit for Discharges of Storm Water Associated with Industrial Activities Excluding Construction Activities Permit (Order No. 97-03-DWQ). This Order regulate storm water discharges and authorized non-storm water discharges from ten specific categories of industrial facilities, including but not limited to manufacturing facilities, oil and gas mining facilities, landfills, and transportation facilities. As of the writing of this TMDL, there are fourteen discharges enrolled under the general industrial storm water permit within the Ballona Creek watershed. Potential pollutants from an industrial site will depend on the type of facility and operations that take place at that facility. In the Ballona Creek watershed there are sand and gravel operations, oil and natural gas facilities, transportation, recycling and manufacturing facilities. Potential pollutants from manufacturing facilities may include metals, oils and grease, and organic chemicals.

There is a potential for metals loadings from these types of facilities, especially transportation, recycling and manufacturing facilities. During wet weather, runoff from industrial sites has the potential to contribute metals loadings to the creek. This finding is supported by Stenstrom et al. in their final report on the industrial storm water monitoring program under the existing general permit. In the summary of existing data, the report found that although the data collected by the monitoring program were highly variable, the mean values for copper, lead and zinc were 1010, 2960, and 4960 µg/L, respectively (Stenstrom et al., 2005). During dry weather, the potential contribution of metals loadings from industrial storm water is low. Under Order No. 97-03-

DWQ, non-storm water discharges are authorized only when they do not contain significant quantities of pollutants, where BMPs are in place to minimize contact with significant materials and reduce flow, and when they are in compliance with Regional Board and local agency requirements.

On August 19, 1999, State Board issued a statewide general NPDES permit for Discharges of Storm Water Runoff Associated with Construction Activities (Order No. 99-08-DQW). As of the writing of this TMDL, there are seventeen construction sites enrolled under the general construction storm water permit within the Ballona Creek watershed. Potential pollutants from construction sites include sediment, which may contain historic pesticides or PCBs, as well as metals from construction materials and the heavy equipment used on construction sites. In addition, in the highly urbanized Ballona Creek watershed re-development of former industrial sites has a higher potential to discharge sediments laden with pollutants such as metals, PCBs and PAHs. During wet weather, runoff from construction sites has the potential to contribute metals loadings to the creek. In their final report to SWRCB, Raskin et al. found that building materials and construction waste exposed to storm water can leach metals and contribute metals loadings to waterways (Raskin et al., 2004). During dry weather, the potential contribution of metals loadings is low. Under Order No. 99-08-DWQ, discharges of non-storm water are authorized only where they do not cause or contribute to a violation of any water quality standard and are controlled through implementation of appropriate BMPs for elimination or reduction of pollutants.

4.2.2 Other NPDES Permits

There are two types of NPDES permits: individual and general permits. An individual NPDES permit is classified as either a major or a minor permit. Other than the MS4 and Caltrans storm water permits there are no major individual NPDES permits in the Ballona Creek watershed. The discharge flows associated with minor individual NPDES permits and general NPDES permits are typically less than 1 million gallons per day (MGD). General NPDES permits often regulate episodic discharges (e.g. dewatering operations) rather than continuous flows. The minor NPDES permits issued within the Ballona Creek watershed are also for episodic discharges.

4.2.2.1 Minor Individual NPDES Permits

There were 12 minor individual discharges to Ballona Creek, for a combined permitted discharge flow of approximately 9.1 MGD. Actual combined discharges at any one time are probably less due to the intermittent nature of the permitted activities.

The Inglewood Oil Field located in Baldwin Hills (7.55 MGD) makes up the majority of the flow from the individual minor dischargers. This permit is for the discharge of storm water from on-site retention basins, during or immediately after a rain event. The NPDES permit was issued in 1994 and only contains effluent limits for oil and grease and phenols. Therefore, it is possible that this discharge may exceed the numeric targets established in Section 3. The impact of this discharge is most realized during wet weather.

Three individual minor NPDES permits were issued in 1999 to gasoline service stations for the discharge of treated contaminated groundwater. The effluent limits (e.g., lead) are not based on

CTR, therefore, these discharges may exceed the numeric targets established in Section 3. These discharges would have the greatest impact during dry weather.

Other permits issued under this category address intermittent, small volume discharges of cooling tower blowdown, groundwater dewatering, pool or fountain filter backwash, and water softener waste. The permits for these discharges were issued in 1997, and effluent limits for metals are not based on CTR. Therefore, the discharges may exceed the numeric targets established in Section 3. These discharges would have the greatest impact during dry weather.

4.2.2.2 General NPDES Permits

Pursuant to 40 CFR parts 122 and 123, the State Board and the Regional Boards have the authority to issue general NPDES permits to regulate a category of point sources if the sources: involve the same or substantially similar types of operations; discharge the same type of waste; required the same type of effluent limitations; and require similar monitoring. The Regional Board has issued general NPDES permits for six categories of discharges: construction and project dewatering; petroleum fuel cleanup sites; volatile organic compounds (VOCs) cleanup sites; potable water; non-process wastewater; and hydrostatic test water.

The general NPDES permit for Discharges of Groundwater from Construction and Project Dewatering to Surface Waters (Order No. R4-2003-0111) covers wastewater discharges, including but not limited to, treated or untreated groundwater generated from permanent or temporary dewatering operations. Currently, there are 92 dischargers enrolled under this Order in the Ballona Creek watershed for a combined total discharge flow of approximately 14.1 MGD. The actual combined discharges at any one time are probably less due to the intermittent nature of the permitted activities. The effluent limits for metals, pesticides, PCBs and PAHs are based on CTR. Therefore, these discharges have a low potential to contribute to metals, pesticides, PCBs or PAHs loadings.

The general NPDES permit for Treated Groundwater and Other Wastewaters from Investigation and/or Cleanup of Petroleum Fuel-Contaminated Sites to Surface Waters (Order No. R4-2002-0125) covers discharges, including but not limited to, treated groundwater and other wastewaters from the investigation, dewatering, or cleanup of petroleum contamination arising from current and former leaking underground storage tanks or similar petroleum contamination. Currently, there are 15 dischargers enrolled under this Order in the Ballona Creek watershed for a combined total discharge flow of 1.5 MGD. There are effluent limitations for lead and PCBs, since these pollutants may be found at gasoline service stations. The effluent limitation for lead is based on the CTR default hardness value of 100 mg/L. Therefore, these discharges have a low potential to contribute to metals, pesticides, PCBs or PAHs loadings.

The general NPDES permit for Discharges of Treated Groundwater from Investigation and/or Cleanup of VOCs-Contaminated Sites to Surface Waters (Order No. R4-2002-0107) covers discharges, including but not limited to, treated groundwater and other wastewaters from the investigation, cleanup, or construction dewatering of VOCs only (or VOCs commingled with petroleum fuel hydrocarbons) contaminated groundwater. Currently, there are seven dischargers enrolled under this Order in the Ballona Creek watershed for a combined total discharge flow of approximately 0.5 MGD. There are effluent limitations for lead and PCB, since these pollutants may be found at industrial facilities that use VOCs, cutting oils, heat transfer fluids, and lubricants. The effluent limitation for lead is based on the CTR default hardness value of 100 mg/L. Therefore, these discharges have a low potential to contribute to metals, pesticides, PCBs or PAHs loadings.

The general NPDES permit for Discharges of Groundwater from Potable Water Supply Wells to Surface Waters (Order No. R4-2003-0108) covers discharges of groundwater from potable supply wells generated during well purging, well rehabilitation and redevelopment, and well drilling, construction and development. Currently, there are seven dischargers enrolled under this Order in the Ballona Creek watershed for a combined total discharge flow of 1.2 MGD. The effluent limits are based on the maximum contaminant levels (MCLs) for drinking water. Discharges of potable water from water supply wells have a low potential to contribute metals, pesticides, PCBs or PAHs loadings, since these pollutants are not expected to be in potable water.

The general NPDES permit for Discharges of Nonprocess Wastewater to Surface Waters (Order No. R4-2004-0058) covers waste discharges, including but not limited to, noncontact cooling water, boiler blowdown, air conditioning condensate, water treatment plant filter backwash, filter backwash, swimming pool drainage, and/or groundwater seepage. Currently, there are five dischargers enrolled under this Order in the Ballona Creek watershed for a combined total discharge flow of 0.2 MGD. The effluent limits for metals, pesticides, PCBs and PAHs are based on CTR. Therefore, these discharges have a low potential to contribute to metals, pesticides, PCBs or PAHs loadings.

The general NPDES permit for Discharges of Low Threat Hydrostatic Test Water to Surface Waters (Order No. R4-2004-0109) covers waste discharges from hydrostatic testing of pipes, tanks, and storage vessels using domestic/potable water. Currently, there is one discharger, with a design flow of 0.98 MGD, enrolled under this Order in the Ballona Creek watershed. The effluent limits are based on the maximum contaminant levels (MCLs) for drinking water. Discharges of domestic/potable water from hydrostatic testing have a low potential to contribute metals, pesticides, PCBs or PAHs loadings, since these pollutants are not expected to be in domestic/potable water.

Table 4.2 Summary of non-storm water general NPDES permits in Ballona Creek Watershed

Type of General NPDES Permit	Number of Permits	Permitted Volume (MGD)	Screening for pollutants?	Permit Limits for pollutants?	Potential for significant contribution?
Construction and Project Dewatering	92	14.1	Yes	CTR	Low
Petroleum Fuel Cleanup Sites	15	1.5	Yes	CTR (lead, PCBs)	Low
VOCs Cleanup Sites	7	0.5	Yes	CTR (lead, PCBs)	Low
Potable Water	7	1.2	Yes	Not CTR	Low
Non-Process Wastewater	5	0.2	Yes	CTR	Low
Hydrostatic Test Water	1	0.98	Yes	Not CTR	Low

4.2.3 Summary Point Sources

Urban storm water has been recognized as a substantial source of metals (Characklis and Wiesner 1997, Davis et al. 2001, Buffleben et al. 2002) and organic pollutants such as PAHs and organochlorine compounds (Suffet and Stenstrom, 1997). This is reflected in routine storm water monitoring performed by LACDPW under the MS4 permit (LACDPW, 2002). Studies have also shown that dry-weather pollutant loadings are not insignificant (McPherson et al., 2002). In drier year, the annual dry-weather load associated with urban runoff may be comparable to the annual wet-weather load (Stein et al., 2004).

The total loadings of metals and organic pollutants reflects sum of inputs from urban runoff and multiple NPDES permits within the watershed (see Table 4.1). In the Ballona Creek Watershed storm water discharges are regulated under the MS4 permit, the Caltrans permit, the general industrial storm water permit and the general construction storm water permit. There are thirteen minor NPDES permits with the potential to contribute loadings to the system. There are also over 100 non storm water general permits with low potential to contribute significant loadings to the system on an individual basis but may in the aggregate contribute significantly to the system

The most prevalent metals in urban storm water (i.e., copper, lead, zinc, and to a lesser degree cadmium) are consistently associated with the suspended solids (Sansalone and Buchberger 1997, Davis et al. 2001). These metals are typically associated with fine particles in storm water runoff (Characklis and Wiesner 1997, Liebens 2001), and have the potential to accumulate in estuarine sediments posing a risk of toxicity (Williamson and Morrisey, 2000). Locally, McPherson et al. (2002) have documented that the majority of storm water metals loading in Ballona Creek is associated with the particle phase.

The organic contaminants in storm water are also associated with suspended solids and the particulate fraction. Noblet et al. (2001) have shown that there is toxicity associated with suspended solids in urban runoff discharged from Ballona Creek, as well as with the receiving water sediments. This toxicity was likely attributed to metals and PAHs associated with the suspended sediments.

The major contributor of associated metals, organochlorine compounds, PCBs and PAHs loading to Ballona Creek and Estuary is assumed to be wet-weather runoff discharged from the storm water conveyance system. While the loadings of metals (cadmium, copper, lead, silver, zinc) and PAHs are attributable to ongoing activities in the watershed, the loadings of chlordane, DDT, and PCBs, reflect historic uses. Although the uses of these compounds are banned, these legacy pollutants continue to remain elevated in sediments. DDT and PCB loadings appear to have declined over the last 30 years (Stein et al., 2003).

4.3 NONPOINT SOURCES

A nonpoint source is a source that discharges to water of the US and/or State via sheet flow or natural discharges. An example of this would be the runoff from National Parks and State lands. In the Ballona Creek watershed National Park Service and State lands cover approximately 430 acres[2] (0.5% of the watershed). While not subject to the MS4 Permit, in the highly urbanized

[2] This acreage does not include the approximate 400 acres that the State purchased from the Playa Capital Company LLC in 2003.

Ballona Creek watershed the contribution of runoff from these areas drain to the MS4 system, therefore, this discharge is regulated as a point source.

Atmospheric deposition may be a potential nonpoint source of metals and PAHs to the watershed, through either direct or indirect deposition. PAHs are released to the atmosphere through natural and synthetic sources of emissions. The largest sources of PAHs to the atmosphere are from synthetic sources, including wood burning in homes; automobile and truck emissions; and hazardous waste sites such as abandoned wood-treatment plants (sources of creosote) and former manufactured-gas sites (sources of coal tar).

Direct atmospheric deposition of metals during dry weather was quantified by multiplying the surface area of the waterbody times the rate of atmospheric deposition by Sabin et al. (2004). These numbers are generally small because the portion of Ballona Creek watershed that is covered by water is small, approximately 480 acres or 0.6% of the watershed (Table 4-3). Therefore, direct deposition of metals is insignificant relative to the annual dry-weather loading or the total annual loading. Therefore, it is assumed that the amount of PAHs that would be directly deposited to the waterbodies through atmospheric deposition is also insignificant.

Indirect atmospheric deposition reflects the process by which metals and PAHs deposited on the land surface may be washed off during storm events and delivered through storm water runoff to Ballona Creek and Estuary. In the Ballona Creek watershed, Sabin et al. (2004) calculated the ratio of storm water runoff to indirect atmospheric deposition as 21% for copper, 11% for lead, and 29% for zinc. The loading of metals and PAHs associated with indirect atmospheric deposition are accounted for as part of the point source loading from storm water runoff.

Table 4-3. Estimate of direct and indirect atmospheric deposition (kg/year). (Source: Sabin et al., 2004)

Type of Deposition	Copper	Lead	Zinc
Direct	1.3	0.9	4.3
Indirect	3,500	2,000	13,000

5 LINKAGE ANALYSIS, TMDL AND POLLUTANT ALLOCATION

The linkage analysis is used to identify the assimilative capacity of the receiving water for the pollutant of concern by linking the source loading information to the water quality target. The TMDL is then divided among existing pollutant sources through the calculation of load and waste load allocations. This section discusses the linkage analysis used for Ballona Creek and Estuary and identifies the resulting pollutant allocations.

The goal of the contaminated sediment TMDLs is to reduce pollutant loads of cadmium, copper, lead, silver, zinc, chlordane, DDT, PCBs and PAHs from the Ballona Creek watershed to the sediments of the Estuary. These contaminants which are associated with fine-grained particles are delivered to the sediments through deposition. It is expected that reductions in loadings of these pollutants will lead to reductions in sediment concentrations over time. The existing contaminants in surface sediments will be removed over time as sediments are scoured during storms or removed in dredging operations. For the legacy pollutants (chlordane, DDT, and PCBs), some loss will also occur through the slow decay and breakdown of these organic compounds. Concentrations in surface sediments will be reduced through mixing with cleaner sediments.

The loading capacity of the sediments was estimated from the annual average net deposition of fine-grained material at the mouth of the Ballona Creek Estuary. This was translated into pollutant specific numbers using the sediment targets and an estimate of bulk sediment density of the fine-grained deposits. This provides a pollutant-specific estimate of the maximum load that can be deposited to the sediments on an annual basis. The pollutant-specific loading capacities were then divided into load and waste load allocations using information provided in Section 4 Source Assessment.

5.1 LOADING CAPACITY

In order to maintain navigability, the USACE needs to dredge the harbor entrance regularly. On average the USACE dredges the entrance to Marina del Rey Harbor every two years. Estimates of the sediment loading capacity were obtained from these historical dredging records. Hydrographic condition, pre-dredge and post-dredge bathymetric surveys of Marina del Rey Harbor were obtained by the USACE for the period between July 1991 and February 2001. Sequential combinations of surveys were then examined to determine shoal volumes within the entrance channel of Marina del Rey Harbor (M&N, 1999, USACE, 2003). The entrance channel was divided into sub-areas to help quantify the spatial distribution of shoaling rates and patterns (Figure 4). Area A and Area B cover the south and north entrance channel, respectively. Area G represents the dredging area at the mouth of Ballona Creek and Area H is the north jetty fillet, which traps sand at the north entrance. Sediment yield from Ballona Creek has been shown to be the main contributor to shoaling in Areas A and G (M&N, 1999, USACE, 2003). The shoal volumes were calculated by overlaying the successive pairs of survey and calculating relative changes in bottom elevation (Table 5-1).

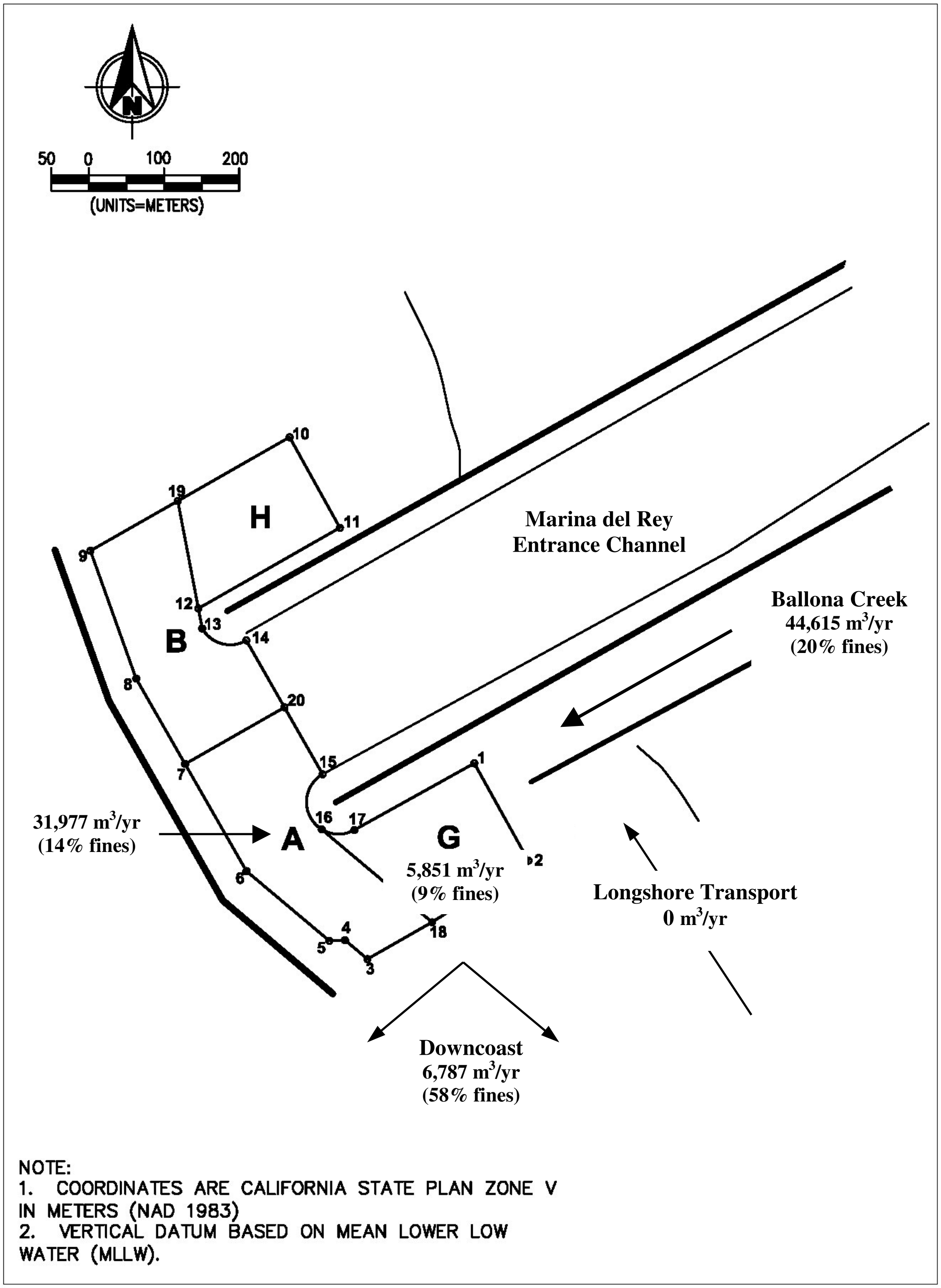
Shoaling volume changes were calculated between sequential bathymetric surveys for periods during which natural processes of shoaling and erosion occurred (i.e. not for periods that included dredging). The shoal volume was then divided by the time period in fraction of years between surveys to give an annual shoaling rate for that period. Annual shoaling rates were then averaged to provide an average annual shoaling rate (Table 5-1). A sufficient number of surveys are desirable to smooth seasonal and annual variations. This calculation provides information on the spatial variation of shoaling rates within each sub-area of the entrance. The average annual sediment discharge from Ballona Creek was estimated to be 44,615 m^3/year (USACE, 2003). The estimated sedimentation rate at Area A was 31,977 m^3/year. The estimated sedimentation rate at Area G was 5,851 m^3/year. The estimated net sedimentation rate for Areas A and G was 37,828 m^3/year. Therefore, approximately 6,787 m^3/year of sediment is discharged beyond the harbor entrance. The finer material is deposited offshore while the coarser sand material replenishes the down coast beaches. The USACE also analyzed longshore transport and found that the northerly longshore transport of sediment into the south entrance channel is negligible (USACE, 2003).

The percentages of fine sediments (defined as silt with a grain size of 0.004 to 0.0625 millimeters and smaller) and coarse (defined as sand and larger) discharging from Ballona Creek were calculated based on grain size analyses for sediment samples collected along Ballona Creek (USACE, Hydrology and Hydraulics Analyses, 2003). Based on the grain size analyses, sediments discharging from Ballona Creek contain about 20% fine and 80% coarse sediments (USACE, Supplementary Analyses Appendix, 2003). The percentages of fine and coarse sediments deposited at Area A and Area G were calculated based on core log data collected during maintenance dredging by USACE. In Area A approximately 14% (4,477 m^3/year) of the sediment deposited is fine and in Area G approximately 9% (527 m^3/year) of the sediment deposited is fine (USACE, Supplementary Analyses Appendix, 2003). Therefore, approximately 5,004 m^3/year of fine sediments are deposited in Areas A and G.

Table 5-1. Shoal Volume Changes and Annual Shoaling Rates by Sub-Area (USACE, 2003)

<table>
<tr><th rowspan="2">Time Period</th><th rowspan="2">Yrs.</th><th colspan="2">Area A</th><th colspan="2">Area B</th><th colspan="2">Area G</th><th colspan="2">Area H</th></tr>
<tr><th>Δ Vol (m^3)</th><th>Rate (m^3/yr)</th><th>Δ Vol (m^3)</th><th>Rate (m^3/yr)</th><th>Δ Vol (m^3)</th><th>Rate (m^3/yr)</th><th>Δ Vol (m^3)</th><th>Rate (m^3/yr)</th></tr>
<tr><td>July 91 – May 92</td><td>0.86</td><td>20,483</td><td>23,734</td><td>11,031</td><td>12,782</td><td>50,548</td><td>58,571</td><td></td><td></td></tr>
<tr><td>May 92 – Oct 92</td><td>0.36</td><td>-3,391</td><td>-9,448</td><td>-1,967</td><td>-5,481</td><td>-1,751</td><td>-4,879</td><td></td><td></td></tr>
<tr><td>Dec 92 – Dec 93</td><td>1.00</td><td>26,297</td><td>26,297</td><td>18,785</td><td>18,785</td><td>-13,748</td><td>-13,748</td><td></td><td></td></tr>
<tr><td>Dec 93 – June 94</td><td>0.56</td><td>1,005</td><td>1,807</td><td>1,504</td><td>2,704</td><td>4,353</td><td>7,827</td><td></td><td></td></tr>
<tr><td>June 94 – Oct 94</td><td>0.50</td><td>-9,943</td><td>-20,051</td><td>-3,629</td><td>-7,318</td><td>-12,132</td><td>-24,465</td><td></td><td></td></tr>
<tr><td>Dec 94 – Jan 95</td><td>0.10</td><td>23,569</td><td>238,963</td><td>11,987</td><td>121,535</td><td>1,260</td><td>12,775</td><td>25,153</td><td>255,023</td></tr>
<tr><td>Jan 95 – June 95</td><td>0.36</td><td>19,291</td><td>53,750</td><td>17,490</td><td>48,732</td><td>7,102</td><td>19,788</td><td rowspan="3">3,820</td><td rowspan="3">3,445</td></tr>
<tr><td>June 95 – Dec 95</td><td>0.50</td><td>-8,103</td><td>-16,206</td><td>-4,983</td><td>-9,966</td><td>-6,440</td><td>-12,880</td></tr>
<tr><td>Dec 95 – Mar 96</td><td>0.25</td><td>14,071</td><td>56,284</td><td>18,405</td><td>73,620</td><td>1,862</td><td>7,448</td></tr>
<tr><td>Apr 96 – Sept 96</td><td>0.47</td><td>4,909</td><td>10,540</td><td>4,851</td><td>10,415</td><td>-1,208</td><td>-2,594</td><td>5,580</td><td>11,981</td></tr>
<tr><td>Sept 96 – Aug 97</td><td>0.90</td><td>8,065</td><td>8,975</td><td>9,626</td><td>10,712</td><td>2,515</td><td>2,799</td><td>38,853</td><td>43,236</td></tr>
<tr><td>Aug 97 – Feb 98</td><td>0.50</td><td>18,554</td><td>37,210</td><td>25,750</td><td>51,641</td><td>1,591</td><td>3,191</td><td rowspan="2">51,732</td><td rowspan="2">96,338</td></tr>
<tr><td>Feb 98 – Mar 98</td><td>0.04</td><td>6,219</td><td>162,138</td><td>1,952</td><td>50,891</td><td>2,469</td><td>64,370</td></tr>
<tr><td>Apr 98 – Jun 98</td><td>0.14</td><td>-1,316</td><td>-9,418</td><td rowspan="2">-48,269</td><td rowspan="2">-77,957</td><td>-2,111</td><td>-15,108</td><td rowspan="2">-36,634</td><td rowspan="2">-59,166</td></tr>
<tr><td>Jun 98 – Nov 98</td><td>0.48</td><td>4,204</td><td>8,768</td><td>336</td><td>701</td></tr>
<tr><td>Nov 98 – May 99</td><td>0.48</td><td>310</td><td>647</td><td>14,280</td><td>29,784</td><td>-879</td><td>-1,833</td><td>32,293</td><td>67,354</td></tr>
<tr><td>May 99 – Oct 99</td><td>0.44</td><td>-3,171</td><td>-7,145</td><td>-357</td><td>-804</td><td>-3,344</td><td>-7,534</td><td>-7,100</td><td>-15,997</td></tr>
<tr><td>Mar 00 –Feb 01</td><td>0.96</td><td>8,373</td><td>8,732</td><td>9,637</td><td>10,050</td><td>10,439</td><td>10,886</td><td>56,390</td><td>58,807</td></tr>
<tr><td>Average annual shoal rate by area</td><td></td><td></td><td>31,977</td><td></td><td>20,007</td><td></td><td>5,851</td><td></td><td>51,225</td></tr>
</table>

Figure 4. Marina del Rey Harbor, Entrance Channel Sub-Areas



Source: USACE, Supplementary Analyses Appendix, 2003

The translation to pollutant specific loading capacity was calculated by multiplying the average annual deposition of 5,004 m^3/year of fine sediment, defined as silts (grain size 0.0625 millimeters) and smaller, by the numeric sediment targets (Table 3-1). The bulk sediment density of the deposition was assumed to be 1.42 metric tons per cubic meter (mt/m^3) (Steinberger et al., 2003). The resultant numbers are presented in Table 5-2. The TMDL is set equal to the loading capacity.

Table 5-2. Relationship between numeric targets and the loading capacity expressed as mass per year

Metals	Numeric Target ERL (mg/g)	TMDL (kg/year)
Cadmium	1.2	8.5
Copper	34	241.6
Lead	46.7	332
Silver	1	7.1
Zinc	150	1,066
Organics	**Numeric Target ERL (µg/kg)**	**TMDL (g/year)**
Chlordane	0.5	3.55
DDT	1.58	11.2
PCBs	22.7	161
PAHs	4,022	28,580

Calculations based on net deposit of 37,828 m^3/yr, fines 5,004 m^3/yr, bulk density of 1.42 mt/m^3

5.1.1 Critical Conditions

There is a high degree of inter- and intra-annual variability in sediments deposited at the mouth of Ballona Creek. This is a function of the storms, which are highly variable between years. Studies by the Corps of Engineers have shown that sediment delivery in Ballona Creek is related to the size of the storm (USACE, 2003). The TMDL is based on a long-term average deposition patterns over a 10-year period from 1991 to 2001. This time period contains a wide range of storm conditions and flows in the Ballona Creek watershed. Use of the average condition for the TMDL is appropriate because issues of sediment effects on benthic communities and potential for bioaccumulation to higher trophic levels occurs over long time periods.

5.1.2 Margin of Safety

TMDLs must include a margin of safety to account for any uncertainty concerning the relationships between sources and sediment quality. An implicit margin of safety is applied through the use of more protective SQG values. The ERLs were selected over the higher ERMs as the numeric targets.

5.2 ALLOCATIONS

Most contaminants of concern generated in the watershed are transported to the Estuary through the storm water conveyance system. These are regulated directly in the NPDES process through storm water permits or indirectly through the issuance of NPDES permits for discharges to the storm water system. Mass-based load allocations are developed for direct atmospheric deposition and open space. A grouped mass-based waste load allocation is developed for storm water permittees (Los Angeles County MS4, Caltrans, General Industrial and General

Construction) by subtracting the mass-based waste load and load allocations from the total loading capacity according to the following equation:

TMDL = Direct Atmospheric Deposition + Open Space + Combined Storm Water Sources (1)

Concentration-based waste load allocations are developed for other point sources in the watershed. These other point sources have intermittent flows and should discharge little to no sediment. These sources will have a minor impact on sediment loading if they are limited by concentration to the applicable ERL-based waste load allocations.

5.2.1 Load Allocations

Mass-based load allocations are developed for open space and direct atmospheric deposition. In equation 1 "Open Space" refers to opens space that discharges directly to Ballona Creek or a tributary and not through the storm drain system. Once drainage from open space is collected by the storm drain system, it becomes a point source and is included with the storm water allocation. In the Ballona Creek watershed most of the land area is served by the storm drain system with the exception of the Ballona Wetlands, which discharges through a tide gate directly to the Estuary. The Ballona Wetlands are approximately 460 acres or 0.6% of the watershed. The load allocation for open space is calculated by multiplying the percentage of the watershed by the total loading capacity, according to the following equation:

Open Space = 0.006 x TMDL (2)

An estimate of direct atmospheric deposition was developed based on the percent area of surface water, which is approximately 480 acres or 0.6% of the total watershed area. The load allocation for atmospheric deposition is calculated by multiplying this percentage by the total loading capacity, according to the following equation:

Direct Atmospheric Deposition = 0.006 x TMDL (3)

The loadings associated with indirect atmospheric deposition are included in the storm water waste load allocations.

5.2.2 Waste Load Allocation for Storm Water

The waste load allocations consisting of pollutant loadings of metal and organics must be less than the numeric targets as listed in Table 5-2. A mass-based waste load allocation is developed for the storm water permittees according to the following equation:

Combined Storm Water Sources = TMDL - Direct Atmospheric Deposition - Open Space (4)

Since, the direct atmospheric deposition and open space are calculated as a percentage of the total loading capacity equation 4 becomes:

Combined Storm Water Sources = TMDL - 0.006 x TMDL - 0.006 x TMDL (5)

Combined Storm Water Sources = 0.988 x TMDL (6)

For accounting purposes, it is assumed that Caltrans and the general storm water permittees discharge entirely to the MS4 system. This assumption has been supported though review of the permits. The resulting allocations are presented in Table 5-3.

Table 5-3. Mass-based Allocations

Metals	**Direct Air (kg/yr)**	**Open Space (kg/yr)**	**Stormwater (kg/yr)**
Cadmium	0.05	0.05	8.4
Copper	1.4	1.4	238.8
Lead	2	2	328
Silver	0.04	0.04	7.02
Zinc	6	6	1,054
Organics	**Direct Air (g/yr)**	**Open Space (g/yr)**	**Stormwater (g/yr)**
Chlordane	0.02	0.02	3.51
DDT	0.1	0.1	11
PCBs	1	1	159
PAHs	170	160	28,250

USEPA requires that waste load allocations be developed for NPDES-regulated storm water discharges. Allocations for NPDES-regulated storm water discharges from multiple point sources may be expressed as a single categorical waste load allocation when data and information are insufficient to assign each source or outfall individual allocations. The combined storm water waste load allocation is partitioned among the four storm water permittees (MS4, Caltrans, general industrial and general construction) based on an estimate of the percentage of land area covered under each permit (Table 5-4).

Table 5-4. Areal extent of watershed and percent area covered under storm water permits

Category	**Area in acres**	**Percent area**
MS4 Permit	77,086	94.1%
Caltrans Storm Water Permit	1080	1.3%
General Construction Storm Water Permit	2,250	2.7%
General Industrial Storm Water Permit	564	0.7%
Water (LA for direct atmospheric deposition)	480	0.6%
Parks (LA for non-permitted runoff)	460	0.6%
Total	**81,920**	**100%**

Based on these areas, the waste load allocations for each storm water permittee are presented in Table 5-5. In the storm water permits, permit writers may translate the numeric waste load allocations to BMPs, based on BMP performance data. It is anticipated that reductions will be achieved either through pollutant control measures or sediment control measures.

Table 5-5. Combined storm water allocation apportioned based on percent of watershed.

Metals	**General Construction permittees (kg/yr)**	**General Industrial permittees (kg/yr)**	**Caltrans (kg/yr)**	**MS4 Permittees (kg/yr)**
Cadmium	0.23	0.06	0.11	8.0
Copper	6.6	1.7	3.2	227.3
Lead	9.1	2.3	4.4	312.3
Silver	0.20	0.05	0.09	6.69
Zinc	29	7	14	1003
Organics	**General Construction permittees (g/yr)**	**General Industrial permittees (g/yr)**	**Caltrans (g/yr)**	**MS4 Permittees (g/yr)**
Chlordane	0.10	0.02	0.05	3.34
DDT	0.31	0.08	0.15	10.56
PCBs	4	1	2	152
PAHs	800	200	400	26,900

Each storm water permittee enrolled under the general construction or industrial storm water permits will receive an individual waste load allocation on a per acre basis, based on the acreage of their facility as presented in Table 5-6.

Table 5-6. Per acre waste load allocation for an individual general construction or industrial storm water permittee (g/day/ac).

Metals	**Individual General Construction or Individual General Industrial Permittee (g/yr/ac)**
Cadmium	0.1
Copper	3
Lead	4
Silver	0.1
Zinc	13
Organics	**Individual General Construction or Individual General Industrial Permittee (mg/yr/ac)**
Chlordane	0.04
DDT	0.14
PCBs	2
PAHs	350

5.2.3 Waste Load Allocation for other NPDES Permits

Concentration-based waste load allocations have been developed for the minor NPDES permits and general non-storm water NPDES permits that discharge to Ballona Creek or its tributaries to ensure that these do not contribute significant loadings to the system. The concentration-based waste load allocations are equal to the numeric targets. All minor NPDES permittees and general non-storm water NPDES permittees shall not discharge sediments with concentrations greater than the ERLs as listed in Table 5-7. Monitoring requirements will be placed on these discharges as appropriate in their respective NPDES permits. Any future minor NPDES permits or enrollees under a general non-storm water NPDES permit will also be subject to the concentration-based waste load allocations.

Table 5-7. Concentration-based waste load allocation for sediment discharged to Ballona Creek Estuary.

Metals	Waste Load Allocation for Sediment
Cadmium	1.2 mg/kg
Copper	34 mg/kg
Lead	46.7 mg/kg
Silver	1.0 mg/kg
Zinc	150 mg/kg
Organics	**Waste Load Allocation for Sediment**
Chlordane	0.5 μg/kg
Total DDT	1.58 μg/kg
Total PCBs	22.7 μg/kg
Total PAHs	4,022 μg/kg

5.3 SUMMARY OF TMDL

The TMDL is based on pollutant loadings to the sediments of Ballona Creek Estuary. The loading capacity is based on an estimate of the annual pollutant loads that can be delivered to the sediments and still meet the sediment targets. A margin of safety is provided through the use of ERLs. A grouped waste load allocation has been developed for the storm water permittees (MS4, Caltrans, general industrial and construction storm water permittees). Load allocations have been developed for open space and direct atmospheric deposition. Concentration-based waste load allocations apply to all other non-storm water NPDES permittees. It is anticipated that implementation will be based on BMPs which address pollution prevention and/or sediment reduction. Compliance with the TMDL will be determined through the sediment monitoring program.

6 IMPLEMENTATION

The County of Los Angeles, City of Los Angeles, Beverly Hills, Culver City, Inglewood, Santa Monica, and West Hollywood are jointly responsible for meeting the mass-based waste load allocations for the MS4 permittees. Caltrans is responsible for meeting their mass-based waste load allocations, however, they may choose to work with the MS4 permittees. The primary jurisdiction for the Ballona Creek watershed is the City of Los Angeles. Staff expects that after additional studies and monitoring are conducted, the new information will assist municipalities in focusing their implementation efforts on key land uses, critical sources and/or storm periods.

The City of Los Angeles, County of Los Angeles, Beverly Hills, Culver City, Inglewood, Santa Monica, West Hollywood, and Caltrans may jointly decide how to achieve the necessary reductions in organics and metals loading by employing one or more of the implementation strategies discussed below or any other viable strategy. The Porter Cologne Water Quality Control Act prohibits the Regional Board from prescribing the method of achieving compliance with water quality standards, and likewise TMDLs. Below staff have identified some potential implementation strategies; however, there is no requirement to follow the particular strategies proposed herein as long as the allowable organics and metals loading are not exceeded.

6.1 INTRODUCTION

As required by the federal Clean Water Act, discharges of pollutants to Ballona Creek and its tributaries from municipal storm water conveyances are prohibited, unless the discharges are in compliance with a NPDES permit. In December 2001, the Los Angeles County Municipal NPDES Storm Water Permit was re-issued jointly to Los Angeles County and 84 cities as co-permittees. The regulatory mechanisms used to implement the TMDL will include the Los Angeles County MS4 storm water permit, the Caltrans storm water permit, general industrial storm water permits, general construction storm water permits, minor NPDES permits, and general NPDES permits. Each NPDES permit assigned a WLA shall be reopened or amended at re-issuance, in accordance with applicable laws, to address implementation and monitoring of this TMDL and to be consistent with the waste load allocations of this TMDL.

The concentration-based waste load allocations for the minor NPDES permits and general non-storm water NPDES permits will be implemented through NPDES permit conditions. Permit writers for the non-storm water permits may translate applicable waste load allocations into effluent limits for the minor and general NPDES permits by applying applicable engineering practices. The minor and general non-storm water NPDES permittees are allowed up to seven years from the effective date of the TMDL to achieve the waste load allocations.

The mass-based waste load allocations for the general construction and industrial storm water permittees (Table 5-6) will be incorporated into watershed specific general permits. Concentration-based permit limits may be set to achieve the mass-based waste load allocations. These concentration-based limits would be equal to the concentration-based waste load allocations assigned to the other NPDES permits (Table 5-7). It is expected that permit writers will translate the waste load allocations into BMPs, based on BMP performance data. However, the permit writers must provide adequate justification and documentation to demonstrate that specified BMPs are expected to result in attainment of the numeric waste load allocations. The general industrial storm water permits are allowed up to seven years from the effective date of the TMDL to achieve the waste load allocations.

Within seven years of the effective date of the TMDL, the construction industry will submit the results of BMP effectiveness studies to determine BMPs that will achieve compliance with the waste load allocations assigned to construction storm water permittees. Regional Board staff will bring the recommended BMPs before the Regional Board for consideration within eight years of the effective date of the TMDL. General construction storm water permittees will be considered in compliance with waste load allocations if they implement these Regional Board approved BMPs.

The general industrial storm water permit shall contain a model monitoring and reporting program to evaluate BMP effectiveness. A permittee enrolled under the general industrial storm water permit shall have the choice of conducting individual monitoring based on the model program or participating in a group monitoring effort. A group monitoring effort will not only assess individual compliance, but will also assess the effectiveness of chosen BMPs to reduce pollutant loading on an industry-wide or permit category basis. MS4 permittees are encouraged to take the lead in group monitoring efforts for industrial facilities within their jurisdiction because compliance with waste load allocations by these facilities will translate to reductions in contaminate loads to the MS4 system.

All general construction permittees must implement the approved BMPs within nine years of the effective date of the TMDL. If no effectiveness studies are conducted and no BMPs are approved by the Regional Board within eight years of the effective date of the TMDL, each general construction storm water permit holder will be subject to site-specific BMPs and monitoring requirements to demonstrate compliance with waste load allocations.

The MS4 and Caltrans permittees shall be allowed a phased implementation schedule to achieve the waste load allocations. A phased implementation approach, using a combination of non-structural and structural BMPs could be used to achieve compliance with the waste load allocations. The administrative record and the fact sheets for the MS4 and Caltrans storm water permits must provide reasonable assurance that the BMPs selected will be sufficient to implement the WLAs in the TMDL. We expect that reductions to be achieved by each BMP will be documented and that sufficient monitoring will be put in place to verify that the desired reductions are achieved. The permits should also provide a mechanism to make adjustments to the required BMPs as necessary to ensure their adequate performance. If non-structural BMPs alone adequately implement the waste load allocations then additional controls are not necessary. Alternatively, if the non-structural BMPs selected prove to be inadequate then structural BMPs or additional controls may be required.

Each municipality and permittee will be required to meet the WLAs at the designated assessment locations as defined in the TMDL effectiveness monitoring plan, not necessarily an allocation for their jurisdiction or for specific land uses. Therefore, the focus should be on developed areas where the contribution of metals, historic pesticides, PCBs and PAHs are highest and areas where activities occur that contribute significant loading of these toxic pollutants (e.g., high-density residential, industrial areas and highways). Flexibility will be allowed in determining how to reduce these toxic pollutants as long as the WLAs are achieved.

To achieve the necessary reductions to meet the allowable waste load allocations, permittees will need to balance short-term capital investments directed to addressing this and other TMDLs in the Ballona Creek watershed with long-term planning activities for storm water management in the region as a whole. It should be emphasized that the potential implementation strategies discussed below may contribute to the implementation of other TMDLs for Ballona Creek and Estuary. Likewise, implementation of other TMDLs in the Ballona Creek Watershed may contribute to the implementation of this TMDL.

6.2 IMPLEMENTATION STRATEGIES OF RELATED TMDLS IN BALLONA CREEK WATERSHED

The Regional Board supports, in concept, an integrated water resources approach to improving water quality during wet weather, such as the City of Los Angeles' Integrated Plan for the Wastewater Program (IPWP). An integrated water resources approach takes a holistic view of regional water resources management by integrating planning for future wastewater, storm water, recycled water, and potable water needs and systems, and focusing on beneficial re-use of storm water at multiple points throughout a watershed to preserve local groundwater resources and reduce the need for imported water where feasible. The City's IPWP is intended to meet the wastewater and water resource management needs for year 2020.

The Integrated Resources Plan (IRP) is Phase 2 of the IPWP. The IRP is a City-wide strategy developed by the City of Los Angeles and does not specifically focus on the Ballona Creek Watershed. The goal of the plan is to increase the amount of wet-weather urban runoff that can be captured and beneficially used in Los Angeles; however, it is not known what portion of this runoff will be in the Ballona Creek Watershed. Furthermore, increasing capture and beneficial use of wet-weather urban runoff may not achieve the waste load allocations during very wet years. The implementation strategy proposed below could be designed to achieve the TMDL requirements, while remaining consistent with the goals of the City's IPWP and addressing any shortfall of the IRP in achieving implementation with this TMDL.

One component of the IRP is a Runoff Management Plan, which could provide a framework for implementing runoff management practices to meet the IRP goals and address protection of public health and the environment. The Runoff Management Plan as described in the IRP will include consideration of structural Best Management Practices (BMPs) to achieve reduction of pollutant loadings to receiving waters. Urban runoff can be treated at strategic locations throughout the watershed or subwatersheds. This is also similar to the structural and non-structural BMPs described below.

The Ballona Creek and Wetlands Trash TMDL, effective date August 2, 2002, is now in its first year of implementation. Compliance with the Trash TMDL requires permittees to install either full capture systems, partial capture systems and/or implement institutional controls. At a minimum, the full capture systems must be designed to treat the peak flow rate resulting from a one-year, one-hour storm. A secondary benefit of the trash removal systems also referred to as gross solids removal systems has been the removal of sediments and other pollutants.

6.3 POTENTIAL IMPLEMENTATION STRATEGIES

The implementation strategy selected will need to control the loading of sediments to Ballona Creek and Estuary during wet weather, since, metals, historic pesticides, PCBs and PAHs are predominately bound to sediment, which are transported with storm runoff. Municipalities may employ a variety of implementation strategies to meet the required waste load allocations such as non-structural and structural best management practices (BMPs). The implementation strategy discussed below is very similar to the implementation strategy presented in the Ballona Creek Metals TMDL. The implementation for both TMDLs focuses on source control and sediment control. Specific projects, which may have a significant impact, would be subject to a separate environmental review. The lead agency for subsequent projects would be obligated to mitigate any impacts they identify, for example by mitigating potential flooding impacts by designing the BMPs with adequate margins of safety.

6.3.1 Non-Structural Best Management Practices

The non-structural BMPs are based on the premise that specific land uses or critical sources can be targeted to achieve the TMDL waste load allocations. Non-structural BMPs provide several advantages over structural BMPs. Non-structural BMPs can typically be implemented in a relatively short period of time. The capital investment required to implement non-structural BMPs is generally less than for structural BMPs. However, the labor costs associated with non-structural BMPs may be higher, therefore, in the long-term the non-structural BMPs may be more costly. Examples of non-structural controls include better sediment control at construction sites; improved street cleaning by upgrading to vacuum type sweepers; and, educating industries of good housekeeping practices.

6.3.2 Structural Best Management Practices

The structural BMPs are based on the premise that specific land uses, critical sources, or specific periods of a storm event can be targeted to achieve the TMDL waste load allocations. Structural BMPs may include placement of storm water treatment devices specifically designed to reduce sediment loading such as infiltration trenches or filters at critical points in the storm water conveyance system. During storm events, when flow rates are high these types of filters may require surge control, such as an underground storage vaults or detention basins to avoid bypassing of the treatment unit. If these filters are placed in series with the gross solids removal systems being installed to meet the Ballona Creek Trash TMDL, they will operate more efficiently and will require less maintenance.

6.4 IMPLEMENTATION SCHEDULE

The implementation schedule for all permittees is summarized in Table 6-1. For the MS4 and Caltrans storm water permittees the proposed implementation schedule consists of a phased approach, with compliance to be achieved in incremental percentages of the watershed, with total compliance achieved within 15 years. The municipalities and Caltrans are encourage to work together to meet the waste load allocations.

The Regional Board intends to reconsider this TMDL in six years after the effective date of the TMDL to re-evaluate the waste load allocations based on the additional data obtained from the special studies. Until the TMDL is revised, the waste load allocations will remain as presented in Section 5. Revising the TMDL will not create a conflict, since the total sediment reductions are not required until 15-years after the effective date.

Table 6-1. Implementation Schedule

Date	Action
Effective date of the TMDL	Regional Board permit writers shall incorporate the waste load allocations for sediment into the NPDES permits. Waste load allocations will be implemented through NPDES permit limits in accordance with the implementation schedule contained herein, at the time of permit issuance, renewal or re-opener.
Within 6 months after the effective date of the State Board adopted sediment quality objectives and implementation policy	The Regional Board will re-assess the numeric targets and waste load allocations for consistency with the State Board adopted sediment quality objectives.
5 years after effective date of the TMDL	Responsible jurisdictions and agencies shall provide to the Regional Board result of any special studies.
6 years after effective date of the TMDL	The Regional Board shall reconsider this TMDL to re-evaluate the waste load allocations and the implementation schedule.
MINOR NPDES PERMITS AND GENERAL NON-STORM WATER NPDES PERMITS)	
7 years after effective date of the TMDL	The non-storm water NPDES permits shall achieve the concentration-based waste load allocations for sediment per provisions allowed for in NPDES permits.
GENERAL INDUSTRIAL STORM WATER PERMITS	
7 years after effective date of the TMDL	The general industrial storm water permits shall achieve the mass-based waste load allocations for sediment per provisions allowed for in NPDES permits. Permits shall allow an iterative BMP process including BMP effectiveness monitoring to achieve compliance with permit requirements.
GENERAL CONSTRUCTION STORM WATER PERMIT	
7 years from the effective date of the TMDL	The construction industry will submit the results of the BMP effectiveness studies to the Regional Board for consideration. In the event that no effectiveness studies are conducted and no BMPs are approved, permittees shall be subject to site-specific BMPs and monitoring to demonstrate BMP effectiveness.
8 years from the effective date of the TMDL	The Regional Board will consider results of the BMP effectiveness studies and consider approval of BMPs no later than six years from the effective date of the TMDL.
9 years from the effective date of the TMDL	All general construction storm water permittees shall implement Regional Board-approved BMPs.
MS4 AND CALTRANS STORM WATER PERMITS	
12 months after the effective date of the TMDL	The MS4 and Caltrans storm water NPDES permittees must submit a coordinated monitoring plan, to be approved by the Executive Officer, which includes both ambient monitoring and TMDL effectiveness monitoring. Once the coordinated monitoring plan is approved by the Executive Officer, ambient monitoring shall commence.

Date	Action
5 years after effective date of TMDL (Draft Report) 5 ½ years after effective date of TMDL (Final Report)	The MS4 and Caltrans storm water NPDES permittees shall provide a written report to the Regional Board outlining how they will achieve the waste load allocations for sediment to Ballona Creek Estuary. The report shall include implementation methods, an implementation schedule, proposed milestones, and any applicable revisions to the TMDL effectiveness monitoring plan.
7 years after effective date of the TMDL	The MS4 and Caltrans storm water NPDES permittees shall demonstrate that 25% of the total drainage area served by the MS4 system is effectively meeting the waste load allocations for sediment.
9 years after effective date of the TMDL	The MS4 and Caltrans storm water NPDES permittees shall demonstrate that 50% of the total drainage area served by the MS4 system is effectively meeting the waste load allocations for sediment.
11 years after effective date of the TMDL	The MS4 and Caltrans storm water NPDES permittees shall demonstrate that 75% of the total drainage area served by the MS4 system is effectively meeting the waste load allocations for sediment.
15 years after effective date of the TMDL	The MS4 and Caltrans storm water NPDES permittees shall demonstrate that 100% of the total drainage area served by the MS4 system is effectively meeting the waste load allocations for sediment.

6.5 IMPLEMENTATION COST ANALYSIS AND CEQA CONSIDERATIONS

This section takes into account a reasonable range of economic factors in estimating potential costs associated with this TMDL. As mentioned previously, the implementation strategy is very similar to the implementation strategy for metals, therefore, the cost analysis is the same. This analysis, together with the other sections of this staff report, CEQA checklist, response to comments Basin Plan amendment and supporting documents, were completed in fulfillment of the applicable provisions of the California Environmental Quality Act (Public Resources Code Section 21159.) [3]

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[3] Because this TMDL implements existing water quality objectives it does not "establish" water quality objectives and no further analysis of the factors identified in Water Code section 13241 is required. However, the staff notes that its CEQA analysis provides the necessary information to properly "consider" the factors specified in Water Code section 13241. As a result, the section 13241 analysis would at best be redundant.

This cost analysis focuses on achieving the grouped waste load allocation by the MS4 and Caltrans storm water permittees in the urbanized portion of the watershed[4]. The BMPs and potential compliance approaches analyzed here could apply to the general industrial and construction storm water permittees as well. An evaluation of the costs of implementing this TMDL amounts to evaluating the costs of preventing sediments from entering storm drains and/or reaching the Ballona Creek Estuary. Most permittees would likely implement a combination of the structural and non-structural BMPs to achieve their waste load allocations. This analysis considers a potential strategy combining structural and non-structural BMPs through a phased implementation approach and estimates the costs for this strategy. It will also be important to document reductions in sediment loading already being achieved via BMPs currently implemented under the Trash TMDL.

In addition to achieving the WLAs in this TMDL, such a strategy could be used to achieve the compliance with the Ballona Creek and Wetlands Trash TMDL as well as the Ballona Creek Metals and Bacteria TMDLs. Therefore, this cost analysis reflects the potential costs of compliance with both the metals and toxic pollutants TMDLs based on likely implementation scenarios.

6.5.1 Phased Implementation

Under a phased implementation approach, it is assumed that compliance with the grouped waste load allocation could be achieved in 30% of the urbanized portion of the watershed through an IRP. Costs of implementing an IRP are not estimated for the purposes of this analysis because metals removal is not the primary goal of an IRP, which addresses multiple wastewater and water resource management needs. Compliance in another 30% of the urbanized portion of the watershed could be achieved through various iterations of non-structural BMPs. Compliance with the remaining 40% of the urbanized portion of the watershed could be achieved through structural BMPs. These percentages are approximately estimated based on the removal efficiencies of various non-structural and structural BMPs, as discussed below.

The first step of the potential phased approach would include the implementation of non-structural BMPs by permittees, such as increasing the frequency and efficiency of street sweeping. In their National Menu of Best Management Practices for Stormwater – Phase II, USEPA reports that conventional mechanical street sweepers can reduce non-point source pollution by 5 to 30% (USEPA, 1999a). The removal efficiencies of sediment for conventional sweepers are dependent on the size of particles. Conventional sweepers, including mechanical broom sweepers and vacuum-assisted wet sweepers, have removal efficiencies of approximately 15 to 50% for particles less than 500 micrometers and up to approximately 65% for larger particles (Walker and Wong, 1999). USEPA reports that vacuum-assisted dry street sweeping can remove significantly more pollution, including fine sediment and metals, before the

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[4] The Ballona Creek watershed is 128 square miles. Open space comprises 17.5 square miles and water comprises 0.75 square miles of the Ballona Creek watershed. It is not expected that the MS4 and Caltrans permittees will need to address areas of open space to meet the waste load allocations. Therefore, areas of open space and water are not considered in the calculation of the cost analysis. The remaining 110 square miles is considered the portion of the watershed that may require BMPs and therefore, used in the cost analysis for the purposes of this TMDL.

pollutants are mobilized by rainwater. USEPA reports a 50 to 88% overall reduction in annual sediment loading for residential areas by vacuum-assisted dry street sweepers. Sutherland and Jelen (1997) showed a total removal efficiency of 70% for fine particles and up to 96% for larger particles by vacuum – assisted dry sweepers (also known as small-micron surface sweepers). Upgrading to vacuum-assisted dry sweeping would translate to a significant reduction of sediments. In their 1999 Preliminary Data Summary of Urban Stormwater Best Management Practices, USEPA estimated cost data for both standard mechanical and vacuum-assisted dry sweepers as shown in Table 6-2.

Table 6-2. Estimated costs for two types of street sweepers. (Source: USEPA, 1999b.)

Sweeper Type	Life (Years)	Purchase Price ($)	O&M Cost ($/curb mile)
Mechanical	5	75,000	30
Vacuum-assisted	8	150,000	15

Table 6-2 illustrates that while the purchase price of vacuum-assisted dry sweepers is higher, the operation and maintenance costs are lower than for standard sweepers. Based on this information, USEPA determined the total annualized cost of operating street sweepers per curb mile, for a variety of frequencies (Table 6-3). In their estimates, USEPA assumed that one sweeper serves 8,160 curb miles during a year and assumed an annual interest rate of 8 percent (USEPA, 1999b). According to Table 6-3, permittees would save money in the long-term by switching to vacuum-assisted dry sweepers.

Table 6-3. Annualized sweeper costs, including purchase price and operation and maintenance costs ($/curb mile/year).

Sweeper Type	Sweeping Frequency					
	Weekly	Bi-weekly	Monthly	Quarterly	Twice per year	Annually
Mechanical	1,680	840	388	129	65	32
Vacuum-Assisted	946	473	218	73	36	18

Under a phased implementation approach, the permittees could monitor effectiveness using flow-weighted composite sampling of runoff throughout representative storms to determine the effectiveness of this first step of implementing non-structural BMPs. If monitoring showed ineffectiveness, permittees could adapt their approach by increasing frequency of street sweeping or incorporating other non-structural BMPs.

If the WLAs can not be achieved through non-structural BMPs, permittees could incorporate structural BMPs. Two potential structural BMPs were analyzed in this cost analysis:

1. Infiltration trenches
2. Sand filters

These approaches are specifically designed to treat urban runoff and to accommodate high-density areas. They were chosen for this analysis because in addition to addressing sediment loadings to the creek, they have the additional positive impact of addressing the effects of development and increased impervious surfaces in the watershed. Both approaches can be designed to capture and treat 0.5 to 1 inch of runoff. When flow exceeds the design capacity of each device, untreated runoff is allowed to bypass the device and enter the storm drain.

Both infiltration trenches and sand filters must be used in conjunction with some type of pretreatment device such as a biofiltration strip or gross solids removal system to remove sediment and trash in order to increase their efficiency and service life. This combination could be used to achieve the WLAs in both the Ballona Creek Trash TMDL and the Metals TMDL. The Trash TMDL provided a cost estimate of gross solids removal systems, including structural vortex separation systems and end of pipe nets. This analysis provides an estimate of the additional costs associated with installing sand filters or infiltration trenches.

In addition, both infiltration trenches and sand filters are efficient in removing bacteria and could be used to achieve the WLAs in the upcoming bacteria TMDL. USEPA reports that sand filters have a 76% removal rate and infiltration trenches have a 90% removal rate for fecal coliform (USEPA, 1999c).

As stated previously, it is assumed that 40% of the urbanized portion of the watershed would need to be treated by structural BMPs. In this cost analysis, it was assumed that 20% of the watershed would be treated by infiltration trenches and sand filters would treat the other 20%. Costs were estimated using data provided by USEPA (USEPA, 1999a and 1999c) and the Federal Highway Administration (FHWA, 2003). USEPA cost data were reported in 1997 dollars. FHWA costs were reported in 1996 dollars for infiltration trenches and 1994 dollars for sand filters. Where costs were reported as ranges, the highest reported cost was assumed. These costs were then compared to costs determined by Caltrans in their BMP Retrofit Pilot Program (Caltrans, 2004). Caltrans costs were reported in 1999 dollars. To estimate land acquisition cots for individual projects in this cost analysis would be purely speculative.

Infiltration trenches. Infiltration trenches store and slowly filter runoff through the bottom of rock-filled trenches and then through the soil. Infiltration trenches can be designed to treat any amount of runoff, but are ideal for treating small urban drainage areas less than five to ten acres. Soils and topography are limiting factors in design and siting, as soils must have high percolation rates and groundwater must be of adequate depth. Potential impacts to groundwater by infiltration trenches could be avoided by proper design and siting. Infiltration trenches are reported to achieve 75 to 90% suspended solids removal and 75 to 90% metals removal by USEPA and FHWA. In their BMP Retrofit Pilot Program, Caltrans assumed that constituent removal was 100 percent for storm events less than the design storm, because all runoff would be infiltrated.

Table 6-4 presents estimated costs for infiltration trenches designed to treat 0.5 inches of runoff over a five-acre drainage area with a runoff coefficient equal to one. Staff determined that 2,816 devices, designed to treat five acres each, would be required to treat 20% of the urbanized portion of the watershed.

Table 6-4. Estimated Costs for Infiltration Trenches.

	Construction Costs ($ million)	Maintenance Costs ($ million/year)
Based on USEPA estimate (1997 dollars)	128	26
Based on FHWA estimate (1996 dollars)	122	Not reported

Sand Filters. Sand filters work by a combination of sedimentation and filtration. Runoff is temporarily stored in a pretreatment chamber or sedimentation basin, and then flows by gravity or is pumped into a sand filter chamber. The filtered runoff is then discharged to a storm drain or natural channel. The costs of two types of sand filters were analyzed: 1) the Delaware sand filter, which is installed underground and suited to treat drainage areas of approximately one acre and 2) the Austin sand filter, which is installed at-grade and suited to larger drainage areas up to 50 acres. The underground sand filter is especially well adapted for applications with limited land area and is independent of soil conditions and depth to groundwater. However, both types of sand filters must consider the imperviousness of the drainage areas in their design.

USEPA estimated a 70% removal of total suspended solids and 45% removal of lead and zinc for both types of sand filters. FHWA reported high sediment, zinc and lead removal, but low copper removal for Austin sand filters and high sediment and moderate to high metals removal for Delaware sand filters. Caltrans reported a 50% reduction in total copper, a 7% reduction in dissolved copper, an 87% reduction in total lead, a 40% reduction in dissolved lead, an 80% reduction in total zinc and a 61% reduction in dissolved zinc by the Austin sand filters they tested. Caltrans reported a 66% reduction in total copper, a 40% reduction in dissolved copper, an 85% reduction in total lead, a 31% reduction in dissolved lead, a 92% reduction in total zinc and a 94% reduction in dissolved zinc by the Delaware sand filter they tested.

USEPA and FHWA reported costs per acre for 0.5 inches of runoff. Total costs were calculated by multiplying the per-acre cost by the total acreage of the urbanized portion of the watershed not addressed through an integrated resources plan or non-structural BMPs. Estimated costs are presented in Table 6-5. There are significant economies of scale for Austin filters. USEPA reported that costs per acre decrease with increasing drainage area. FHWA reported two separate costs based on drainage area served. Economies of scale are not a factor for Delaware filters, as they are limited to drainage areas of about one acre.

Table 6-5. Estimated Costs for Austin and Delaware Sand Filters

	Austin Sand Filter Construction Costs ($ million)	Austin Sand Filter Maintenance Costs ($ million/year)	Delaware Sand Filter Construction Costs ($ million)	Delaware Sand Filter Maintenance Costs ($ million/year)
Based on USEPA estimate (1997 dollars)	130	7	77	4
Based on FHWA estimate* (1994 dollars)	24	Not reported	99	Not reported

*FHWA cost estimate for Austin filter was calculated assuming a drainage area greater than five acres. The costs would be $113 million for Austin filters designed for a drainage area of less than two acres.

Based on the adaptive management approach, and some assumptions about the efficiencies of each stage of the approach, the cost analysis arrived at the total costs for achieving the WLAs in the Toxic Pollutants TMDL as shown in Table 6-6. The total costs do not include the cost savings associated with switching to vacuum-assisted street sweepers. As stated previously, the costs associated with this adaptive management approach could be applied towards the cost of achieving the WLAs in the Metals TMDLs and the upcoming Bacteria TMDL.

Table 6-6. Total Estimated costs of adaptive management approach.

	Total Construction ($ million)	Total Maintenance ($ million/year)

Based on USEPA estimate(1997 dollars)	335	37
Based on FHWA estimate(1994/1996 dollars)	245	Not reported

6.5.2 Comparison of Costs Estimates with Caltrans Reported Costs

Estimated costs for structural BMPs were compared to costs reported by Caltrans in their BMP Retrofit Pilot Program (Caltrans, 2004). Caltrans sited five Austin sand filters and one Delaware sand filter as part of their study. The five Austin sand filters served an average area of 2 acres and the Delaware sand filter served an area of 0.7 acres. Caltrans sited two infiltration trench/biofiltration strip combinations as part of their study. Each trench and biofiltration strip used in combination served an area of 1.7 acres. Based on these drainage areas, the average adjusted cost of the Austin sand filters in the Caltrans study was $156,600 per acre, the adjusted cost of the Delaware filter was $310,455 per acre and the average adjusted cost of the infiltration trench/biofiltration strips was $84,495 per acre. These costs are approximately an order of magnitude greater than the costs determined using estimates provided by USEPA and FHWA. It should be noted that costs calculated using EPA and FHWA estimates were based on infiltration trench and sand filter designs that would treat 0.5 inches of runoff, while the Caltrans study costs were based on an infiltration trench design that would treat 1 inch of runoff and sand filter designs that would treat 0.56 to 1 inches of runoff. This could explain some of the differences in costs.

The differences in costs can also be explained by a third party review of the Caltrans study, conducted by Holmes & Narver, Inc. and Glenrose Engineering (Caltrans, 2001). The review compared adjusted Caltrans costs with costs of implementing BMPs by other state transportation agencies and public entities. The adjusted costs exclude costs associated with the unique pilot program and ancillary costs such as improvements to access roads, landscaping or erosion control, and non-BMP related facilities. For the comparison, all costs were adjusted for differences in regional economies. The third party review determined that the median costs reported by Caltrans were higher than the median costs reported by the other agencies for almost every BMP considered, including sand filters and infiltration BMPs. The review attributed the higher Caltrans costs to the small scale and accelerated nature of the pilot program. The third party review then gave recommendations for construction cost reductions based on input from other state agencies. These included simplifying design and material components, combining retrofit work with ongoing construction projects, changing methods used to select and work with construction contractors, allowing for a longer planing horizon, constructing a larger number of BMPs at once, and implementing BMPs over a larger drainage area.

6.5.3 Results of a Region-wide Cost Study

In their report entitled "Alternative Approaches to Storm Water Quality Control, Prepared for the Los Angeles Regional Water Quality Board," Devinny et al. estimated the total costs for compliance with Regional Board storm water quality regulations as ranging from $2.8 billion, using entirely non-structural systems, to between $5.7 billion and $7.4 billion, using regional treatment or infiltration systems. The report stated that final costs would likely fall somewhere within this range. Table 6-7 presents the report's estimated costs for the various types of structural and non-structural systems that could be used to achieve compliance with municipal storm water requirements throughout the Region.

Table 6-7. Estimated costs of structural and non-structural compliance measures for the entire Los Angeles Region. (Source: Devinny et al.)

Compliance Approach	Estimated Costs
Enforcement of litter ordinances	$9 million/year
Public Education	$5 million/year
Increased storm drain cleaning	$27 million/year
Installation of catch basin screens, enforcing litter laws, improving street cleaning	$600 million
Low –flow diversion	$28 million
Improved street cleaning	$7.5 million/year
On-site BMPs for individual facilities	$240 million
Structural BMPs – 1st estimation method	$5.7 billion
Structural BMPs – 2nd estimation method	$4.0 billion

The Devinny et al. study calculates costs for the entire Los Angeles Region, which is 3,100 square miles, while the Ballona Creek watershed is 128 square miles. When compared on a per square mile basis, the costs estimated in section 6.5.1 are within the range calculated by Devinny et al. (Table 6-8).

Table 6-8. Comparison of costs for storm water compliance on a per square mile basis.

	Construction Costs ($ million/square mile)
Based on U.S. EPA estimate	2.62
Based on FHWA estimate	1.91
Maximum cost calculated by Devinny et al.	1.84 –2.39

The Devinny et al. study also estimated benefits associated with storm water compliance. It was determined that the Region-wide benefits of a non-structural compliance program would equal approximately $5.6 billion while the benefits of non-structural and regional measures would equal approximately $18 billion. Region-wide estimated benefits included:

Flood control savings due to increased pervious surfaces of about $400 million,
Property value increase due to additional green space of about $5 billion,
Additional groundwater supplies due to increased infiltration worth about $7.2 billion,
Willingness to pay to avoid storm water pollution worth about $2.5 billion,
Cleaner streets worth about $950 million,
Improved beach tourism worth about $100 million (not applicable to Ballona Creek),
Improved nutrient recycling and atmospheric maintenance in coastal zones worth about $2 billion,
Savings from reduction of sedimentation in Regional harbors equal to about $330 million, and
Unquantifiable health benefits of reducing exposure to fine particles from streets.

7 MONITORING

There are three objectives of monitoring associated with the TMDL. The first is to collect additional water, fish tissue and sediment quality data (e.g., metals and organochlorine concentrations) to evaluate assumptions made in the TMDL, including the loading and extent of exceedances. The second is to assess the effectiveness of the TMDL and ultimately achieving the waste load allocations. The third is to conduct special studies to address the uncertainties in the TMDL and to assist in the design and sizing of BMPs. To achieve these objectives, a monitoring program will need to be developed for the TMDL that consists of three components: (1) ambient monitoring, (2) effectiveness monitoring and (3) special studies.

The monitoring program and any required technical reports will be established pursuant to a subsequent order issued by the Executive Officer. As a planning document, the TMDL identifies the type of information necessary to refine and update the TMDL, and to assess the TMDL's effectiveness. The Executive Officer will comply with any necessary legal requirements in developing the monitoring program, requiring technical reports, and establishing special studies.

7.1 AMBIENT MONITORING

An ambient monitoring program is necessary to assess water quality throughout Ballona Creek and its tributaries and to assess sediment quality in Ballona Creek Estuary. Data on background water quality for organics and sediments will help refine the numeric targets and waste load allocations and assist in the effective placement of BMPs. In addition, fish and mussel tissue data is required in Ballona Creek Estuary to confirm the fish tissue listings.

Water quality samples shall be collected from Ballona Creek and the Estuary monthly and analyzed for cadmium, copper, lead, silver, zinc, chlordane, dieldrin, DDT, total PCBs and total PAHs at detection limits that are at or below the minimum levels until the TMDL is reconsidered in the sixth year. The minimum levels are those published by the State Water Resources Control Board in Appendix 4 of the Policy for the Implementation of Toxic Standards for Inland Surface Water, Enclosed Bays, and Estuaries of California, March 2, 2000. Special emphasis should be placed on achieving detection limits that will allow evaluation relative to the CTR standards. If these can not be achieved with conventional techniques, then a special study should be proposed to evaluate concentrations of organics.

Storm water monitoring conducted as part of the MS4 storm water monitoring program should continue to provide assessment of water quality during wet-weather conditions and loading estimates from the watershed to the Estuary. If analysis of chlordane, dieldrin, DDT, total PCBs or total PAHs are not currently part of the sampling programs these organics should be added. In addition, special emphasis should be placed on achieving lower detection limits for DDTs, PCBs and PAHs.

The MS4 and Caltrans storm water permittees are jointly responsible for conducting bioaccumulation testing of fish and mussel tissue within the Estuary. The permittees are required to submit for approval of the Executive Officer a monitoring plan that will provide the data needed to confirm the 303(d) listing or delisting, as applicable.

Representative sediment sampling locations shall be randomly selected within the Estuary and analyzed for cadmium, copper, lead, silver, zinc, chlordane, dieldrin, DDT, total PCBs and total PAHs at detection limits that are lower than the ERLs. Sediment samples shall also be analyzed for total organic carbon, grain size and sediment toxicity testing. Initial sediment monitoring should be done quarterly in the first year of the TMDL to define the baseline and semi-annually, thereafter, to evaluate effectiveness of the BMPs until the TMDL is reconsidered in the sixth year.

The sediment toxicity testing shall include testing of multiple species, a minimum of three, for lethal and non-lethal endpoints. Toxicity testing may include: the 28-day and 10-day amphipod mortality test; the sea urchin fertilization testing of sediment pore water; and the bivalve embryo testing of the sediment/water interface. The chronic 28-day and shorter-term 10-day amphipod tests may be conducted in the initial year of quarterly testing and the results compared. If there is no significant difference in the tests, then the less expensive 10-day test can be used throughout the rest of the monitoring, with some periodic 28-day testing.

7.2 EFFECTIVENESS MONITORING

The water quality samples collected during wet weather as part of the MS4 storm water monitoring program shall be analyzed for total dissolved solids, settable solids and total suspended solids if not already part of the sampling program. Sampling shall be designed to collect sufficient volumes of settable and suspended solids to allow for analysis of cadmium, copper, lead, silver, zinc, chlordane, dieldrin, total DDT, total PCBs, total PAHs, and total organic carbon in the bulk sediment.

Semi-annually, representative sediment sampling locations shall be randomly selected within the Estuary and analyzed for cadmium, copper, lead, silver, zinc, chlordane, dieldrin, DDT, total PCBs, and total PAHs at detection limits that are lower than the ERLs. The sediment samples shall also be analyzed for total organic carbon, grain size and sediment toxicity. The sediment toxicity testing shall include testing of multiple species, a minimum of three, for lethal and non-lethal endpoints. Toxicity testing may include: the 28-day and 10-day amphipod mortality test; the sea urchin fertilization testing of sediment pore water; and the bivalve embryo testing of the sediment/water interface.

Toxicity shall be indicated by an amphipod survival rate of 70% or less in a single test. Accelerated monitoring shall be conducted to confirm toxicity at stations identified as toxic. Accelerated monitoring shall consist of six additional tests, approximately every two weeks, over a 12-week period. If the results of any two of the six accelerated tests are less than 90% survival, then the MS4 and Caltrans permittees shall conduct a Toxicity Identification Evaluation (TIE). The TIE shall include reasonable steps to identify the sources of toxicity and steps to reduce the toxicity.

The Phase I TIE shall include the following treatments and corresponding blanks: baseline toxicity; particle removal by centrifugation; solid phase extraction of the centrifuged sample using C8, C18, or another media; complexation of metals using ethylenediaminetetraacetic acid (EDTA) addition to the raw sample; neutralization of oxidants/metals using sodium thiosulfate addition to the raw sample; and inhibition of organo-phosphate (OP) pesticide activation using piperonyl butoxide addition to the raw sample (crustacean toxicity tests only).

Bioaccumulation monitoring of fish and mussel tissue within the Estuary shall be conducted. The permittees are required to submit for approval of the Executive Officer a monitoring plan that will provide the data needed to assess the effectiveness of the TMDL.

7.3 SPECIAL STUDIES

Special studies are recommended to refine source assessments, to provide better estimates of loading capacity, and to optimize implementation efforts. The Regional Board will re-consider the TMDL in the sixth year after the effective date in light of the findings of these studies. Special studies may include:

- Evaluation and use of low detection level techniques to evaluate water quality concentrations for those contaminants where standard detection limits cannot be used to assess compliance for CTR standards or are not sufficient for estimating source loadings from tributaries and storm water;
- Developing and implementing a monitoring program to collection the data necessary to apply a multiple lines of evidence approach;
- Evaluate partitioning coefficients between water column and sediment to assess the contribution of water column discharges to sediment concentrations in the Estuary;
- Evaluation and use of sediment TIEs to evaluate causes of any recurring sediment toxicity;
- Studies to refine relationship between pollutants and suspended solids aimed at better understanding of the delivery of pollutants to the watershed;
- Studies to understand transport of sediments to the estuary, including the relationship between storm flows, sediment loadings to the estuary, and sediment deposition patterns within the estuary; and,
- Studies to evaluate effectiveness of BMPs to address pollutants and/or sediments.

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