COUNTYWIDE MODEL SUSMP

Standard Urban Stormwater Mitigation Plan
Requirements for Development Applications

January 2, 2009
Visit www.projectcleanwater.org for updates.

STATEMENT OF CERTIFICATION

Updated Model Standard Urban Stormwater Management Plan

I certify, under penalty of law, that this **Updated Model Standard Urban Stormwater Management Plan** and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

This document was reviewed and approved by the Copermittees of Order No. R9-2007-0001, NPDES No. CAS0108758, on January 15, 2009.

Chandra Wallar

CHANDRA L. WALLAR
Deputy Chief Administrative Officer
County of San Diego

1-21-09
Date

Countywide Model SUSMP

Project Clean Water
Cid Tesoro
Sara Agahi

This Model SUSMP is to be adapted for local use by:

City of Carlsbad
David Hauser
www.carlsbadca.gov

City of El Cajon
Jaime Campo
619-441-1653
www.ci.el-cajon.ca.us

City of La Mesa
Malik Tanimi
www.ci.la-mesa.ca.us

City of Poway
Danis Bechter
858-668-4630
www.ci.poway.ca.us

City of Solana Beach
Denny King
858-720-2477
www.ci.solana-beach.ca.us

San Diego County Regional Airport Authority
Richard Gilb
619-400-2405
www.sdcraa.com

City of Chula Vista
Khosro Aminpour
www.chulavistaca.gov

City of Encinitas
Erik Steenblock
www.ci.encinitas.ca.us

City of Lemon Grove
Cora Long
www.ci.lemon-grove.ca.us

City of San Diego
Sumer Hasenin
619-525-8634
www.sandiego.gov

City of Vista
Greg Mayer
760-726-1340 ext. 1206
www.ci.vista.ca.us

City of Coronado
Scott Huth
619-522-7380
www.coronado.ca.us

City of Escondido
Cheryl Filar
www.ci.escondido.ca.us

City of National City
Din Daneshfar
619-336-4386
www.ci.national-city.ca.us

City of San Marcos
Sassan Haghgoo
www.ci.san-marcos.ca.us

County of San Diego
Sara Agahi
858-694-2665
sdpublic.sdcounty.ca.gov

City of Del Mar
Joe DeStefano
www.delmar.ca.us

City of Imperial Beach
Judith Keir
www.ci.imperial-beach.ca.us

City of Oceanside
Mo Lasaie
www.ci.oceanside.ca.us

City of Santee
Julie Procopio
www.ci.santee.ca.us

San Diego Unified Port District
Karen Holman
www.portofsandiego.org

Prepared with assistance from **Brown and Caldwell**

subconsultants: **Philip Williams & Associates and Dan Cloak Environmental Consulting**

JANUARY 2, 2009

Updated Countywide Model Standard Urban Stormwater Mitigation Plan (SUSMP)

SUMMARY

In January 2007, the California Regional Water Quality Control Board for the San Diego Region (Regional Water Board) reissued a municipal stormwater NPDES permit to San Diego area municipal Copermittees. The reissued permit updates and expands stormwater requirements for new developments and redevelopments. Stormwater treatment requirements have been made more widely applicable and more stringent; minimum standards for Low Impact Development (LID) have been added, and the Copermittees are required to develop and implement criteria for the control of runoff peaks and durations from development sites.

Low Impact Development is an integrated site design methodology that uses small-scale detention and retention to minimize pollutants conveyed by runoff and to mimic pre-project site hydrological conditions.

As required by the reissued permit, the Copermittees have prepared an updated Countywide Model SUSMP to replace the current countywide model SUSMP, which has been in effect since 2002. Each municipality will update its local SUSMP to implement the requirements. To assist the land development community, to streamline project reviews, and to maximize cost-effective environmental benefits, the updated Countywide Model SUSMP incorporates a unified LID design procedure. This design procedure integrates site planning and design measures with engineered, small-scale Integrated Management Practices (IMPs) such as bioretention. By following the procedure, applicants can develop a single integrated design which complies with the complex and overlapping NPDES permit LID requirements, stormwater treatment requirements, and runoff peak-and-duration-control (hydromodification management) requirements.

Along with the detailed design procedure, the updated Countywide Model SUSMP includes design information and criteria for dispersal of runoff to landscaped areas and for pervious pavements, bioretention facilities, flow-through planters, dry wells, infiltration basins, and cisterns. Where feasible and where allowed, water in cisterns may be directed to nonpotable uses, augmenting water supplies. Bioretention facilities and planter boxes can be designed with an impermeable barrier so that runoff does not saturate native soils; instead, runoff is filtered through an engineered soil mix before being captured in an underdrain and conveyed to off-site storm drains. This configuration may be needed where groundwater is high, is contaminated, or where increasing soil moisture may present a hazard to foundations or slope stability.

Applicants for development project approvals may choose not to use the unified LID design procedure; however, they will still need to demonstrate compliance with the applicable LID criteria, stormwater treatment criteria, and hydromodification management criteria. The updated Countywide Model SUSMP requires that runoff be infiltrated or else treated by bioretention facilities, planter boxes, filters, settling ponds, or constructed wetlands. In some special circumstances—retrofit of existing drainage systems, some pedestrian-oriented developments, and roadway widening projects—where it can also be demonstrated it is not be feasible to construct any of these facilities, higher-rate surface biofilters or higher-rate vault-based filtration units may be used.

Applicants for approval of Priority Development Projects must demonstrate compliance with the hydromodification management criteria in the NPDES permit. The updated Countywide Model SUSMP includes guidance for demonstrating compliance. Submittals for projects smaller than 50 acres may demonstrate compliance by using the integrated LID design procedure. For larger projects, the applicant may use a continuous simulation hydrologic computer model to

simulate pre-project and post-project runoff, including the effect of LID facilities, detention basins, or other stormwater management facilities, or may identify an exemption applicable to the site.

Applicants must also incorporate into their project design features to control pollutants from specified on-site sources, such as refuse areas, outdoor storage areas, and vehicle washing and repair facilities. The Copermittees have developed a table listing the types of sources to be controlled and for each, the corresponding source control measures required.

The updated Countywide Model SUSMP provides the applicant with step-by-step instructions for preparing a Project Submittal for review by the municipal staff. The recommended steps are:

1. Assemble needed information.

2. Identify site opportunities and constraints.

3. Follow the LID Design Guidance to analyze the project for LID and to develop and document the drainage design.

4. Specify source controls using the sources/source control checklist in the appendix.

5. Plan for ongoing maintenance of treatment and flow-control facilities.

6. Complete the Project Submittal.

The step-by-step instructions are augmented by an example checklist which municipal staff may use as a guide when reviewing the Project Submittal. The SUSMP also includes an example project submittal outline and contents. As stated in the SUSMP, municipalities may adapt these submittal requirements to their own needs and procedures.

As required by the reissued NPDES permit, each Copermittee implements a program to verify that approved stormwater treatment facilities are operating effectively. To facilitate implementation of these programs, the updated Countywide Model SUSMP includes instructions for applicants to prepare detailed maintenance plans.

The updated Countywide Model SUSMP is available for download in .pdf format at www.projectcleanwater.org. The 126-page document is formatted for 2-sided printing, and may also be navigated online. Hyperlinks throughout the document provide ready access to references and additional information resources.

Table of Contents

Figures

Tables

Checklists

Design Sheets

Glossary

Best Management Practice (BMP) Any procedure or device designed to minimize the quantity of pollutants that enter the storm drain system.

California Association of Stormwater Quality Agencies (CASQA) Publisher of the California Stormwater Best Management Practices Handbooks, available at www.cabmphandbooks.com. Successor to the Storm Water Quality Task Force (SWQTF).

California BMP Method A method for determining the required volume of stormwater treatment facilities. Described in Section 5.5.1 of the California Stormwater Best Management Practice Manual (New Development) (CASQA, 2003).

Conditions of Approval (COAs) Requirements a municipality may adopt for a project in connection with a discretionary action (e.g., adoption of an EIR or negative declaration or issuance of a use permit). COAs may include features to be incorporated into the final plans for the project and may also specify uses, activities, and operational measures that must be observed over the life of the project.

Continuous Simulation Modeling A method of hydrological analysis in which a set of rainfall data (typically hourly for 30 years or more) is used as input, and runoff rates are calculated on the same time step. The output is then analyzed statistically for the purposes of comparing runoff patterns under different conditions (for example, pre- and post-development-project).

Copermittees See **Dischargers**.

Detention The practice of holding stormwater runoff in ponds, vaults, within berms, or in depressed areas and letting it discharge slowly to the storm drain system. See definitions of **infiltration** and **retention**.

Directly Connected Impervious Area Any impervious surface which drains into a catch basin, area drain, or other conveyance structure without first allowing flow across pervious areas (e.g. lawns).

Direct Infiltration Infiltration via methods or devices, such as dry wells or infiltration trenches, designed to bypass unsaturated surface soils and transmit runoff directly to groundwater.

Dischargers The agencies named in the **stormwater NPDES permit** (see definition): the County of San Diego; the Cities of Carlsbad, El Cajon, La Mesa, Poway, Solana Beach, Chula Vista, Encinitas, Lemon Grove, San Diego, Vista, Coronado, Escondido, National City, San Marcos, Del Mar, Impervial Beach, Oceanside, and Santee; the San Diego Unified Port District, and the San Diego County Regional Airport Authority.

Drainage Management Areas Areas delineated on a map of the development site showing how drainage is detained, dispersed, or directed to **Integrated Management Practices**. There are four types of Drainage Management Areas, and specific criteria apply to each type of area. See Chapter 4.

Drawdown time The time required for a stormwater detention or infiltration facility to drain and return to the dry-weather condition. For detention facilities, drawdown time is a function of basin volume and outlet orifice size. For infiltration facilities, drawdown time is a function of basin volume and infiltration rate.

Environmentally Sensitive Areas Areas that include but are not limited to all Clean Water Act Section 303(d) impaired water bodies; areas designated as Areas of Special Biological Significance by the State Water Resources Control Board (Water Quality Control Plan for the San Diego Basin (1994) and amendments); water bodies designated with the RARE beneficial use by the State Water Resources Control Board (Water Quality Control Plan for the San Diego Basin (1994) and amendments); areas designated as preserves or their equivalent under the Multi Species Conservation Program within the Cities and County of San Diego; and any other equivalent environmentally sensitive areas which have been identified by the Copermittees.

Flow Control Control of runoff rates and durations as required by the Hydromodification Management Plan.

Head In hydraulics, energy represented as a difference in elevation. In slow-flowing open systems, the difference in water surface elevation, e.g., between an inlet and outlet.

Higher-Rate Biofilter A biofilter with a design surface loading rate higher than the 5 inches per hour rate specified in this document for bioretention facilities and planter boxes.

Hydrograph Runoff flow rate plotted as a function of time.

Hydromodification Management Plan (HMP) A Plan implemented by the **dischargers** so that post-project runoff shall not exceed estimated pre-project rates and/or durations, where increased runoff would result in increased potential for erosion or other adverse impacts to beneficial uses. Also see definition for **flow control.**

Hydrologic Soil Group Classification of soils by the Natural Resources Conservation Service (NRCS) into A, B, C, and D groups according to infiltration capacity.

Impervious surface Any material that prevents or substantially reduces infiltration of water into the soil. See discussion of imperviousness in Chapter Two.

Infeasible As applied to best management practices, impossible to implement because of technical constraints specific to the site.

Infiltration Seepage of runoff into soils underlying the site. See definition of **retention.**

Infiltration Device Any structure, such as a dry well, that is designed to infiltrate stormwater into the subsurface and, as designed, bypasses the natural groundwater protection afforded by surface or near-surface soil. See definition for **direct infiltration**.

Integrated Management Practice (IMP) A facility **(BMP)** that provides small-scale treatment, retention, and/or detention and is integrated into site layout, landscaping and drainage design. See **Low Impact Development.**

Integrated Pest Management (IPM) An approach to pest management that relies on information about the life cycles of pests and their interaction with the environment. Pest control methods are applied with the most economical means and with the least possible hazard to people, property, and the environment.

Interim Hydromodification Criteria Pursuant to NPDES permit Provision D.1.d.g.(6), the Copermittees prepared Interim Hydromodification Management criteria, which apply to projects disturbing 50 acres or more. The criteria are described in Chapter 2 and in memoranda on the Project Clean Water website.

Jurisdictional Urban Runoff Management Plan (JURMP) A written description of the specific jurisdictional urban runoff management measures and programs that each Copermittee implements to comply with the **stormwater NPDES permit** and ensure pollutant discharges are reduced to the MEP and do not cause or contribute to a violation of water quality standards. See **Stormwater Pollution Prevention Program.**

Lead Agency The public agency that has the principal responsibility for carrying out or approving a project. (CEQA Guidelines §15367).

Low Impact Development An integrated site design methodology that uses small-scale detention and retention (Integrated Management Practices, or **IMPs**) to mimic pre-existing site hydrological conditions.

Maximum Extent Practicable (MEP) Standard, established by the 1987 amendments to the Clean Water Act, for the implementation of municipal **stormwater pollution prevention programs** (see definition). According to the Act, municipal stormwater NPDES permits "shall require controls to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques and system, design and engineering methods, and such other provisions as the Administrator or the State determines appropriate for the control of such pollutants."

National Pollutant Discharge Elimination System (NPDES) As part of the 1972 Clean Water Act, Congress established the NPDES permitting system to regulate the discharge of pollutants from municipal sanitary sewers and industries. The NPDES was expanded in 1987 to incorporate permits for stormwater discharges as well.

Numeric Criteria Sizing requirements for stormwater treatment facilities established in Provision D.1.d.(6)(c) of the San Diego RWQCB's stormwater NPDES permit.

Operation and Maintenance (O&M) Refers to requirements in the **Stormwater NPDES Permit** to inspect treatment BMPs and implement preventative and corrective maintenance in perpetuity. See Chapter Five.

Parking Lot A land area or facility for the temporary parking or storage of motor vehicles used personally, for business, or for commerce.

Permeable Pavements Pavements for roadways, sidewalks, or plazas that are designed to infiltrate a portion of rainfall, including pervious concrete, pervious asphalt, unit-pavers-on-sand, and crushed gravel.

Priority Development Project A project subject to SUSMP requirements. Defined in **Stormwater NPDES Permit** Provision D.1.d.(1). See Chapter One.

Project Area The entire project area comprises all areas to be altered or developed by the project, plus any additional areas that drain on to areas to be altered or developed.

Project Submittal Documents submitted to a municipality in connection with an application for development approval and demonstrating compliance with Stormwater NPDES Permit requirements for the project. Specific requirements vary from municipality to municipality.

Proprietary A proprietary device is one marketed under legal right of the manufacturer.

Redevelopment The creation, addition, and or replacement of impervious surface on an already developed site. Examples include the expansion of a building footprint, road widening, the addition to or replacement of a structure, and creation or addition of impervious surfaces. Replacement of impervious surfaces includes any activity that is not part of a routine maintenance activity where impervious material(s) are removed, exposing underlying soil during construction. Redevelopment does not include trenching and resurfacing associated with utility work; resurfacing and reconfiguring surface parking lots and existing roadways; new sidewalk construction, pedestrian ramps, or bikelane on existing roads; and routine replacement of damaged pavement, such as pothole repair.

Rational Method
A method of calculating runoff flows based on rainfall intensity, tributary area, and a factor representing the proportion of rainfall that runs off.

Regional (or Watershed) Stormwater Treatment Facility
A facility that treats runoff from more than one project or parcel.

Regional Water Quality Control Board (Regional Water Board or RWQCB)
California RWQCBs are responsible for implementing pollution control provisions of the Clean Water Act and California Water Code within their jurisdiction. There are nine California RWQCBs.

Retention
The practice of holding stormwater in ponds or basins, or within berms or depressed areas, and allowing it to slowly infiltrate into underlying soils. Some portion will evaporate. See definitions for **infiltration** and **detention**.

Self-retaining area
An area designed to retain runoff. Self-retaining areas may include graded depressions with landscaping or pervious pavements and may also include tributary impervious areas up to a 2:1 impervious-to-pervious ratio.

Self-treating area
A natural, landscaped, or turf area drains directly off site or to the public storm drain system.

Source Control
Land use or site planning practices, or structural or nonstructural measures that aim to prevent urban runoff pollution by reducing the potential for contamination at the source of pollution. Source control BMPs minimize the contact between pollutants and urban runoff.

Standard Industrial Classification (SIC)
A Federal government system for classifying industries by 4-digit code. It is being supplanted by the North American Industrial Classification System but SIC codes are still referenced by the Regional Water Board in identifying development sites subject to regulation under the NPDES permit. Information and an SIC search function are available at http://www.bls.gov/bls/NAICS.htm

Stormwater NPDES Permit
A permit issued by a **Regional Water Quality Control Board** (see definition) to local government agencies (**Dischargers**) placing provisions on allowable discharges of municipal stormwater to waters of the state.

Storm Water Pollution Prevention Plan (SWPPP)
A plan providing for temporary measures to control sediment and other pollutants during construction as required by the statewide stormwater NPDES permit for construction activities.

Stormwater Pollution Prevention Program A comprehensive program of activities designed to minimize the quantity of pollutants entering storm drains. See **Jurisdictional Urban Runoff Management Plan.**

Standard Urban Stormwater Mitigation Plan (SUSMP) Refers to various documents prepared in connection with implementation of the stormwater **NPDES permit** mandate to control pollutants from new development and redevelopment. Each **discharger** will adapt this **model countywide SUSMP** to create a **local SUSMP** for their respective jurisdiction. Applicants for development project approvals will use the local SUSMP to prepare a submittal for each **Priority Development Project** they propose.

Treatment Removal of pollutants from runoff, typically by filtration or settling.

Water Board See **Regional Water Quality Control Board.**

Water Quality Volume (WQV) For stormwater treatment facilities that depend on detention to work, the volume of water that must be detained to achieve maximum extent practicable pollutant removal. This volume of water must be detained for a specified **drawdown time**.

How to Use the SUSMP

Review Chapters 1 and 2 to get a general understanding of the requirements. Then follow step-by-step instructions in Chapter 3 to prepare your Project Submittal.

THIS *Standard Urban Stormwater Mitigation Plan (SUSMP)* will help you ensure your project complies with the California Regional Water Quality Control Boards' requirements. Most applicants will require the assistance of a qualified civil engineer, architect, and/or landscape architect. Because every project is different, you should begin by checking specific requirements with municipal staff.

ICON KEY
☞ Helpful Tip
Submittal Requirement
Terms to Look Up
References & Resources

To use the *SUSMP,* start by reviewing **Chapter One** to find out whether and how stormwater quality requirements apply to your project. Chapter One also provides an overview of the process of planning, design, construction, operation, and maintenance leading to compliance.

If there are terms and issues you find puzzling, try finding answers in the glossary or in **Chapter T wo**. Chapter Two provides background on key stormwater concepts and water quality regulations, including design criteria.

Then proceed to **Chapter Three** and follow the step-by-step guidance to prepare a Project Submittal for your site.

Chapter Four, the Low Impact Development Design Guide, includes design procedures, calculation procedures, and instructions for presenting your design and calculations in your Project Submittal.

In **Chapter Fiv e** you'll find a detailed description of the process for ensuring operation and maintenance of your stormwater facilities over the life of the project. The chapter includes step-by-step instructions for preparing a Stormwater Facilities Operation and Maintenance Plan.

Local Requirements

Cities or the County may have requirements that differ from, or are in addition to, this countywide model SUSMP.

Throughout each Chapter, you'll find references and resources to help you understand the regulations, complete your Project Submittal, and design stormwater control measures for your project.

The most recent, updated version of the *Model SUSMP,* including updates and errata between editions, is on the Project Clean Water website. The on-line *Model SUSMP* is in Adobe Acrobat format. If you are reading the Acrobat version on a computer with an internet connection, you can use hyperlinks to navigate the document and to access various references. The hyperlinks are throughout the text, as well as in "References and Resources" sections (marked by the 🕮 icon) and in the **Bibliography**. Some of these links (URLs) may be outdated. In that case, try entering portions of the title or other keywords into a web search engine.

Construction-Phase Controls

Your Project Submittal for SUSMP compliance is a separate document from the Storm Water Pollution Prevention Plan (SWPPP). A SWPPP provides for temporary measures to control sediment and other pollutants during construction at sites that disturb one acre or more. See the Construction Handbook at www.cabmphandbooks.org for more information on SWPPPs.

► PLAN AHEAD TO AVOID THE THREE MOST COMMON MISTAKES

The most common (and costly) errors made by applicants for development approvals with respect to stormwater quality compliance are:

1. Not planning for compliance early enough. You should think about your strategy for stormwater quality compliance before completing a conceptual site design or sketching a layout of subdivision lots (Chapter 3).

2. Assuming proprietary stormwater treatment facilities will be adequate for compliance. Most aren't (Chapter 2).

3. Not planning for periodic inspections and maintenance of treatment and flow-control facilities. Consider who will own and who will maintain the facilities in perpetuity and how they will obtain access, and identify which arrangements are acceptable to your municipality (Chapter 5).

Chapter 1

Policies and Procedures

Determine if your development project must comply with stormwater quality requirements, and review the steps to compliance.

A Low Impact Development Design Procedure

The San Diego Regional Water Board reissued a municipal stormwater NPDES permit to the municipal **Copermittees** in January 2007. The permit updates and expands stormwater requirements for new developments and redevelopments. Stormwater treatment requirements have been made more stringent, minimum standards for **Low Impact Development** (LID) have been added, and the Copermittees are required to develop and implement criteria for the control of runoff peaks and durations from development sites.

ICON KEY
Helpful Tip
Submittal Requirement
Terms to Look Up
References & Resources

To assist the land development community, streamline project reviews, and maximize cost-effective environmental benefits, the Copermittees have developed a unified LID design procedure. This design procedure integrates site planning and design measures with engineered, small-scale **Integrated Management Practices** (IMPs) such as bioretention. By following the procedure, applicants can develop a single integrated design which complies with the complex and overlapping NPDES permit LID requirements, stormwater treatment requirements, and flow-control (**hydromodification management**) requirements.

The design approach is detailed in Chapter 4. General instructions for preparing a complete Project Submittal are in Chapter 3, and specific local submittal requirements are available from municipal staff.

Applicants may choose not to use this design procedure, in which case they will need to demonstrate, in their submittal, compliance with applicable LID criteria, stormwater treatment criteria, and flow-control criteria. These criteria are described in Chapter 2 and in the NPDES permit.

Requirements for All Development Projects

All development projects must include control measures to reduce the discharge of stormwater pollutants to the maximum extent practicable.

In general, for projects that are not "Priority Development Projects," this will include:

- Implementation of source control BMPs as listed in the Appendix.
- Inclusion of some LID features that conserve natural features, set back development from natural water bodies, minimize imperviousness, maximize infiltration, and retain and slow runoff.
- Compliance with requirements for construction-phase controls on sediment and other pollutants.

Municipal staff may also require additional controls appropriate to the project, which may include stormwater treatment controls. LID treatment controls such as infiltration or bioretention are preferred. See "Selection of Treatment Facilities" on page 21. If treatment facilities are included, provisions must be made to ensure their long-term maintenance.

Local Requirements
Project Submittal requirements vary from project to project. Check with municipal staff.

Priority Development Projects

The NPDES permit requires more specific criteria be applied to Priority Development Projects.

► NEW DEVELOPMENT

Projects on previously undeveloped land are Priority Development Projects if they are in one or more of the categories listed in Table 1-1.

TABLE 1-1. Priority Development Projects.

Is the project in any of these categories?

Yes ❑	No ❑	**A**	**Housing subdivisions of 10 or more dwelling units.** Examples: single-family homes, multi-family homes, condominiums, and apartments.
Yes ❑	No ❑	**B**	**Commercial—greater than one acre.** Any development other than heavy industry or residential. Examples: hospitals; laboratories and other medical facilities; educational institutions; recreational facilities; municipal facilities; commercial nurseries; multi-apartment buildings; car wash facilities; mini-malls and other business complexes; shopping malls; hotels; office buildings; public warehouses; automotive dealerships; airfields; and other light industrial facilities.
Yes ❑	No ❑	**C**	**Heavy industry—greater than one acre.** Examples: manufacturing plants, food processing plants, metal working facilities, printing plants, and fleet storage areas (bus, truck, etc.).
Yes ❑	No ❑	**D**	**Automotive repair shops.** A facility categorized in any one of Standard Industrial Classification (SIC) codes 5013, 5014, 5541, 7532-7534, or 7536-7539.
Yes ❑	No ❑	**E**	**Restaurants.** Any facility that sells prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (SIC code 5812), where the land area for development is greater than 5,000 square feet. Restaurants where land development is less than 5,000 square feet shall meet all SUSMP requirements except for structural treatment BMP and numeric sizing criteria requirements and hydromodification requirements.
Yes ❑	No ❑	**F**	**Hillside development greater than 5,000 square feet.** Any development that creates 5,000 square feet of impervious surface and is located in an area with known erosive soil conditions, where the development will grade on any natural slope that is twenty-five percent or greater.
Yes ❑	No ❑	**G**	**Environmentally Sensitive Areas (ESAs).** All development located within or directly adjacent to or discharging directly to an ESA (where discharges from the development or redevelopment will enter receiving waters within the ESA), which either creates 2,500 square feet of impervious surface on a proposed project site or increases the area of imperviousness of a proposed project site to 10% or more of its naturally occurring condition. "Directly adjacent" means situated within 200 feet of the ESA. "Discharging directly to" means outflow from a drainage conveyance system that is composed entirely of flows from the subject development or redevelopment site, and not commingled with flows from adjacent lands.
Yes ❑	No ❑	**H**	**Parking lots 5,000 square feet or more** or with 15 or more parking spaces and potentially exposed to urban runoff.
Yes ❑	No ❑	**I**	**Street, roads, highways, and freeways.** Any paved surface that is 5,000 square feet or greater used for the transportation of automobiles, trucks, motorcycles, and other vehicles.
Yes ❑	No ❑	**J**	**Retail Gasoline Outlets (RGOs)** that are: (a) 5,000 square feet or more or (b) a projected Average Daily Traffic (ADT) of 100 or more vehicles per day.

To use the table, review each definition A through J. If any of the definitions match, the project is a **Priority Development Project**. Note some thresholds are defined by square footage of impervious area created; others by the total area of the development.

► PREVIOUSLY DEVELOPED SITES

Projects on previously developed sites ("**redevelopment** projects") are Priority Development Projects if they create, add, or replace 5,000 square feet or more of impervious surface and also are in one of the categories listed in Table 1-1.

Local municipal staff may choose to designate projects not within the categories in Table 1-1 as Priority Development Projects, based on potential impacts to stormwater quality.

► THE "50% RULE" FOR PREVIOUSLY DEVELOPED PROJECTS

Projects on previously developed sites may also need to retrofit drainage of **all** impervious areas of the **entire** site. For sites creating or replacing more than 5,000 square feet of impervious area:

- If the new project results in an increase of, or replacement of, 50% or more of the previously existing impervious surface, and the existing development was not subject to SUSMP requirements, then the entire project must be included in the treatment measure design.

- If less than 50% of the previously impervious surface is to be affected, only that portion must be included in the treatment measure design.

If a new Development Project feature such as a parking lot falls into a Priority Development Project category, then the entire project footprint is subject to SUSMP requirements.

Projects limited to interior remodels, routine maintenance or repair, roof or exterior surface replacement, resurfacing and reconfiguring surface parking lots and existing roadways, new sidewalk construction, pedestrian ramps, or bike lanes on existing roads, and routine replacement of damaged pavement such as pothole repair are not subject to treatment requirements. However, other requirements, including incorporation of appropriate source controls, still apply.

Compliance Process at a Glance

For the applicant for development project approval, stormwater compliance follows these general steps:

1. Discuss requirements during a pre-application meeting with municipal staff.

2. Review the instructions in this *SUSMP* before you prepare your tentative map, preliminary site plan, drainage plan, and landscaping plan.

3. Prepare your **Project Submittal**, which is typically made with your application for development approvals (entitlements).

4. Create your detailed project design, incorporating the features described in your Project Submittal.

5. In a table on your construction plans, list each stormwater compliance feature and facility and the plan sheet where it appears.

6. Prepare a draft Stormwater Facility Operation and Maintenance Plan and submit it as required by your local jurisdiction.

7. Maintain stormwater facilities during construction and following construction in accordance with required warranties.

8. Following construction, formally transfer responsibility for maintenance to the owner.

9. The owner must periodically verify stormwater facilities are properly maintained.

Preparation of a complete and detailed Project Submittal is the key to cost-effective stormwater compliance and expeditious review of your project. Instructions for preparing your Project Submittal are in Chapter 3.

Phased Projects

When determining whether SUSMP requirements apply, a "project" should be defined consistent with California Environmental Quality Act (CEQA) definitions of "project." That is, the "project" is the whole of an action which has the potential for adding or replacing or resulting in the addition or replacement of roofs, pavement, or other impervious surfaces and thereby resulting in increased flows and stormwater pollutants. "Whole of an action" means the project may not be segmented or piecemealed into small parts if the effect is to reduce the quantity of impervious area for any part to below the SUSMP thresholds.

Local Requirements

Cities or the County may have requirements that differ from, or are in addition to, this countywide model SUSMP. Check with local planning and community development staff.

Municipal staff may require, as part of an application for approval of a phased development project, a conceptual or master Project Submittal which describes and illustrates, in broad outline, how the drainage for the project will comply with the SUSMP requirements. The level of detail in the conceptual or master Project Submittal should be consistent with the scope and level of detail of the development approval being considered. The conceptual or master Project Submittal should specify that a more detailed Project Submittal for each later phase or portion of the project will be submitted with subsequent applications for discretionary approvals.

CEQA

Preparers of CEQA documents may wish to visit the Project Clean Water website for guidance on how to document stormwater impacts and mitigations in Initial Studies and Environmental Impact Reports.

Note these minimum standards for SUSMP applicability are for the purpose of ensuring a consistent minimum level or "floor" for countywide implementation consistent with the requirements of the NPDES permit. Individual municipalities may choose a more expansive interpretation of the NPDES permit's applicability and may also choose to apply source control, treatment, and flow-control requirements to projects that would be exempt under these minimum standards.

New Subdivisions

If a tentative map approval would potentially entitle future owners to construct new or replaced impervious area which, in aggregate, could exceed one of the SUSMP thresholds (Table 1-1), then the applicant must take steps to ensure SUSMP requirements can and will be implemented as the subdivision is built out.

If the tentative map application does not include plans for site improvements, the applicant should nevertheless identify the type, size, location, and final ownership of stormwater treatment and flow-control facilities adequate to serve common private roadways and any other common areas, and to also manage runoff from an expected reasonable estimate of the square footage of future roofs, driveways, and other impervious surfaces on each individual lot. The municipality may condition approval of the map on implementation of stormwater treatment and other SUSMP measures when construction occurs on the individual lots. At the municipality's discretion, this condition may be enforced by a grant deed of development rights or by a development agreement.

If a municipality deems it necessary, the future impervious area of one or more lots may be limited by a deed restriction. This might be necessary when a project is exempted from one or all SUSMP provisions because the total impervious area is below a threshold, or to ensure runoff from impervious areas added after the project is approved does not overload a stormwater treatment and flow-control facility.

Municipalities may require subdivision maps to dedicate an "open space easement, as defined by Government Code Section 51075," to suitably restrict the future building of structures at each stormwater facility location if necessary.

In general, in new subdivisions **stormwater treatment, infiltration, or flow-control facilities should not be located on individual single-family residential lots**, particularly when those facilities manage runoff from other lots, from streets, or from common areas. A better alternative is to locate stormwater facilities on one or more separate, jointly owned parcels.

After consulting with local planning staff, applicants for subdivision approvals will propose one of the following four options, depending on project characteristics and local policies:

1. Show the number of parcels and the total impervious area to be created on all parcels could not, in the future, exceed any of the thresholds in Table 1-1.

2. Show that, for each and every lot, the intended use can be achieved with a design which disperses runoff from roofs, driveways, streets, and other impervious areas to self-retaining pervious areas, using the criteria in Chapter 4.

3. Prepare improvement plans showing drainage to treatment and/or flow-control facilities designed in accordance with this *SUSMP,* and commit to constructing the facilities prior to transferring the lots.

4. Prepare improvement plans showing drainage to treatment and/or flow-control facilities designed in accordance with this *SUSMP*, and provide appropriate legal instruments to ensure the proposed facilities will be constructed and maintained by subsequent owners.

For the option selected, municipal staff will determine the appropriate conditions of approval, easements, deed restrictions, or other legal instruments necessary to assure future compliance.

Compliance with Flow-Control Requirements

Priority Development Projects (Table 1-1) must be designed so that runoff rates and durations are controlled to maintain or reduce downstream erosion conditions and protect stream habitat.

For projects disturbing areas smaller than 50 acres, this can be accomplished by implementing **Low Impact Development** (LID) design using the design criteria and procedures in Chapter 4. The criteria will be updated following RWQCB approval of the Copermittees' **Hydromodification Management Plan** (see Option 2 below).

Priority Development Projects disturbing 50 acres or more must meet the following **interim hydromodification standard**:

> "...post-project runoff flow rates and durations shall not exceed pre-project runoff flow rates and durations ... where the increased discharge flow rates and durations will result in increased potential for erosion or other significant adverse impacts to beneficial uses, attributable to increased flow rates and durations."

Project Clean Water is developing a Hydromodification Management Plan (HMP) in compliance with Provision D.1.g of the NPDES Permit. As required, the Program has adopted interim hydromodification criteria which will be superseded after the HMP is accepted by the Regional Water Board.

Compliance with the interim hydromodification criteria can be achieved by one of the following options:

1. Use a continuous simulation hydrologic computer model such as USEPA's Hydrograph Simulation Program—Fortran (HSPF) to simulate pre-project and post-project runoff, including the effect of proposed IMPs, detention basins, or other stormwater management facilities, and demonstrate the standard is achieved.

2. Use Low Impact Development Integrated Management Practices to manage hydrograph modification impacts, using design procedures, criteria, and sizing factors (ratios of LID IMP volume or area to tributary area) specified by the Co-permittees.

3. Identify an exemption applicable to the site.

► OPTION 1: CONTINUOUS SIMULATION

Prepare an analysis of pre-project and post-project runoff following the instructions in the memoranda "Using Continuous Simulation to Size Stormwater Control Facilities" (May 9, 2008) and "Development of Interim Hydromodification Criteria" (October 30, 2007). Both memoranda are available on the Project Clean Water website.

Before preparing the analysis, discuss with municipal staff the required documentation for your Project Submittal, which will include assumptions and modeling parameters used in the analysis and a graphical presentation demonstrating compliance with the following:

1. For flow rates from 20% of the pre-project 5-year runoff event (0.2Q5) to the pre-project 10-year runoff event (Q10), the post-project discharge rates and durations shall not deviate above the pre-project rates and durations by more than 10% over and more than 10% of the length of the flow duration curve.

2. For flow rates from 0.2Q5 to Q5, the post-project peak flows shall not exceed pre-project peak flows. For flow rates from Q5 to Q10, post-project peak flows may exceed pre-project flows by up to 10% for a 1-year frequency interval. For example, post-project flows could exceed pre-project flows by up to 10% for the interval from Q9 to Q10 or from Q5.5 to Q6.5, but not from Q8 to Q10. (Note that the 0.2Q5 end of the range may be modified).

► OPTION 2: LID INTEGRATED MANAGEMENT PRACTICES

Low Impact Development Integrated Management Practices, such as bioretention facilities, planter boxes, and dry wells, can achieve the hydromodification standard. However, the Copermittees have not yet prepared design criteria and sizing factors for these facilities applicable to projects 50 acres or more. Project proponents for projects 50 acres or more may use Option 1 to demonstrate their IMPs meet the interim criteria.

► OPTION 3: EXEMPTION FROM HYDROMODIFICATION MANAGEMENT

Exemption from the IHC is allowed for development projects when any of the following conditions are met. (However, plans to restore a channel reach may re-introduce the applicability of hydromodification management.)

1. The project would discharge into channels that are concrete-lined or significantly hardened (e.g., with rip-rap, sackcrete, etc.) downstream to their outfall in bays or the ocean;

2. The project would discharge into underground storm drains discharging directly to bays or the ocean;

3. The project would discharge to a channel where the sub-watershed areas below the project's discharge points are highly impervious (e.g. >70%) and the potential for single-project and/or cumulative impacts is minimal; or

4. The applicant conducts an assessment incorporating sediment transport modeling across the range of geomorphically-significant flows that demonstrates project flows and sediment reductions will not detrimentally affect the receiving water. A May 15, 2008 memorandum, "Geomorphic Analysis for Interim Hydrograph Modification Plan" is available on the Project Clean Water website.

Grandfathering. Projects with prior lawful approval (such as a development agreement, vested tentative map, or a building or grading permit) that have started construction before March 25, 2008, may not have to meet the interim hydromodification management requirements. Verify with municipal staff.

Note these are interim requirements and will be superseded following approval of the HMP by the Regional Water Board sometime after mid-2009. Updated hydromodification criteria for all Priority Development Projects will be incorporated into local SUSMP requirements sometime in 2010 or later.

Waivers from Numeric Sizing Criteria

The NPDES permit allows for a project to be waived from numeric sizing criteria for stormwater treatment **only** if all available treatment facilities have been considered and found **infeasible**. Municipal staff must inform the Water Board within 5 days of granting a waiver. Other SUSMP requirements—including site designs to minimize imperviousness and source control BMPs—will still apply.

Experience has shown implementation of LID facilities, as described in Chapter 4, is feasible on nearly all development sites. However, the use of LID to retrofit existing drainage systems, to manage runoff from sites smaller than one acre in pedestrian-oriented developments, or to manage runoff from widened portions of roadways, sometimes presents special challenges. In these special situations, applicants should see the discussion of "Selection of Stormwater Treatment Facilities" in Chapter 2 and evaluate the options described on page 23 in order (depending on the specific characteristics of the project and as determined by local development review staff). All the options listed meet the numeric sizing criteria in the NPDES permit.

If infeasibility of all these options can be established, local development review staff may determine eligibility of the project for a waiver.

References and Resources:

- RWQCB Order R9-2007-0001 (Stormwater NPDES Permit)
- Project Clean Water web page

Chapter

2

Concepts and Criteria

Technical background and explanations of policies and design requirements

The Regional Water Board reissued a municipal stormwater NPDES permit to San Diego County, its 18 cities, the San Diego Unified Port District, and the San Diego Regional Airport Authority in January 2007. The permit mandates a comprehensive program to prevent stormwater pollution. That program now includes street sweeping, maintenance of storm drains, business inspections, public outreach, construction site inspections, monitoring and studies of stream and ocean health, and control of runoff pollutants from new developments and redevelopments.

Permit Provision D.1.d. requires Copèrmittees to regulate projects in specific categories (Table 1-1) to:

1. Reduce discharges of pollutants to the maximum extent practicable.
2. Prevent runoff discharges from causing or contributing to a violation of water quality standards.

The Copermittees have created a Low Impact Development (LID) design procedure (Chapter 4) that ensures consistent and thorough implementation of the Regional Water Board's requirements. This chapter explains the technical background of the LID approach and how it was derived.

The previous permit, issued in 2001, included a requirement to control the post-development peak storm water runoff rates and velocities to maintain or reduce pre-development downstream erosion and protect stream habitat. The 2007 permit includes, in addition to this ongoing requirement, a new requirement to develop a hydromodification management plan (HMP) to identify and define a methodology and performance criteria to ensure flow rates and durations do not exceed pre-project runoff where increased runoff could cause erosion or other significant adverse impacts to beneficial uses.

As required by the NPDES permit, the Copermittees have adopted interim hydromodification criteria. See Chapter One.

Water-Quality Regulations

Provision D.1 requires the Copermittees to condition development approvals on incorporation of specified stormwater controls.

Provision D.1 requires applicable new developments and redevelopments:

- Design the site to conserve natural areas, existing trees and vegetation and soils, to maintain natural drainage patterns, to minimize imperviousness, to detain runoff, and to infiltrate runoff where feasible
- Cover or control sources of stormwater pollutants
- Treat runoff prior to discharge. Provision E.10 states: "Urban runoff treatment and/or mitigation must occur prior to the discharge of urban runoff into a receiving water. Federal regulations at 40 CFR 131.10(a) state that in no case shall a state adopt waste transport or waste assimilation as a designated use for any waters of the U.S."
- Ensure runoff does not exceed pre-project peaks and durations where increases could affect downstream habitat or other beneficial uses
- Maintain treatment and flow-control facilities

The municipalities each maintain a database to track approved installations of treatment facilities and to verify facilities are maintained. The Copermittees' annual report to the Regional Water Board includes a list of development projects subject to SUSMP conditions and descriptions of those projects that:

- Received a waiver from SUSMP criteria;
- Used hydrologic controls used to meet HMP requirements, including a description of the controls;

- Have an area of 50 acres or greater, thus subject to **Interim Hydromodification Criteria**; and

The Copermittees must also report the number of violations and enforcement actions taken upon development projects. The Copermittees' programs are subject to audit by the Regional Water Board.

The municipalities—not the Regional Water Board or its staff—are charged with ensuring development projects comply with the D.1 requirements. Regional Water Board staff sometimes review stormwater controls and hydromodification impacts in connection with applications for Clean Water Act Section 401 water-quality certification, which is required for projects that involve work, such as dredging or placement of fill, within streams, creeks, or other waters of the US.

► MAXIMUM EXTENT PRACTICABLE

Clean Water Act Section 402(p)(3)(iii) sets the standard for stormwater controls as "maximum extent practicable," but doesn't define that term. As implemented, "maximum extent practicable" is ever-changing and varies with conditions.

Many stormwater controls, including LID facilities, have proven to be practicable in most site development projects. To achieve fair and effective implementation, criteria and guidance, requirements for controls must be detailed and specific—while also offering the right amount of flexibility or exceptions for special cases. The NPDES permit includes various standards, including hydrologic criteria, which have been found to comprise "maximum extent practicable." This model SUSMP is to be continuously improved and refined based on the experience of municipal planners and engineers, with input from land developers and development professionals. By following the model SUSMP, applicants can ensure their project design meets "maximum extent practicable."

► BEST MANAGEMENT PRACTICES

Clean Water Act Section 402(p) and USEPA regulations (40 CFR 122.26) specify a municipal program of "management practices" to control stormwater pollutants. **Best Management Practice (BMP)** refers to any kind of procedure, activity or device designed to minimize the quantity of pollutants that enter the storm drain system. BMPs are typically used in place of assigning numeric effluent limits. The criteria for source control BMPs and treatment and flow-control facilities are crafted to fulfill "maximum extent practicable."

To minimize confusion, this guidebook refers to "facilities," "features," or "controls" to be incorporated into development projects. All of these are BMPs.

Pollutants of Concern

NPDES Permit Provision D.1.d.(3) requires each Copermittee to develop and implement a procedure for pollutants of concern to be identified for each Priority Development Project. The Copermittees have considered this requirement jointly and have determined the LID design procedures in Chapters 3 and 4 of this model SUSMP fully address the need to identify pollutants of concern insofar as that identification may affect the selection of source control BMPs and treatment facilities.

Documentation of the approach to identifying pollutants of concern and selecting BMPs and facilities follows.

► GROUPING OF POTENTIAL POLLUTANTS OF CONCERN

Urban runoff from a developed site has the potential to contribute pollutants, including oil and grease, suspended solids, metals, gasoline, pesticides, and pathogens to the storm water conveyance system and receiving waters. For the purposes of identifying pollutants of concern and associated storm water BMPs, pollutants are grouped in nine general categories as follows:

- **Sediments** are soils or other surficial materials eroded and then transported or deposited by the action of wind, water, ice, or gravity. Sediments can increase turbidity, clog fish gills, reduce spawning habitat, lower young aquatic organisms survival rates, smother bottom dwelling organisms, and suppress aquatic vegetation growth.

- **Nutrients** are inorganic substances, such as nitrogen and phosphorus. They commonly exist in the form of mineral salts that are either dissolved or suspended in water. Primary sources of nutrients in urban runoff are fertilizers and eroded soils. Excessive discharge of nutrients to water bodies and streams can cause excessive aquatic algae and plant growth. Such excessive production, referred to as cultural eutrophication, may lead to excessive decay of organic matter in the water body, loss of oxygen in the water, release of toxins in sediment, and the eventual death of aquatic organisms.

- **Metals** are raw material components in non-metal products such as fuels, adhesives, paints, and other coatings. Primary sources of metal pollution in storm water are typically commercially available metals and metal products. Metals of concern include cadmium, chromium, copper, lead, mercury, and zinc. Lead and chromium have been used as corrosion inhibitors in primer coatings and cooling tower systems. At low concentrations naturally occurring in soil, metals are not toxic. However, at higher concentrations, certain metals can be toxic to aquatic life. Humans can be impacted from contaminated groundwater resources, and bioaccumulation of metals in fish and shellfish. Environmental concerns, regarding the potential for release of metals to the environment, have already led to restricted metal usage in certain applications.

- **Organic compounds** are carbon-based. Commercially available or naturally occurring organic compounds are found in pesticides, solvents, and hydrocarbons. Organic compounds can, at certain concentrations, indirectly or directly constitute a hazard to life or health. When rinsing off objects, toxic levels of solvents and cleaning compounds can be discharged to storm drains. Dirt, grease, and grime retained in the cleaning fluid or rinse water may also adsorb levels of organic compounds that are harmful or hazardous to aquatic life.

- **Trash** (such as paper, plastic, polystyrene packing foam, and aluminum materials) and biodegradable organic matter (such as leaves, grass cuttings, and food waste) are general waste products on the landscape. The presence of trash & debris may have a significant impact on the recreational value of a water body and aquatic habitat. Excess organic matter can create a high biochemical oxygen demand in a stream and thereby lower its water quality. Also, in areas where stagnant water exists, the presence of excess organic matter can promote septic conditions resulting in the growth of undesirable organisms and the release of odorous and hazardous compounds such as hydrogen sulfide.

- **Oxygen-Demanding Substances** includes biodegradable organic material as well as chemicals that react with dissolved oxygen in water to form other compounds. Proteins, carbohydrates, and fats are examples of biodegradable organic compounds. Compounds such as ammonia and hydrogen sulfide are examples of oxygen-demanding compounds. The oxygen demand of a substance can lead to depletion of dissolved oxygen in a water body and possibly the development of septic conditions.

- Primary sources of **oil and grease** are petroleum hydrocarbon products, motor products from leaking vehicles, esters, oils, fats, waxes, and high molecular-weight fatty acids. Introduction of these pollutants to the water bodies are very possible due to the wide uses and applications of some of these products in municipal, residential, commercial, industrial, and construction areas. Elevated oil and grease content can decrease the aesthetic value of the water body, as well as the water quality.

- **Bacteria and Viruses** are ubiquitous microorganisms that thrive under certain environmental conditions. Their proliferation is typically caused by the transport of animal or human fecal wastes from the watershed. Water, containing excessive bacteria and viruses can alter the aquatic habitat and create a harmful environment for humans and aquatic life. Also, the decomposition of excess organic waste causes increased growth of undesirable organisms in the water.

- **Pesticides** (including herbicides) are chemical compounds commonly used to control nuisance growth or prevalence of organisms. Excessive application of a pesticide may result in runoff containing toxic levels of its active component.

► IDENTIFYING POLLUTANTS OF CONCERN BASED ON LAND USES

Table 2-1 associates pollutants with the categories of Priority Development Projects. Pollutants associated with any hazardous material sites that have been remediated or are not threatened by the proposed project are not considered a pollutant of concern.

► WATERSHEDS WITH SPECIAL POLLUTANT CONCERNS

Local receiving water conditions may require specialized attention. The three local conditions to consider include:

- Ocean waters designated as an "Area of Special Biological Significance" (ASBS)

- 303(d) listed waters; and

- Waters with established TMDLs.

TABLE 2-1. ANTICIPATED AND POTENTIAL Pollutants Generated by Land Use Type.

	General Pollutant Categories								
Priority Project Categories	Sediment	Nutrients	Heavy Metals	Organic Compounds	Trash & Debris	Oxygen Demanding Substances	Oil & Grease	Bacteria & Viruses	Pesticides
Detached Residential Development	X	X			X	X	X	X	X
Attached Residential Development	X	X			X	P(1)	P(2)	P	X
Commercial Development >one acre	P(1)	P(1)	X	P(2)	X	P(5)	X	P(3)	P(5)
Heavy Industry	X		X	X	X	X	X		
Automotive Repair Shops			X	X(4)(5)	X		X		
Restaurants					X	X	X	X	P(1)
Hillside Development >5,000 ft2	X	X			X	X	X		X
Parking Lots	P(1)	P(1)	X		X	P(1)	X		P(1)
Retail Gasoline Outlets			X	X	X	X	X		
Streets, Highways & Freeways	X	P(1)	X	X(4)	X	P(5)	X	X	P(1)

X = anticipated
P = potential
(1) A potential pollutant if landscaping exists on-site.
(2) A potential pollutant if the project includes uncovered parking areas.
(3) A potential pollutant if land use involves food or animal waste products.
(4) Including petroleum hydrocarbons.
(5) Including solvents.

The State Water Resources Control Board's California Ocean Plan identifies thirty-four locations along the California coast as **Areas of Special Biological Significance (ASBS)**. The Ocean Plan prohibits the discharge of wastes into these locations, thus barring discharges associated with industrial activities, publicly owned treatment works, and other traditional point discharges. In 2004 the SWRCB informed affected municipal stormwater programs throughout the state that urban runoff contained a waste and was subject to the prohibition. In March 2008, the SWRCB released a draft *Special Protections for Selected Storm Water and Nonpoint Source Discharges into Areas of Special Biological Significance* that defines design criteria for treating stormwater discharges and elimination of dry-weather discharges associated with non-stormwater sources. San Diego County contains two ASBS locations, the La Jolla ASBS and the San Diego-Scripps ASBS. These locations are adjacent and extend from the northern bluffs of La Jolla through the UC San Diego campus of the Scripps Institute of Oceanography. Proposed development in the watershed of an ASBS may be prohibited; however, the project proponent should immediately contact the municipality for further guidance in contending with ASBS prohibitions.

The NPDES Permit identifies several receiving waters as impaired for constituents or water quality effects pursuant to **Section 30 3(d)** of the Clean Water Act. Placement of a water onto the list requires the Regional Board to make further analysis of the impairment and development of total maximum daily loads (TMDLs) for addressing the impairment. The 303(d) listing in itself does not demand that a project proponent select BMPs on the basis of the impairment; however, the project proponent should be cognizant of the impairment and the future implications a TMDL might have upon the proposed land use.

Once a TMDL is established it may impose conditions on development either through an implementation plan and schedule for the listed water, or through special conditions required of the municipality affected by the numeric criteria of the TMDL. At this time, several 303(d) listings in San Diego County are at various stages of TMDL development with only four TMDLs having been adopted by the Regional Board. However, there are approximately 190 pending TMDLs in the county.

The **adopted TMDLs** in the San Diego area include:

- Diazinon for Chollas Creek;
- Nitrogen and phosphorous for Rainbow Creek;
- Dissolved copper for Shelter Island Yacht Basin;
- Copper, lead, and zinc for Chollas Creek, and
- Indicator bacteria for beaches and creeks in the San Diego Region.

The applicant should meet with municipal staff to determine if any project characteristics or watershed characteristics affect selection and design of BMPs. Except in rare circumstances, the use of the LID Design Guide (Chapter 4) and the Stormwater Pollutant Sources/Source Control Checklist (Appendix) will ensure your project complies with all stormwater requirements.

Selection of Permanent Source Control BMPs

Based on identification of potential pollutants of concern associated with various types of facilities, the Co-permittees have developed a Stormwater Pollutant Sources/Source Control Checklist (Appendix) of "maximum extent practicable" source controls associated with each facility type. This approach ensures appropriate BMPs are applied to potential sources of each pollutant of concern.

Selection of Stormwater Treatment Facilities

The model SUSMP updated in early 2008 groups pollutants of concern by how easily they are removed by various treatment processes (Table 2-2).

The same document also includes a general comparison of how various types of treatment facilities perform for each group of pollutants (Table 2-3).

TABLE 2-2. GROUPING OF POTENTIAL POLLUTANTS of Concern by fate during stormwater treatment

Pollutant	Coarse Sediment and Trash	Pollutants that tend to associate with fine particles during treatment	Pollutants that tend to be dissolved following treatment
Sediment	X	X	
Nutrients		X	X
Heavy Metals		X	
Organic Compounds		X	
Trash & Debris	X		
Oxygen Demanding		X	
Bacteria		X	
Oil & Grease		X	
Pesticides		X	

TABLE 2-3. GROUPS OF POLLUTANTS and relative effectiveness of treatment facilities

Pollutants of Concern	Bioretention Facilities (LID)	Settling Basins (Dry Ponds)	Wet Ponds and Constructed Wetlands	Infiltration Facilities or Practices (LID)	Media Filters	Higher-rate biofilters*	Higher-rate media filters*	Trash Racks & Hydro -dynamic Devices
Coarse Sediment and Trash	High	High	High	High	High	High	High	High
Pollutants that tend to associate with fine particles during treatment	High	High	High	High	High	Medium	Medium	Low
Pollutants that tend to be dissolved following treatment	Medium	Low	Medium	High	Low	Low	Low	Low

*See page 23 for a discussion of selection of treatment facilities in special situations.

Based on this analysis, the Copermittees have determined that the following types of facilities are appropriate for treatment of runoff potentially containing most pollutants of concern. These types of facilities can be used for stormwater treatment for all land uses in all watersheds, except where site-specific constraints make them infeasible.

- Infiltration facilities or practices, including dry wells, infiltration trenches, infiltration basins, and other facilities that infiltrate runoff to native soils (sized to detain and infiltrate a volume equivalent to the 85^{th} percentile 24-hour event).
- Bioretention facilities and media filters that detain stormwater and filter it slowly through soil or sand (sized with a surface area at least 0.04 times the effectively impervious tributary area).
- Extended detention basins, wet ponds, and wetlands or other facilities using settling (sized to detain a volume equivalent to runoff from the tributary area generated by the 85^{th} percentile 24-hour event).

The recommended design procedure in Chapter 4 integrates LID practices—optimizing the site design, using pervious surfaces, and dispersing of runoff to adjacent pervious areas—with the use of infiltration facilities and practices and bioretention facilities to meet NPDES permit LID requirements, treatment requirements, and flow-control requirements in a cost-effective, unified design.

Oil/water separators ("water quality inlets"), storm drain inlet filters, and hydrodynamic separators, including vortex separators and continuous deflection separators ("CDS units"), are less effective means of stormwater treatment, although they may be used in series with more effective facilities.

Underground vaults typically lack the detention time required for settling of fine particles associated with stormwater pollutants. They also require frequent maintenance and may retain stagnant water, potentially providing harborage for mosquitoes. Because vaults may be "out of sight, out of mind," experience shows that the required maintenance may not occur.

Lack of space, in itself, is not a suitable justification for using a less-effective treatment on a development site, because the uses of the site and the site design can be altered as needed to accommodate bioretention facilities or planter boxes. In most cases, these effective facilities can be fit into required landscaping setbacks, easements, or other unbuildable areas.

Where possible, drainage to inlets, and drainage away from overflows and underdrains, should be by gravity. Where site topography makes it infeasible to accommodate gravity-fed facilities in the project design, the design flow may be captured in a vault or sump and pumped via force main to an effective facility.

The following situations sometimes present special challenges:

- Portions of sites which are not being developed or redeveloped, but which must be retrofit to meet treatment requirements in accordance with Provision D.1.d.(1)(a) which states in part: "Where redevelopment results in an increase of, or replacement of, more than fifty percent of the impervious surface of a previously existing development, the numeric sizing criteria applies to the entire development."

- Sites smaller than one acre approved for development or redevelopment as part of a municipality's stated objective to preserve or enhance a pedestrian-oriented "smart-growth" type of urban design. Municipalities are encouraged to identify areas where this objective applies, based on General Plans or zoning.

- Roadway widening projects.

In these special situations, the following types of facilities should each be evaluated in priority order (depending on the specific characteristics of the site and as determined by the municipal stormwater coordinator) until a feasible design is found.

1. Bioretention areas or planter boxes fed by gravity.

2. Capture of the design flow in a vault or sump and pumping to bioretention areas or planter boxes.

3. A subsurface sand or media filter with a maximum design surface loading rate of 5 inches per hour and a minimum media depth of 18

inches. The sand surface must be made accessible for periodic inspection and maintenance (for example, via a removable grating).

4. A higher-rate surface biofilter, such as a tree-pit-style unit. The grading and drainage design should minimize the area draining to each unit and maximize the number of discrete drainage areas and units.

5. A higher-rate vault-based filtration unit (for example, vaults with replaceable cartridge filters filled with inorganic media).

Many proprietary stormwater treatment devices are currently marketed, and new brands will be introduced. Applicants and applicants' engineers and design professionals should review with municipal staff any proposals for using proprietary devices for stormwater treatment before they commence work on preliminary site layout, drainage plans, grading plans, or landscape plans.

Proprietary Devices

Many currently available proprietary devices do not meet municipalities' requirements when used alone for stormwater treatment. Consult with municipal staff before proposing these devices.

Hydrology for NPDES Compliance

▶ IMPERVIOUSNESS

Schueler (1995) proposed **imperviousness** as a "unifying theme" for the efforts of planners, engineers, landscape architects, scientists, and local officials concerned with urban watershed protection. Schueler argued (1) that imperviousness is a useful indicator linking urban land development to the degradation of aquatic ecosystems, and (2) imperviousness can be quantified, managed, and controlled during land development.

Imperviousness has long been understood as the key variable in urban hydrology. Peak runoff flow and total runoff volume from small urban catchments is usually calculated as a function of the ratio of impervious area to total area **(rational method)**. The ratio correlates to the runoff factor, usually designated "C". Increased flows resulting from urban development tend to increase the frequency of small-scale flooding downstream.

Imperviousness links urban land development to degradation of aquatic ecosystems in two ways.

First, the combination of paved surfaces and piped runoff efficiently collects urban pollutants and transports them, in suspended or dissolved form, to surface waters. These pollutants may originate as airborne dust, be washed from the atmosphere during rains, or may be generated by automobiles and outdoor work activities.

Second, increased peak flows and runoff durations typically cause erosion of stream banks and beds, transport of fine sediments, and disruption of aquatic habitat. Measures taken to control stream erosion, such as hardening banks with riprap or concrete, may permanently eliminate habitat. By reducing infiltration to groundwater, imperviousness may also reduce dry-weather stream flows.

Imperviousness has two major components: rooftops and transportation (including streets, highways, and parking areas). The transportation component is usually larger and is more likely to be **directly connected** to the storm drain system.

The effects of imperviousness can be mitigated by disconnecting impervious areas from the drainage system and by encouraging detention and retention of runoff near the point where it is generated. Detention and retention reduce peak flows and volumes and allow pollutants to settle out or adhere to soils before they can be transported downstream.

► LOW IMPACT DEVELOPMENT REQUIREMENTS

The NPDES permit requires LID be used on all projects to minimize directly connected impervious area and promote infiltration. For Priority Development Projects, the minimum standards are:

- Drain a portion of impervious areas into pervious areas, if any.
- Design and construct pervious areas, if any, to effectively receive and infiltrate runoff from impervious areas, taking into account soil conditions, slope, and other pertinent factors.
- Construct a portion of paved areas with low traffic and appropriate soil conditions with permeable surfaces.

The LID design procedure in Chapter 4 incorporates these requirements into an integrated design which also meets sizing requirements for stormwater treatment facilities and flow-control (hydromodification management) requirements.

► SIZING REQUIREMENTS FOR STORMWATER TREATMENT FACILITIES

The guidance in Chapter 4 was crafted to ensure LID facilities comply with the NPDES permit's hydraulic sizing requirements for stormwater treatment facilities and flow-control facilities. The technical background follows.

Most runoff is produced by frequent storms of small or moderate intensity and duration. Treatment facilities are designed to treat smaller storms and the first flush of larger storms—approximately 80% of average annual runoff.

The NPDES permit identifies two types of treatment facilities—volume-based and flow-based.

Volume-based facilities must be designed to infiltrate, filter, or treat the volume of runoff produced from a 24-hour 85^{th} percentile storm event as determined from the County of San Diego's 85^{th} Percentile Precipitation Isopluvial Map. As shown on the map, rainfall depths vary from about 0.55" to 1.55".

For **flow-based** facilities, the NPDES permit specifies the rational method be used to determine flow. The rational method uses the equation

$Q = CiA$, where

Q = flow

C = weighted runoff factor between 0 and 1

i = rainfall intensity

A = area

The permit identifies two alternatives for calculating rainfall intensity:

1. the 85^{th} percentile rainfall intensity times two, or
2. 0.2 inches per hour.

It is typically found that both methods yield similar results. The 0.2 inches per hour rainfall intensity should be used for sizing flow-based treatment facilities within the Copermittees' jurisdiction.

The 0.2 inches per hour criterion is the basis for a **consistent countywide sizing factor** for bioretention facilities when used for stormwater treatment only (i.e., not for flow control). The factor is based on maintaining a minimum percolation rate of 5 inches per hour through the engineered soil mix. The sizing factor is the ratio of the design intensity of rainfall on tributary impervious surfaces (0.2 inches/hour) to the design percolation rate in the facility (5 inches/hour), or **0.04** (dimensionless).

► FLOW-CONTROL (HYDROMODIFICATION MANAGEMENT)

The NPDES permit specifies for applicable projects:

> … post-project runoff flow rates and durations shall not exceed pre-project runoff flow rates and durations where the increased discharge

> flow rates and durations will result in increased potential for erosion or other significant adverse impacts to beneficial uses, attributable to changes in flow rates and durations.

Under current Interim Hydromodification Criteria, the requirement applies to projects disturbing 50 acres or more, and applicants may select among **three options** for compliance: Use a continuous simulation model to compare pre-project and post-project runoff, use LID facilities with sizing factors and design criteria developed by the Co-permittees, or identify a specified exemption. See Chapter One.

The technical background for the Interim Hydromodification Criteria is in the memorandum "Development of Interim Hydromodification Criteria" (October 30, 2007) and other technical documents available on the Project Clean Water website.

Criteria for Infiltration Devices

The NPDES permit restricts the design and location of "infiltration devices" that, as designed, may bypass filtration through surface soils before reaching groundwater. These devices include:

- Infiltration basins.
- Infiltration trenches (includes french drains).
- Unlined retention basins (i.e., basins with no outlets).
- Unlined or open-bottomed vaults or boxes installed below grade (dry wells).

Infiltration devices may not be used in:

- Areas of industrial or light industrial activity; areas subject to high vehicular traffic (25,000 or greater average daily traffic on main roadway or 15,000 or more average daily traffic on any intersecting roadway);
- Automotive repair shops;
- Car washes;
- Fleet storage areas (bus, truck, etc.);

- Nurseries;
- Other areas with pollutant sources that could pose a threat to groundwater, as designated by each Permittee.

The vertical distance from the base of any infiltration device to the seasonal high groundwater mark shall be at least 10 feet. Infiltration devices shall be located a minimum of 100 feet horizontally from any known water supply wells.

In addition, infiltration devices are not recommended where:

- The infiltration device would receive drainage from areas where chemicals are used or stored, where vehicles or equipment are washed, or where refuse or wastes are handled.
- Surface soils or groundwater are polluted.
- The facility could receive sediment-laden runoff from disturbed areas or unstable slopes.
- Increased soil moisture could affect the stability of slopes of foundations.
- Soils are insufficiently permeable to allow the device to drain within 72 hours.

► MOST LID FEATURES AND FACILITIES ARE NOT INFILTRATION DEVICES

Self-treating and self-retaining areas, pervious pavements, bioretention facilities, and planter boxes are not considered to be infiltration devices.

Bioretention facilities work by percolating runoff through 18 inches or more of engineered soil. This removes most pollutants before the runoff is allowed to seep into native soils below. Further pollutant removal typically occurs in the unsaturated (vadose) zone before moisture reaches groundwater.

Where there is concern about the effects of increased soil moisture on slopes or foundations, an impermeable barrier may be added so the facility is "flow through" and all treated runoff is underdrained away from the facility. See the design sheets for Bioretention Facilities and Flow-Through Planters in Chapter 4.

Environmental and Economic Benefit Perspective

The San Diego Region has varied topography consisting of coastal plain, central mountain-valley, and eastern mountain valley areas. Elevations range from sea level at the Pacific Ocean to approximately 6,000 feet at the summit of Palomar

Mountain. Temperature averages about 65 degrees Fahrenheit and average annual precipitation is between 10 and 13 inches.

San Diego County comprises 10 major stream systems: San Onofre Creek, Santa Margarita River, San Luis Rey River, San Marcos Creek, Escondido Creek, San Dieguito River, San Diego River, Sweetwater River, Otay River, and the Tijuana River. Almost all stream systems in the San Diego region have both perennial and ephemeral reaches. In addition, most of these streams have been impacted by impoundments and/or channelization. There are few undisturbed stream reaches left in San Diego County.

San Diego County is approximately 2.7 million acres and roughly 1.8 million acres (66 percent) is developed or in use. Much of the remaining land is preserved from future development.

Impervious surfaces now cover much of the land, and storm drains pipe runoff from urban areas directly into streams. As in many of California's urban areas, growth and development have caused changes in the timing and intensity of stream flows. These changes can then lead to more frequent flooding, destabilized stream banks, armoring of streambanks with riprap and concrete, loss of streamside trees and vegetation, and the destruction of stream habitat.

The remaining habitat in the region is composed of sensitive coastal sage scrub, chaparral, woodlands, and grasslands. Human encroachment and habitat loss threaten close to 300 species of plants and animals in California. Many of those reside in southern California and range from native grasslands to the Fairy Shrimp.

Once altered, natural streams and their ecosystems cannot be fully restored. However, **it is possible to stop, and partially reverse, the trend of declining habitat** and preserve some ecosystem values for the benefit of future generations.

This is an enormous, long-term effort. Managing runoff from a single development site may seem inconsequential, but by changing the way most sites are developed (and redeveloped), we may be able to preserve and enhance existing stream ecosystems in urban and urbanizing areas.

References and Resources:

- RWQCB Order R9-2007-0001 (Stormwater NPDES Permit)
- *County of San Diego Low Impact Development Handbook*
- Clean Water Act Section 402(p)
- 40 CFR 122.26
- San Diego Regional Water Quality Control Board—TMDLs
- State Water Resources Control Board—Ocean Standards
- *Site Planning for Urban Stream Protection* (Scheuler, 1995).
- "Application of Water-Quality Engineering Fundamentals to the Assessment of Stormwater Treatment Devices" (Salvia, 2000).

Chapter

3

Preparing Your Project Submittal

Step-by-step assistance to demonstrate compliance.

Your Project Submittal will demonstrate your project complies with all applicable requirements in the stormwater NPDES permit—to minimize imperviousness, retain or detain stormwater, slow runoff rates, incorporate required source controls, treat stormwater prior to discharge, control runoff rates and durations, and provide for operation and maintenance of treatment and flow-control facilities.

ICON KEY

- Helpful Tip
- Submittal Requirement
- Terms to Look Up
- References & Resources

Submittal requirements vary from jurisdiction to jurisdiction. Obtain the specific requirements from local staff.

Typically, your Project Submittal must be coordinated with your application for discretionary approvals and must have sufficient detail to ensure the stormwater design, site plan, and landscaping plan are congruent.

A complete and thorough Project Submittal will facilitate quicker review and fewer cycles of review. Every municipality in San Diego County requires a submittal for every applicable project.

Be sure to obtain specific submittal requirements from the jurisdiction in which your project is located. Your Project Submittal may consist of a report and an exhibit. **Municipal staff may use a checklist** such as the following example to evaluate your Project Submittal:

EXAMPLE PROJECT SUBMITTAL CHECKLIST

CONTENTS OF EXHIBIT

Show all of the following on drawings:

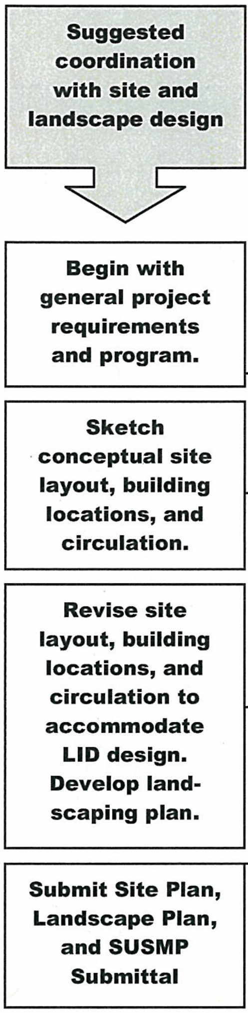
- ❐ Existing natural hydrologic features (depressions, watercourses, floodplains, relatively undisturbed areas) and significant natural resources. (Step 1 in the following step-by-step instructions)
- ❐ Soil types and depth to groundwater. (Step 1)
- ❐ Existing and proposed site drainage network and connections to drainage off-site. (Step 3)
- ❐ Proposed design features and surface treatments used to minimize imperviousness. (Step 3)
- ❐ Entire site divided into separate drainage areas, with each area identified as self-treating, self-retaining (zero-discharge), draining to a self-retaining area, or draining to an IMP. (Step 3)
- ❐ For each drainage area, types of impervious area proposed (roof, plaza/sidewalk, and streets/parking) and area of each. (Step 3)
- ❐ Proposed locations and sizes of treatment or flow-control facilities. (Step 3)
- ❐ Potential pollutant source areas, including refuse areas, outdoor work and storage areas, etc. listed in the Appendix and corresponding required source controls. (Step 4)

CONTENTS OF REPORT

Include all of the following in a report:

- ❐ Narrative analysis or description of site features and conditions that constrain, or provide opportunities for, stormwater control. (Step 2)
- ❐ Narrative description of site design characteristics that protect natural resources. (Step 3)
- ❐ Narrative description and/or tabulation of site design characteristics, building features, and pavement selections that reduce imperviousness of the site. (Step 3)
- ❐ Tabulation of proposed pervious and impervious area, showing self-treating areas, self-retaining areas, and areas tributary to each treatment or flow-control facility. (Step 3)
- ❐ Preliminary designs, including calculations, for each infiltration, treatment, or flow-control facility. Elevations should show sufficient hydraulic head for each. (Step 3)
- ❐ A table of identified pollutant sources and for each source, the source control measure(s) used to reduce pollutants to the maximum extent practicable. See worksheet in the Appendix. (Step 4)
- ❐ General maintenance requirements for infiltration, treatment, and flow-control facilities (Step 5)
- ❐ Means by which facility maintenance will be financed and implemented in perpetuity. (Step 5)
- ❐ Statement accepting responsibility for interim operation & maintenance of facilities (Step 5).
- ❐ Identification of any conflicts with codes or requirements or other anticipated obstacles to implementing the proposed facilities in the submittal (Step 6).
- ❐ Construction Plan SUSMP Checklist (Step 6).
- ❐ Certification by a civil engineer, architect, and landscape architect (Step 6).

Step by Step



Plan and design your stormwater controls integrally with the site planning and landscaping for your project. It's best to start with general project requirements and preliminary site design concepts; then prepare the detailed site design, landscape design, and stormwater control design simultaneously. **This will help ensure that your site plan, landscape plan, and Project Submittal are congruent.**

The following step-by-step procedure should optimize your design by identifying the best opportunities for stormwater controls **early in the design process.**

The recommended steps are:

1. Assemble needed information.
2. Identify site opportunities and constraints.
3. Follow the LID design guidance in Chapter 4 to analyze your project for LID and to develop and document your drainage design.
4. Specify source controls using the sources/source control checklist in the Appendix.
5. Plan for ongoing maintenance of treatment and flow-control facilities.
6. Complete the Project Submittal.

Municipal staff may recommend you prepare and submit a preliminary site design prior to formally applying for planning and zoning approvals. Your preliminary site design should incorporate a conceptual plan for site drainage, including self-treating and self-retaining areas and the location and approximate sizes of any treatment facilities. This additional up-front design effort will save time and avoid potential delays later in the review process.

Step 1: Assemble Needed Information

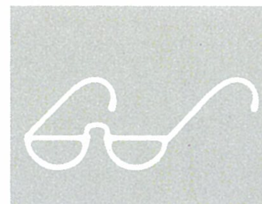
To select types and locations of treatment facilities, the designer needs to know the following site characteristics:

- **Existing natural hydrologic features** and natural resources, including any contiguous natural areas, wetlands, watercourses, seeps, or springs.

- **Existing site topography**, including contours of any slopes of 4% or steeper, general direction of surface drainage, local high or low points or depressions, any outcrops or other significant geologic features.

- **Zoning**, including requirements for **setbacks** and **open space**.

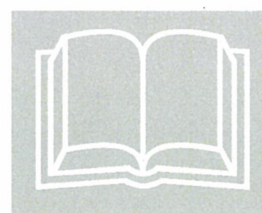
- **Public Works Standards** or other local codes governing minimum street widths, sidewalk construction, allowable pavement types, and drainage. These codes may conflict with Low Impact Development objectives to minimize imperviousness and to maintain or restore natural site hydrology. Municipalities are encouraged to review and revise codes to resolve these conflicts where it is possible to do so.



- Soil types (including **hydrologic soil groups**) and depth to groundwater, which may determine whether infiltration is a feasible option for managing site runoff. Depending on site location and characteristics, and on the selection of treatment and flow-control facilities, site-specific information (e.g. from boring logs or geotechnical studies) may be required.

- **Existing site drainage.** For undeveloped sites, this should be obtained by inspecting the site and examining topographic maps and survey data. For previously developed sites, site drainage and connection to the municipal storm drain system can be located from site inspection, municipal storm drain maps, and plans for previous development.

- Existing **vegetative cover** and **impervious areas**, if any.



References and Resources

- *Site Planning for Urban Stream Protection* (Scheuler 1995).
- *Start at the Source* (BASMAA 1999), p. 36

Step 2: Identify Constraints & Opportunities

Review the information collected in Step 1. Identify the principal constraints on site design and selection of treatment and flow-control facilities as well as opportunities to reduce imperviousness and incorporate facilities into the site and landscape design. For example, **constraints** might include impermeable soils, high groundwater, groundwater pollution or contaminated soils, steep slopes, geotechnical instability, high-intensity land use, heavy pedestrian or vehicular traffic, restricted right-of-way, or safety concerns. **Opportunities** might include existing natural areas, low areas, oddly configured or otherwise unbuildable parcels, easements and landscape amenities including open space and buffers (which can double as locations for bioretention facilities), and differences in elevation (which can provide hydraulic head). Note stormwater treatment facilities should not be located within protected riparian areas.

If required by your municipality, prepare a brief **narrative** describing site opportunities and constraints. This narrative will help you as you proceed with LID design and explain your design decisions to others.

Step 3: Prepare and Document Your LID Design

Use the Low Impact Development Design Guide (Chapter 4) to analyze your project for LID, design and document drainage, and specify preliminary design details for integrated management practices. **Follow the detailed instructions in Chapter 4 to ensure your project complies with NPDES permit LID requirements (Provision D.1.d.(4)) as well as stormwater treatment requirements in Provision D.1.d.(6)).** In future editions of this model SUSMP, the LID Design Guide will be updated so that additional hydromodification management requirements are also met via this unified design procedure. Chapter 4 includes calculation procedures and formats for presenting your calculations.

As shown in the example checklist (page 32), your Project Submittal may need to include a drawing showing:

- The entire site divided into separate drainage management areas (DMAs), with each area identified as one of the following: self-treating, self-retaining, draining to a self-retaining area, or draining to an IMP. Each area should be clearly marked with a unique identifier.

Compliance

The design criteria for DMAs in Chapter 4 ensure the required volume of flow from all developed portions of the project, including landscaped areas, is infiltrated, filtered, or treated (Provision D.1.d.(6)(a).

- For each drainage area, the types of impervious area proposed, and the area of each.
- Proposed locations and sizes of treatment facilities. Each facility should be clearly marked with a unique identifier.

Your Project Submittal may need to include:

- Tabulation of proposed self-treating areas, self-retaining areas, areas draining to self-retaining areas, and areas draining to IMPs, and the corresponding IMPs identified on the Exhibit.
- Calculations, in the format shown in Chapter 4, showing the minimum square footage required and proposed square footage for each IMP.

- Preliminary designs for each IMP. The design sheets and accompanying drawings in Chapter 4 may be used or adapted for this purpose.

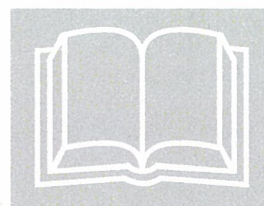
The following may also be required, or may be advisable to assist the reviewer to understand your design:

- A narrative overview of your design and how your design decisions optimize the site layout, use pervious surfaces, disperse runoff from impervious surfaces, and drain impervious surfaces to engineered IMPs. See Chapter 4.

- A narrative briefly describing each **drainage management area** (DMA), its drainage, and where drainage will be directed.

- A narrative briefly describing each IMP. Include any special characteristics or features distinct from the design sheets in Chapter 4.

References and Resources



- Chapter 4
- *County of San Diego Low Impact Development Handbook*
- Your municipality's *General Plan*
- Your municipality's Zoning Ordinance and Development Codes
- *Low Impact Development Manual* (Prince George's County, Maryland, 1999).
- *Bioretention Manual* (Prince George's County, Maryland, rev. 2002)
- *Site Planning for Urban Stream Protection* (Schueler, 1995b).
  Low Impact Development Technical Guidance Manual for Puget Sound (Puget Sound Action Team, 2005)
- *LID for Big Box Retailers* (Low Impact Development Center, 2006)

Step 4. Specify Source Control BMPs

Some everyday activities – such as trash recycling/disposal and washing vehicles and equipment – generate pollutants that tend to find their way into storm drains. These pollutants can be minimized by applying **source control BMPs**.

Source control BMPs include **permanent**, structural features that must be incorporated into your project plans and **operational** BMPs, such as regular sweeping and "housekeeping," that must be implemented by the site's occupant or user. The maximum extent practicable standard typically requires both types of BMPs. In general, operational BMPs cannot be substituted for a feasible and effective permanent BMP.

Use the following procedure to specify source control BMPs for your site:

► IDENTIFY POLLUTANT SOURCES

Review the first column in the **Pollutant Sources/Source Control Checklist** (Appendix). Check off the potential sources of pollutants that apply to your site.

▶ NOTE LOCATIONS ON SUBMITTAL DRAWING

Note the corresponding requirements listed in Column 2 of the Pollutant Sources/Source Control Checklist (Appendix). Show the location of each pollutant source and each permanent source control BMP in your submittal drawing.

▶ PREPARE A TABLE AND NARRATIVE

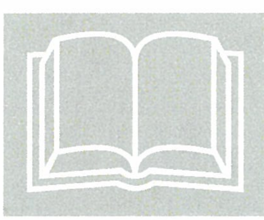
Check off the corresponding requirements listed in Column 3 in the Pollutant Sources/Source Control Checklist (Appendix). Now, create a table using the format in Table 3-1. In the left column, list each potential source on your site (from Appendix, Column 1). In the middle column, list the corresponding **permanent, structural BMPs** (from Columns 2 and 3, Appendix) used to prevent pollutants from entering runoff. Accompany this table with a narrative that explains any special features, materials, or methods of construction that will be used to implement these permanent, structural BMPs.

TABLE 3-1. Format for table of permanent and operational source control measures.

Potential source of runoff pollutants	*Permanent source control BMPs*	*Operational source control BMPs*

▶ IDENTIFY OPERATIONAL SOURCE CONTROL BMPS

To complete your table, refer once again to the Pollutant Sources/Source Control Checklist (Appendix, Column 4). List in the right column of your table the operational BMPs that should be implemented as long as the anticipated activities continue at the site. The same BMPs may also be required as a condition of a use permit or other revocable discretionary approval for use of the site.



References and Resources

- Appendix: Stormwater Pollutant Sources/Source Control Checklist
- RWQCB Order R9-2007-0001, Provision D.1.d.(5)
- *Start at the Source*, Section 6.7: Details, Outdoor Work Areas
- *California Stormwater Industrial/Commercial Best Management Practice Handbook*
- *Urban Runoff Quality Management* (WEF/ASCE, 1998) Chapter 4: Source Controls

Step 5: Stormwater Facility Maintenance

As required by NPDES Permit Provision D.1.c.(5), your local municipality will require submittal of proof of a mechanism under which ongoing long-term maintenance of stormwater treatment and flow-control facilities will be conducted. Your municipality may require one of more of the following items be included in your Project Submittal:

1. A means to finance and implement facility maintenance in perpetuity.

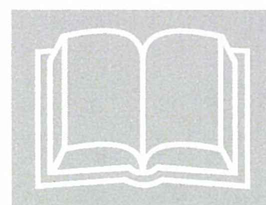
2. Acceptance of responsibility for maintenance from the time the facilities are constructed until responsibility for operation and maintenance is legally transferred. A warranty covering a period following construction may also be required.

3. An outline of general maintenance requirements for the treatment and flow-control facilities you have selected.

Your local municipality may also require that you prepare and submit a detailed plan that sets forth a maintenance schedule for each of the treatment and flow-control facilities built on your site.

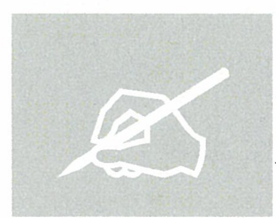
Details of these requirements, and instructions for preparing a detailed operation and maintenance plan, are in Chapter 5.

References and Resources



- *Chapter 5*
- Operation, Maintenance, and Management of Stormwater Management Systems (Watershed Management Institute, 1997)

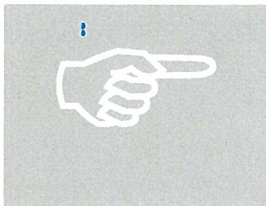
Step 6: Complete Your Project Submittal



Local municipal staff will provide specific instructions for the content and format of your Project Submittal. Your Project Submittal should document the information gathered and decisions made in Steps 1-5. A clear, complete, well-organized Project Submittal will make it possible to confirm your design meets the minimum requirements of the NPDES permit, the municipal stormwater pollution prevention ordinance, and this *SUSMP*.

► COORDINATION WITH SITE, ARCHITECTURAL, AND LANDSCAPING PLANS

Before completing your Project Submittal, ensure your stormwater control design is fully coordinated with the site plan, grading plan, and landscaping plan being proposed for the site.



Information submitted and presentations to design review committees, planning commissions, and other decision-making bodies must incorporate relevant aspects of the stormwater design. In particular, ensure:

- Curb elevations, elevations, grade breaks, and other features of the drainage design are consistent with the delineation of DMAs.
- The top edge (overflow) of each bioretention facility is level all around its perimeter—this is particularly important in parking lot medians.
- The resulting grading and drainage design is consistent with the design for parking and circulation.
- Bioretention facilities and other IMPs do not create conflicts with pedestrian access between parking and building entrances.
- Vaults and utility boxes can be accommodated outside bioretention facilities and will not be placed within bioretention facilities.
- The visual impact of stormwater facilities, including planter boxes at building foundations and any terracing or retaining walls required for the stormwater control design, is shown in renderings and other architectural drawings.
- Landscaping plans, including planting plans, show locations of bioretention facilities, and the plant requirements are consistent with the engineered soils and conditions in the bioretention facilities.
- Renderings and representation of street views incorporate any stormwater facilities located in street-side buffers and setbacks.

► CONSTRUCTION PLAN SUSMP CHECKLIST

When you submit construction plans for City review and approval, the reviewer will compare that submittal with your earlier Project Submittal. By creating a Construction Plan SUSMP Checklist for your project, you can facilitate the reviewer's comparison and speed review of your project.

TABLE 3-2. Format for Construction Plan SUSMP Checklist.

SUSMP Page #	*BMP Description*	*See Plan Sheet #s*

Here's how:

1. Create a table similar to Table 3-2. Number and list each measure or BMP you have specified in your Project Submittal in Columns 1 and 2 of the table. Leave Column 3 blank. Incorporate the table into your Project Submittal.

2. When you submit construction plans, **duplicate the table** (by photocopy or electronically). Now fill in Column 3, identifying the plan sheets where the BMPs are shown. List all plan sheets on which the BMP appears. Submit the updated table with your construction plans.

Note that the updated table—or Construction Plan SUSMP Checklist—is **only a reference tool** to facilitate comparison of the construction plans to your Project Submittal. Planning Department staff can advise you regarding the process required to propose changes to your approved Project Submittal.

► CERTIFICATION

Your local municipality may require that your Project Submittal be certified by an architect, landscape architect, or civil engineer.

The certification should state: "The selection, sizing, and preliminary design of stormwater treatment and other control measures in this plan meet the requirements of Regional Water Quality Control Board Order R9-2007-0001 and subsequent amendments."

▶ EXAMPLE PROJECT SUBMITTAL OUTLINE AND CONTENTS

Check with local municipal staff for requirements specific to your project.

I. Project Setting

- A. Project Name, Location, Description
- B. Existing site features and conditions
- C. Opportunities and constraints for stormwater control

II. Low Impact Development Design Strategies

- A. Optimization of site layout
  - (1) Limitation of development envelope
  - (2) Preservation of natural drainage features
  - (3) Setbacks from creeks, wetlands, and riparian habitats
  - (4) Minimization of imperviousness
  - (5) Using drainage as a design element
- B. Use of permeable pavements
- C. Dispersal of runoff to pervious areas
- D. Use of Integrated Management Practices

III. Documentation of Drainage Design

- A. Drainage Management Areas
  - (1) Tabulation
  - (2) Descriptions
- B. Integrated Management Practices
  - (1) Tabulation and Sizing Calculations
  - (2) Descriptions

IV. Source Control Measures

A. Description of site activities and potential sources of pollutants

B. Table showing sources, permanent source controls, and operational source controls

V. Facility Maintenance Requirements

A. Ownership and responsibility for maintenance in perpetuity.

(1) Commitment to execute any necessary agreements.

(2) Statement accepting responsibility for operation and maintenance of facilities until that responsibility is formally transferred.

B. Summary of maintenance requirements for each stormwater facility.

VI. Construction Plan SUSMP Checklist

VII. Certifications

Attachment: SUSMP Exhibit

► EXAMPLE PROJECT SUBMITTALS

Example Project Submittals may be available from staff at your municipality. Your submittal will reflect the unique character of your own project and should meet the requirements identified in this *SUSMP*. Municipal staff can assist you to determine how specific requirements apply to your project.

Chapter 4

Low Impact Development Design Guide

Guidance for designing and documenting your LID site drainage, stormwater treatment facilities, and flow-control facilities

Follow the Low Impact Development (LID) design in this SUSMP to achieve compliance with the stormwater treatment requirements as well as the LID requirements in the stormwater NPDES permit.

This will require careful documentation of:

- Pervious and impervious areas in the planned project.
- Drainage from each of these areas.
- Locations, sizes, and types of proposed treatment facilities.

Your Project Submittal must include calculations showing the site drainage and proposed LID treatment facilities meet the criteria in this *SUSMP*.

This Low Impact Development Design Guide will help you:

- **Analyze your project** and identify and select options for implementing LID techniques to meet runoff treatment requirements—and flow-control requirements, if they apply.
- **Design and document drainage** for the whole site and document how that design meets this *SUSMP's* stormwater treatment criteria.
- **Specify preliminary design details** and integrate your LID drainage design with your paving and landscaping design.

Alternatives to LID design are discussed in the final section of this chapter.

Analyze Your Project for LID

Conceptually, there are four LID strategies for managing runoff from buildings and paving:

1. **Optimize the site layout** by preserving natural drainage features and designing buildings and circulation to minimize the amount of roofs and paving.

2. **Use pervious surfaces** such as turf, gravel, or pervious pavement—or use surfaces that retain rainfall, such as vegetated roofs. All drainage from these surfaces is considered to be "self-retained" (a detailed definition corresponding to this concept is on page 51). No further management of runoff is necessary. An emergency overflow should be provided for extreme events.

3. **Disperse r unoff** from impervious surfaces on to adjacent pervious surfaces (e.g., direct a roof downspout to disperse runoff onto a lawn).

4. Drain impervious surfaces to engineered **Integrated M anagement Practices** (IMPs), such as bioretention facilities, planter boxes, cisterns, or dry wells. IMPs infiltrate runoff to groundwater and/or percolate runoff through engineered soil and allow it to drain away slowly. Depending on site conditions and local regulations, it may be possible to harvest and reuse rainwater in conjunction with IMPs.

A combination of two or more strategies may work best for your project. With forethought in design, the four strategies can provide multiple, complementary benefits to your development. Pervious surfaces reduce heat island effects and temperature extremes. Landscaping improves air quality, creates a better place to live or work, and upgrades value for rental or sale. Retaining natural hydrology helps preserve and enhance the natural character of the area. LID drainage design can also conserve water and reduce the need for drainage infrastructure.

Table 4-1 includes ideas for applying LID strategies to site conditions and types of development.

TABLE 4-1. Ideas for Runoff Management

Site Features and Design Objectives	*Vegetated Roof*	*Self-retaining Areas*	*Pervious Pavement*	*Bioretention Facility*	*Flow-through Planter*	*Dry Well*	*Cistern with bioretention*
Clayey native soils	✓			✓	✓		✓
Permeable native soils	✓		✓	✓	✓	✓	
Very steep slopes	✓				✓		
Shallow groundwater	✓				✓		
Avoid saturating subsurface soils	✓		✓		✓		
Connect to roof downspouts		✓		✓	✓	✓	✓
Parking lots/islands and medians			✓	✓		✓	
Sites with extensive landscaping		✓	✓	✓			
Densely developed sites with limited space/landscape	✓		✓		✓	✓	✓
Fit IMPs into landscape and setback areas				✓			✓
Make drainage a design feature		✓		✓			✓
Convey as well as treat stormwater				✓			

► OPTIMIZE THE SITE LAYOUT

To minimize stormwater-related impacts, apply the following design principles to the layout of newly developed and redeveloped sites.

Conserve nat ural ar eas, s oils, and v egetation. Define the development envelope and protected areas, identifying areas that are most suitable for development and areas that should be left undisturbed. Use the following guideline to determine the least sensitive areas of the site, in order of increasing sensitivity:

1. Areas devoid of vegetation, including previously graded areas and agricultural fields.
2. Areas of non-native vegetation, disturbed habitats and eucalyptus woodlands where receiving waters are not present.
3. Areas of chamise or mixed chaparral, and non-native grasslands.
4. Areas containing coastal scrub communities.
5. All other upland communities.
6. Occupied habitat of sensitive species and all wetlands (as both are defined by the local jurisdiction).

Within each of the previous categories, hillside areas should be considered more sensitive than flatter areas.

Where possible, conform the site layout along natural landforms, avoid excessive grading and disturbance of vegetation and soils, and replicate the site's natural drainage patterns. Set back development from creeks, wetlands, and riparian habitats. Preserve significant trees, especially native trees and shrubs, and identify locations for planting additional native or drought tolerant trees and large shrubs. Concentrate development on portions of the site with less permeable soils, and preserve areas that can promote infiltration.

Coordination

Chapter One includes a presentation of how review of your project's site design and landscape design is coordinated with review for compliance with stormwater NPDES requirements.

For all types of development, **limit overall coverage** of paving and roofs. Where allowed by local zoning and design standards—and provided public safety and a walkable environment are not compromised—this can be accomplished by designing compact, taller structures, narrower and shorter streets and sidewalks, smaller parking lots (fewer stalls, smaller stalls, and more efficient lanes), and indoor or underground parking. Examine site layout and circulation patterns and identify areas where landscaping can be substituted for pavement.

Detain and retain runoff throughout the site. On flatter sites, it typically works best to intersperse landscaped areas and IMPs among the buildings and paving. On hillside sites, drainage from upper areas may be collected in conventional catch basins and piped to landscaped areas and IMPs in lower areas.

Use drainage as a design element. Use depressed landscape areas, vegetated buffers, and bioretention areas as amenities and focal points within the site and landscape design. Bioretention areas can be almost any shape and should be located at low points. Bioretention areas shaped as swales can detain and treat low runoff flows and also convey higher flows.

▶ **USE PERVIOUS SURFACES**

Consider a vegetated roof. Although not yet widely used in California, vegetated or "green" roofs are growing in popularity. Potential benefits include longer roof life, lower heating and cooling costs, and better sound insulation, in addition to air quality and water quality benefits. For SUSMP compliance purposes, vegetated roofs are considered not to produce increased runoff or runoff pollutants (i.e., any runoff from a vegetated roof requires no further treatment or detention). For more information on vegetated roofs, see www.greenroofs.org.

Consider permeable pavements and surface treatments. Inventory paved areas on your preliminary site plan. Identify where permeable pavements, such as crushed aggregate, turf block, unit pavers, pervious concrete, or pervious asphalt could be substituted for impervious concrete or asphalt paving.

▶ **DISPERSE RUNOFF TO ADJACENT PERVIOUS AREAS**

Look for opportunities to direct runoff from impervious areas to adjacent landscaping. The design, including slopes and soils, must reflect a reasonable expectation that an inch of rainfall will soak into the soil and produce no runoff. For example, a lawn or garden depressed 3-4" below surrounding walkways or driveways provides a simple but functional landscape design element.

For sites subject to stormwater treatment requirements only, a 2:1 maximum ratio of impervious to pervious area is acceptable. Be sure soils will drain adequately.

Under some circumstances, it may be allowable to direct runoff from impervious areas to pervious pavement (for example, from roof downspouts to a parking lot paved with crushed aggregate or turf block). The pore volume of pavement and base course must be sufficient to retain an inch of rainfall, including runoff from the tributary area. The slopes and soils must be compatible with infiltrating that volume without producing runoff.

▶ **DIRECT RUNOFF TO INTEGRATED MANAGEMENT PRACTICES**

Project Clean Water has developed design criteria for the following IMPs:

- **Bioretention facilities**, which can be configured as swales, free-form areas, or planters to integrate with your landscape design.

- **Flow-through planters**, which can be used near building foundations and other locations where infiltration to native soils is not desired.

- **Dry wells** and other infiltration facilities, which can be used only where soils are permeable.

- **Cisterns**, in combination with a bioretention facility.

See the design sheets at the end of this chapter.

It may be possible to create a site-specific design that uses cisterns to achieve stormwater flow control, stormwater treatment, and rainwater reuse for irrigation or indoor uses (**water h arvesting**). Such a design could expand the multiple benefits of LID to include water conservation. Keep in mind:

- Facilities must meet criteria for capturing and treating the volume specified by Equation 4-8 below. This volume must be allowed to empty within 24 hours so runoff from additional storms, which may follow, is also captured and treated. Additional volume may be required if the system also stores runoff for longer periods for reuse.

- Storage of water for longer than 48 hours creates the potential for mosquito harborage. Cisterns must be designed to prevent entry by mosquitoes.

- Indoor uses of non-potable water may be restricted or prohibited. Check with municipal staff.

Some references and resources for water harvesting appear at the end of this chapter.

Finding the right location for treatment facilities on your site involves a careful and creative integration of several factors:

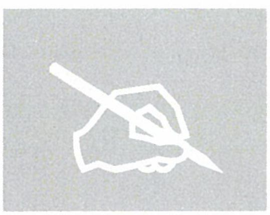
- To make the most efficient use of the site and to maximize aesthetic value, **integrate IMPs with site landscaping**. Many local zoning codes may require landscape setbacks or buffers, or may specify that a minimum portion of the site be landscaped. It may be possible to locate some or all of your site's treatment and flow-control facilities within this same area, or within utility easements or other non-buildable areas.

- Planter boxes and bioretention areas must be **level or nearly level** all the way around. Bioretention areas configured as swales may be gently sloped in the linear direction, but opposite sides must be at the same elevation.

- For effective, low-maintenance operation, **locate facilities so drainage into and out of the device is by gravity flow.** Pumped systems are feasible, but are expensive, require more maintenance, are prone to untimely failure, and can cause mosquito control problems. Most IMPs require 3 feet or more of head.

- If the property is being subdivided now or in the future, the facility should be in a **common, accessible area.** In particular, avoid locating facilities on private residential lots. Even if the facility will serve only one site owner or operator, make sure the facility is located for ready access by inspectors from the local municipality and local mosquito control agency.

- The facility must be accessible to equipment needed for its maintenance. **Access requirements for maintenance** will vary with the type of facility selected. Planter boxes and bioretention areas will typically need access for the same types of equipment used for landscape maintenance.



To complete your analysis, if required by your municipality include in your Project Submittal a brief **narrative** documenting the site layout and site design decisions you made. This will provide background and context for how your design meets the quantitative LID design criteria.

Develop and Document Your Drainage Design

The **design document ation procedure** begins with careful delineation of pervious areas and impervious areas (including roofs) throughout the site. The procedure accounts for how runoff from each delineated area is managed. For areas draining to IMPs, the procedure ensures each IMP is appropriately sized.

The procedure results in a space-efficient, cost-efficient LID design for meeting SUSMP requirements on most residential and commercial/industrial developments. The procedure arranges documentation of drainage design and IMP sizing in a consistent format for presentation and review.

This procedure is intended to facilitate, not substitute for, creative interplay among site design, landscape design, and drainage design. **Several iterations may be needed** to optimize your drainage design as well as aesthetics, circulation, and use of available area for your site.

You should be able to complete the needed calculations using only the project's site development plan.

► STEP 1: DELINEATE DRAINAGE MANAGEMENT AREAS

This is the key first step. You must divide the **entire project area** into individual, discrete Drainage Management Areas (DMAs). Typically, lines delineating DMAs follow grade breaks and roof ridge lines. The Exhibit, tables, text, and calculations in your Project Submittal will illustrate, describe, and account for runoff from each of these areas.

Use separate DMAs for each surface type (e.g., landscaping, pervious paving, or roofs). Each DMA must be assigned a single hydrologic soil group. Assign each DMA an identification number and determine its size in square feet.

► STEP 2: CLASSIFY DMAS AND DETERMINE RUNOFF FACTORS

Next, determine how drainage from each DMA will be handled. Each DMA will be one of the following four types:

1. Self-treating areas.
2. Self-retaining areas (also called "zero-discharge" areas).
3. Areas that drain to self-retaining areas.
4. Areas that drain to IMPs.

Self-treating areas are landscaped or turf areas that do not drain to IMPs, but rather drain directly off site or to the storm drain system. Examples include upslope undeveloped areas which are ditched and drained around a development and grassed slopes which drain off-site to a street or storm drain. In general, self-treating areas include no impervious areas, unless the impervious area is very small (5% or less) in relationship to the receiving pervious area and slopes are gentle enough to ensure runoff will be absorbed into the vegetation and soil. Criteria for self-treating areas are in the design sheet "Self Treating and Self-Retaining Areas" at the end of this chapter.

Rationale

Pollutants in rainfall and windblown dust will tend to become entrained in the vegetation and soils of landscaped areas, so no additional treatment is needed. It is assumed the self-treating landscaped areas will produce runoff less than or equal to the pre-project site condition.

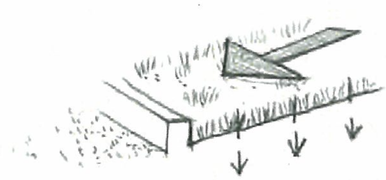


FIGURE 4-1. Self-treating areas are entirely pervious and drain directly off-site or to the storm drain system.

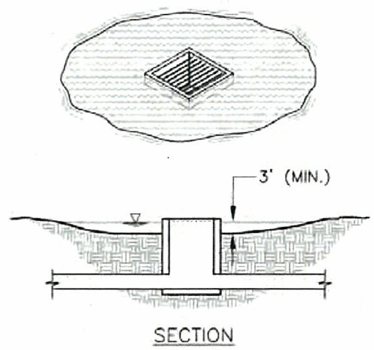


FIGURE 4-2. Self-retaining areas. Berm or depress the grade to retain at least an inch of rainfall and set inlets of any area drains at least 3 inches above low point to allow ponding.

Self-retaining areas are designed to retain the first one inch of rainfall without producing any runoff. The technique works best on flat, heavily landscaped sites. It may be used on mild slopes if there is a reasonable expectation that a one-inch rainfall event would produce no runoff.

To create self-retaining turf and landscape areas in flat areas or on terraced slopes, berm the area or depress the grade into a concave cross-section so that these areas will retain the first inch of rainfall. Specify slopes, if any, toward the center of the pervious area. Inlets of area drains, if any, should be set 3 inches above the low point to allow ponding.

Criteria for self-retaining areas are in the design sheet "Self Treating and Self-Retaining Areas" following this chapter.

Areas draining to self-retaining areas. Runoff from impervious or partially pervious areas can be managed by routing it to self-retaining pervious areas. For example, roof downspouts can be directed to lawns, and driveways can be sloped toward landscaped areas. The maximum ratio is 2 parts impervious area for every 1 part pervious area.

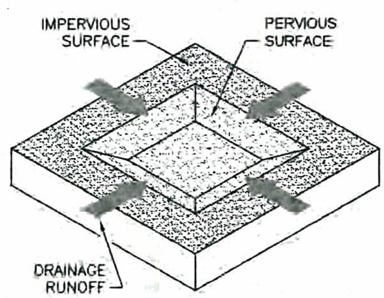


FIGURE 4-3. Relationship of impervious to pervious area for self-retaining areas. Ratio: ***pervious ≥ ½ impervious***

The drainage from the impervious area must be directed to and dispersed within the pervious area, and the entire area must be designed to retain an inch of rainfall without flowing off-site. For example, if the maximum ratio of 2 parts impervious area into 1 part pervious area is used, then the pervious area must absorb 3 inches of water over its surface before overflowing to an off-site drain.

A partially pervious area may be drained to a self-retaining area. For example, a driveway composed of unit pavers may drain to an adjacent lawn. In this case, the maximum ratios are:

(Runoff factor) x (tributary area) ≤ 2 x (self-retaining area) *Equation 4-1*

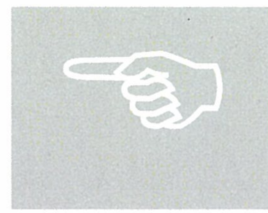
Use the runoff factors in Table 4-2.

Prolonged ponding is a potential problem at higher impervious/pervious ratios. In your design, ensure that the pervious area soils can handle the additional run-on and are sufficiently well-drained.

Under some circumstances, pervious pavement (e.g., crushed stone, pervious asphalt, or pervious concrete) can be self-retaining. Adjacent roofs or impervious pavement may drain on to the pervious pavement in the same maximum ratios as described above.

To design a pervious pavement to be a self-treating area, ensure:

- The gravel base course is a minimum of four or more inches deep.
- The base course is not be underdrained.
- A qualified engineer has been consulted regarding infiltration rates, pavement stability, and suitability for the intended traffic.



Runoff from self-treating and self-retaining areas does not require any further treatment or flow control.

TABLE 4-2. Runoff factors for surfaces draining to IMPs.

Surface	Factor
Roofs	1.0
Concrete	1.0
Pervious Concrete	0.1
Porous Asphalt	0.1
Grouted Unit Pavers	1.0
Solid Unit Pavers on granular base, min. 3/16 inch joint space	0.2
Crushed Aggregate	0.1
Turfblock	0.1
Amended, mulched soil	0.1
Landscape	0.1

Areas draining to IMPs are multiplied by a sizing factor to calculate the required size of the IMP. On most densely developed sites—such as commercial and mixed-use developments and small-lot residential subdivisions—most DMAs will drain to IMPs.

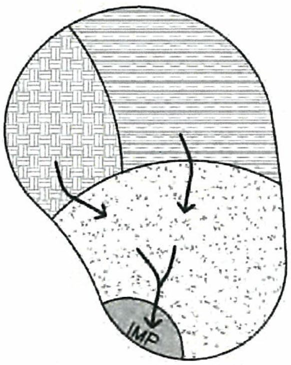


FIGURE 4-4. MORE THAN ONE
Drainage Management Area can drain to a single IMP.

More than one drainage area can drain to the same IMP. However, because the minimum IMP sizes are determined by ratio to drainage area size, a drainage area may not drain to more than one IMP. See Figures 4-4 and 4-5.

Where possible, design site drainage so **only impervious roofs and pavement** drain to IMPs. This yields a simpler, more efficient design and also helps protect IMPs from becoming clogged by sediment.

If it is necessary to include turf, landscaping, or pervious pavements within the area draining to an IMP, list each surface as a separate DMA. A runoff factor (similar to a "C" factor used in the rational method) is applied to account for the reduction in the quantity of runoff. For example, when a turf or landscaped drainage management area drains to an IMP, the resulting increment in IMP size is:

Δ(Area) = (pervious area) × (runoff factor) × (sizing factor).

Use the runoff factors in Table 4-2.

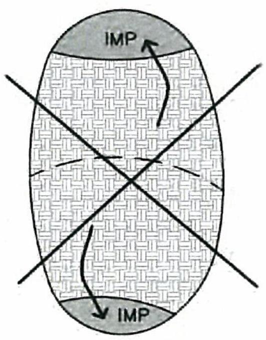


FIGURE 4-5. ONE DRAINAGE
Management Area cannot drain to more than one IMP. Use a grade break to divide the DMA.

► STEP 3: TABULATE DRAINAGE MANAGEMENT AREAS

- Tabulate self-treating areas in the format shown in Table 4-3.
- Tabulate self-retaining areas in the format shown in Table 4-4.
- Tabulate areas draining to self-retaining areas in the format shown in Table 4-5. Check to be sure the total product of (square feet of tributary area × runoff factor) for all DMAs draining to a receiving self-retaining area is no greater than a 2:1 ratio to the square footage of the receiving self-retaining area itself.
- Compile a list of DMAs draining to IMPs. Proceed to Step 4 to check the sizing of the IMPs.

- TABLE 4-3. Format for Tabulating Self-Treating Areas

DMA Name	*Area (square feet)*

TABLE 4-4. Format for Tabulating Self-Retaining Areas

DMA Name	*Area (square feet)*

TABLE 4-5. Format for Tabulating Areas Draining to Self-Retaining Areas

DMA Name	*Area (square feet)*	*Post-project surface type*	*Runoff factor*	*Receiving self-retaining DMA*	*Receiving self-retaining DMA Area (square feet)*

► STEP 4: SELECT AND LAY OUT IMPS ON SITE PLAN

Select from the list of IMPs in Table 4-6. Illustrations, designs, and design criteria for the IMPs are in the "IMP Design Details and Criteria" at the end of this chapter.

Once you have laid out the IMPs, calculate the square footage you have set aside on your site plan for each IMP.

► STEP 5: REVIEW SIZING FOR EACH IMP

For each of the IMPs, use the appropriate sizing from Table 4-6.

TABLE 4-6. IMP Sizing

Bioretention Facilities	Sizing Factor for Area = 0.04
Flow-through Planters	Sizing Factor for Area = 0.04
Dry Well or Infiltration Basin	See Step 6 to Calculate Min. Volume
Cistern with Bioretention	See Step 6 to Calculate Min. Volume of Cistern; then use 0.04 to calculate minimum size of bioretention area

▶ STEP 6: CALCULATE MINIMUM AREA AND VOLUME OF EACH IMP

The minimum area of bioretention facilities and flow-through planters is found by summing up the contributions of each tributary DMA and multiplying by the adjusted sizing factor for the IMP.

Equation 4-7

$$Min.\ IMP\ Area = \sum \begin{pmatrix} DMA & & DMA \\ Square & \times & Runoff \\ Footage & & Factor \end{pmatrix} \times \begin{pmatrix} IMP \\ Sizing \\ Factor \end{pmatrix}$$

Use the format of Table 4-7 to present the calculations of the required minimum area and volumes for **bioretention areas** and **planter boxes**:

TABLE 4-7. Format for presenting calculations of minimum IMP Areas for bioretention areas and planter boxes.

DMA Name	*DMA Area (square feet)*	*Post-project surface type*	*DMA Runoff factor*	*DMA Area × runoff factor*	*Soil Type:*	*IMP Name*			
					IMP Sizing factor		*Minimum Area*	*Proposed Area*	
			Total		***0.04***				***IMP Area***

To size **dry wells**, **infiltration basins**, or **infiltration trenches**, use the following procedure:

1. Use the County of San Diego's 85th Percentile Isopluvial Map to determine the minimum unit volume.

2. Determine the weighted runoff factor ("C" factor) for the area tributary to the facility. The factors in Table 4-2 may be used.

3. Multiply the weighted runoff factor times the tributary area times the minimum unit volume.

   Equation 4-8

   $$Volume = [Tributary\ Area] \times [weighted\ runoff\ factor] \times [unit\ volume]$$

4. Select a facility depth.

5. Determine the required facility area. Dry wells may be designed as an open vault or with rock fill. If rock fill is used, assume a porosity of 40%.

6. Ensure the facility can infiltrate the entire volume within 72 hours.

To size a **cistern in series with a bioretention facility**:

1. Use Equation 4-8 to calculate the required cistern volume.

2. Design a discharge orifice for a drawdown time of 24 hours.

3. Determine the maximum discharge from the orifice.

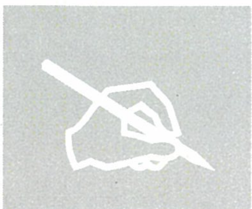
4. The minimum area of the bioretention facility must treat this flow based on a percolation rate of 5" per hour through the engineered soil.

► **STEP 7: DETERMINE IF AVAILABLE SPACE FOR IMP IS ADEQUATE**

Sizing and configuring IMPs may be an iterative process. After computing the minimum IMP area using Steps 1 – 6, review the site plan to determine if the reserved IMP area is sufficient. If so, the planned IMPs will meet the SUSMP sizing requirements. If not, revise the plan accordingly. Revisions may include:

- Reducing the overall imperviousness of the project site.

- Changing the grading and drainage to redirect some runoff toward other IMPs which may have excess capacity.
- Making tributary landscaped DMAs self-treating or self-retaining.
- Expanding IMP surface area.



► STEP 8: COMPLETE YOUR SUMMARY REPORT

Present your IMP sizing calculations in tabular form. Adapt the following format as appropriate to your project. Coordinate your presentation of DMAs and calculation of minimum IMP sizes with the Project Submittal drawing (labeled to show delineation of DMAs and locations of IMPs). It is also helpful to incorporate a brief description of each DMA and each IMP.

Sum the total area of all DMAs and IMPs listed and show it is equal to the total project area. This step may include adjusting the square footage of some DMAs to account for area used for IMPs.

Format:

Project Name:

Project Location:

APN or Subdivision Number:

Total Project Area (square feet):

Mean Annual Precipitation at Project Site:

I. Self-treating areas:

DMA Name	*Area (square feet)*

II. Self-retaining areas:

DMA Name	*Area (square feet)*

III. Areas draining to self-retaining areas:

DMA Name	*Post-project surface type*	*Runoff factor*	*Area (square feet)*	*Receiving self-retaining DMA*	*Receiving self-retaining DMA Area (square feet)*

IV. Areas draining to IMPs (repeat for each IMP):

DMA Name	*DMA Area (square feet)*	*Post-project surface type*	*DMA Runoff factor*	*DMA Area × runoff factor*
			Total	

Soil Type:	*IMP Name*			
IMP Sizing factor		*Minimum Area or Volume*	*Proposed Area or Volume*	
				IMP Area

Specify Preliminary Design Details

In your Project Submittal, describe your IMPs in sufficient detail to demonstrate the area, volume, and other criteria of each can be met within the constraints of the site.

Ensure these details are consistent with preliminary site plans, landscaping plans, and architectural plans submitted with your application for planning and zoning approvals.

Following are design sheets for:

- Self-treating and self-retaining areas
- Pervious pavements
- Bioretention facilities
- Flow-through planter
- Dry wells and infiltration basins
- Cistern with bioretention facility

These design sheets include recommended configurations and details, and example applications, for these IMPs. **The information in these design sheets must be adapted and applied to the conditions specific to the development project such as unstable slopes or the lack of available head. Designated municipal staff have final review and approval authority over the project design.**

Keep in mind that proper and functional design of the IMP is the responsibility of the applicant. Effective operation of the IMP throughout the project's lifetime will be the responsibility of the property owner.

Alternatives to Integrated LID Design

If you believe design of features and facilities as described above is infeasible for your development site, consult with municipal staff before preparing an alternative design for stormwater treatment, flow control, and LID compliance.

For all alternative designs, the applicant must prepare a complete Project Submittal, including a drawing showing the entire site divided into discrete Drainage Management Areas, text and tables showing how drainage is routed from each DMA to a treatment facility, and calculations demonstrating the design achieves the applicable design criteria for each stormwater treatment facility. Alternative treatment facilities are limited to the circumstances and selection criteria identified beginning on page 21. The Project Submittal must also show how the project meets the minimum LID criteria (page 25) and ensures runoff rates, durations, and velocities are controlled to maintain or reduce downstream erosion conditions and protect stream habitat (NPDES Permit Provision D.1.d.(10)).

Local Requirements

Cities or the County may have requirements that differ from, or are in addition to, this countywide model SUSMP. Check with local planning and community development staff.

► DESIGN OF ALTERNATIVE TREATMENT FACILITIES

Here are criteria and design considerations for some alternative treatment facilities:

Sand Filters. To ensure effectiveness is not compromised by compacting or clogging of the filter surface, sand filters must be maintained frequently.

The following criteria apply to sand filters:

- Calculate the design flow using the rational method with an intensity of 0.2"/hour and the "C" factors for "treatment only" from Table 4-2.
- To determine the required filter surface area, divide the design flow by an allowable design surface loading rate of 5"/hour.
- The minimum depth of filter media is 18". The media should be washed sand, with gradation similar to that specified for fine aggregate in ASTM C-33.
- The entire filter area must be accessible for easy maintenance without the need to enter a confined space.

A typical filter design includes a gravel drain layer and a perforated pipe underdrain. Filter fabric may be used to prevent the filter media from entering the gravel layer.

The design should not include any permanent pool or other standing water. Instead of including a pretreatment basin, consider the following features in the area tributary to the filter to reduce the potential for filter clogging:

- Limit the size of the Drainage Management Area.

- Include only impervious areas in the DMA.
- Stabilize slopes and eliminate sources of sediment in the DMA.
- Provide screens for trash and leaves at storm drain inlets (if allowed by municipality).

For additional design considerations and details, see *Design of Stormwater Filtering Systems* by Richard A. Claytor and Thomas R. Schueler, The Center for Watershed Protection, 1996, and *California Stormwater BMP Handbooks* Fact Sheet TC-40, Media Filter.

Extended ("Dry") Detention Basins. The required detention volume is based on the 85th percentile 24-hour storm depth. The steps to calculate the required detention volume are:

1. Use the County of San Diego's 85th Percentile Isopluvial Map to determine the unit basin volume.
2. Determine the weighted runoff factor ("C" factor) for the area tributary to the basin. The factors in Table 4-2 may be used.
3. Multiply the weighted runoff factor times the tributary area times the unit basin volume.

For maximum effectiveness the basin should not be sized substantially larger than this volume.

For design considerations and details, see the *California Stormwater Best Management Practice Handbooks*, Fact Sheet TC-22, "Extended Detention Basins." The basin outlet should be designed for a 24-hour drawdown time.

As noted in Fact Sheet TC-22, "dry" detention basins may not be practicable for drainage areas less than 5 acres. The potential for mosquito harborage is a concern. In the design, do not create any areas that will hold standing water for 72 hours or more.

"Wet" Detention Ponds and Constructed Wetlands. The required detention volume is determined as with a "dry" detention basin. Before proceeding with design, contact the local mosquito control agency to coordinate the design and plan ongoing inspection and maintenance of the facility for mosquito control. For design considerations and details, see the *California Stormwater Best Management Practices Handbooks*, Fact Sheet TC-20, "Wet Ponds," and Fact Sheet TC-21, "Constructed Wetlands."

Vegetated Swales. Design recommendations for conventional vegetated swales are in the *California Stormwater Best Management Practices Handbooks*. The conventional swale design uses available on-site soils and does not include an underdrain system. Where soils are clayey, there is little infiltration. Treatment occurs as runoff flows through grass or other vegetation before exiting at the downstream end. Recommended detention times are on the order of 10 minutes. Linear-shaped bioretention areas should be used in place of conventional vegetated swales because:

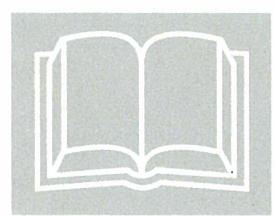
- Conventional swale design has resulted in standing water and associated nuisances.
- Conventional swales often don't obtain even the design residence time because of the length required and because proper design requires runoff enter the swale at the upstream end rather than at various locations along its length, and
- Bioretention areas provide a more flexible drainage design, more effective practicable treatment, and more effective flow control within the same footprint.

▶ TREATMENT FACILITIES FOR SPECIAL CIRCUMSTANCES

Higher-rate surface filters and vault-based proprietary filters can only be used in the circumstances described beginning on page 21 and when sand filters, extended "dry" detention basins, and "wet" detention ponds or constructed wetlands have been found infeasible.

For surface filters, the grading and drainage design should minimize the area draining to each unit and maximize the number of discrete drainage areas and units. Proprietary facilities should be installed consistent with the manufacturer's instructions.

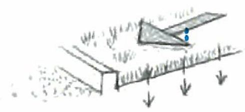
References and Resources:



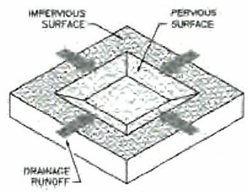
- RWQCB Order R9-2007-0001 (Stormwater NPDES Permit)
- Low Impact Development Center
- *County of San Diego Low Impact Development Handbook*
- *California Best Management Practices Handbooks*
- *Design of Stormwater Filtering Systems* (Claytor and Scheuler, 1996)
- American Rainwater Catchment Systems Association
- Water Conservation Alliance of Southern Arizona
- *Rainwater Harvesting for Drylands and Beyond*
- *The Texas Manual on Rainwater Harvesting*
- *Managing Wet Weather With Green Infrastructure: Municipal Handbook, Rainwater Harvesting Policies* (Low Impact Development Center, 2008)

Self-Treating and Self-Retaining Areas

► **CRITERIA**



Rainfall on self-treating areas infiltrates or—during intense storms— drains directly off-site or to the storm drain system.



Self-retaining areas are designed to retain the first one inch of rainfall without producing any runoff. During intense storms, runoff may drain off-site, to the storm drain system, or to IMPs.

LID design seeks to manage runoff from roofs and paving so effects on water quality and hydrology are minimized. Runoff from landscaping, however, does not need to be managed the same way.

Runoff from landscaping can be managed by creating self-treating and self-retaining areas.

Self-treating areas are natural, landscaped, or turf areas that drain directly off site or to the storm drain system. Examples include upslope undeveloped areas that are ditched and drained around a development and grassed slopes that drain offsite to a street or storm drain. Self-treating areas may not drain on to adjacent paved areas.

Where a landscaped area is upslope from or surrounded by paved areas, a **self-retaining area** (also called a zero-discharge area) may be created. Self-retaining areas are designed to retain the first one inch of rainfall without producing any runoff. The technique works best on flat, heavily landscaped sites. It may be used on mild slopes if there is a reasonable expectation that the first inch of rainfall would produce no runoff.

To create self-retaining turf and landscape areas in flat areas or on terraced slopes, berm the area or depress the grade into a concave cross-section so that these areas will retain the first inch of rainfall. Inlets of area drains, if any, should be set 3 inches above the low point to allow ponding.

Best Uses

- Heavily landscaped sites

Advantages

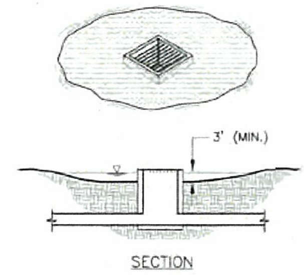
- No maintenance verification requirement
- Complements site landscaping

Limitations

- Requires substantial square footage
- Grading requirements must be coordinated with landscape design

Areas draining to self retaining areas. Drainage from roofs and paving can be directed to self-retaining areas and allowed to infiltrate into the soil. The maximum allowable ratio is 2 parts impervious: 1 part pervious.

The self-retaining area must be bermed or depressed to retain an inch of rainfall including the flow from the tributary impervious area.



Set overflows and area drain inlets high enough to ensure ponding (3" deep) over the surface of the self-retaining area.

▶ DETAILS

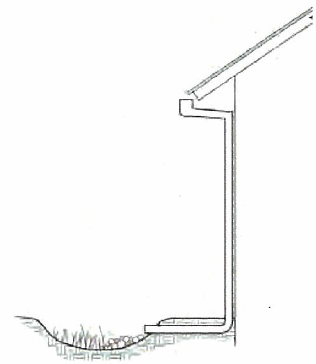
Drainage from self-treating areas must flow to off-site streets or storm drains without flowing on to paved areas.

Pavement within a self-treating area cannot exceed 5% of the total area.

In self-retaining areas, overflows and area drain inlets should be set high enough to ensure ponding over the entire surface of the self-retaining area.

Self–retaining areas should be designed to promote even distribution of ponded runoff over the area.

Leave enough reveal (from pavement down to landscaped surface) to accommodate buildup of turf or mulch.



Connecting a roof leader to a self-retaining area. The head from the eave height makes it possible to route roof drainage some distance away from the building.

▶ APPLICATIONS

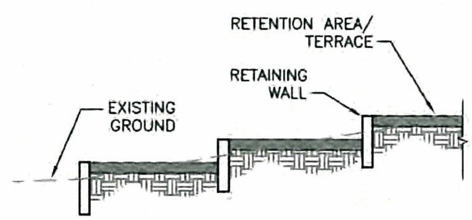
Lawn or landscaped areas adjacent to streets can be considered self-treating areas.

Self-retaining areas can be created by depressing lawn and landscape below surrounding sidewalks and plazas.

Runoff from walkways or driveways in parks and park-like areas can sheet-flow to self-retaining areas.

Roof leaders can be connected to self-retaining areas by piping beneath plazas and walkways. If necessary, a "bubble-up" can be used.

Self-retaining areas can be created by terracing mild slopes. The elevation difference promotes subsurface drainage.



Mild slopes can be terraced to create self-retaining areas.

▶ DESIGN CHECKLIST FOR SELF-TREATING AREAS

- ❒ The self-treating area is at least 95% lawn or landscaping (not more than 5% impervious).
- ❒ Re-graded or re-landscaped areas have amended soils, vegetation, and irrigation as may be required to maintain soil stability and permeability.
- ❒ Runoff from the self-treating area does not enter an IMP or another drainage management area, but goes directly to the storm drain system.

▶ DESIGN CHECKLIST FOR SELF-RETAINING AREAS

- ❒ Area is bermed all the way around or graded concave.
- ❒ Slopes do not exceed 4%.
- ❒ Entire area is lawn, landscaping, or pervious pavement (see criteria in Chapter 4).
- ❒ Area has amended soils, vegetation, and irrigation as may be required to maintain soil stability and permeability.
- ❒ Any area drain inlets are at least 3 inches above surrounding grade.

▶ DESIGN CHECKLIST FOR AREAS DRAINING TO SELF-RETAINING AREAS

- ❒ Ratio of tributary impervious area to self-retaining area is not greater than 2:1.
- ❒ Roof leaders collect runoff and route it to the self-retaining area.
- ❒ Paved areas are sloped so drainage is routed to the self-retaining area.
- ❒ Inlets are designed to protect against erosion and distribute runoff across the area.

This page intentionally left blank.

Pervious Pavements

▶ CRITERIA

Impervious roadways, driveways, and parking lots account for much of the hydrologic impact of land development. In contrast, pervious pavements allow rainfall to collect in a gravel or sand base course and infiltrate into native soil.

Pervious pavements are designed to transmit rainfall through the surface to storage in a base course. For example, a 4-inch-deep base course provides approximately 1.6 inches of storage. Runoff stored in the base course infiltrates to native soils over time. Except in the case of solid pavers, the surface course provides additional storage.

Areas with the following pervious pavements may be regarded as "self-treating" and require no additional treatment or flow control if they drain off-site (not to an IMP).

- Pervious concrete
- Porous asphalt
- Crushed aggregate (gravel)
- Open pavers with grass or plantings
- Open pavers with gravel
- Artificial turf

Areas with these pervious pavements can also be **self-retaining areas** and may receive runoff from impervious areas if they are bermed or depressed to retain the first one inch of rainfall, including runoff from the tributary impervious area.

Solid unit pavers—such as bricks, stone blocks, or precast concrete shapes—are considered to reduce runoff compared to impervious pavement, when the unit pavers are set in sand or gravel with d" gaps between the pavers. Joints must be filled with an open-graded aggregate free of fines.

Best Uses

- Areas with permeable native soils
- Low-traffic areas
- Where aesthetic quality can justify higher cost

Advantages

- No maintenance verification requirement
- Variety of surface treatments can complement landscape design

Limitations

- Initial cost
- Placement requires specially trained crews
- Geotechnical concerns, especially in clay soils
- Concerns about pavement strength and surface integrity
- Some municipalities do not allow in public right of way

When draining pervious pavements to an IMP, use the runoff factors in Table 4-2.

Use the following runoff factors for solid unit pavers:

► DETAILS

Permeable pavements can be used in clay soils; however, special design considerations, including an increased depth of base course, typically apply and will increase the cost of this option. Geotechnical fabric between the base course and underlying clay soil is recommended.

Pavement strength and durability typically determines the required depth of base course. If underdrains are used, the outlet elevation must be a minimum of 3 inches above the bottom elevation of the base course.

Pervious concrete and porous asphalt must be installed by crews with special training and tools. Industry associations maintain lists of qualified contractors.

Parking lots with crushed aggregate or unit pavers may require signs or bollards to organize parking.

DESIGN CHECKLIST FOR PERVIOUS PAVEMENTS

- ❒ No erodible areas drain on to pavement.
- ❒ Subgrade is uniform. Compaction is minimal.
- ❒ Reservoir base course is of open-graded crushed stone. Base depth is adequate to retain rainfall and support design loads.
- ❒ If a subdrain is provided, outlet elevation is a minimum of 3 inches above bottom of base course.
- ❒ Subgrade is uniform and slopes are not so steep that subgrade is prone to erosion.
- ❒ Rigid edge is provided to retain granular pavements and unit pavers.
- ❒ Solid unit pavers are installed with open gaps filled with open-graded aggregate free of fines.
- ❒ Permeable pavements are installed by industry-certified professionals according to vendor's recommendations.
- ❒ Selection and location of pavements incorporates Americans with Disabilities Act requirements, site aesthetics, and uses.

RESOURCES

Southern California Concrete Producers
www.concreteresources.net.

California Asphalt Pavement Association
http://www.californiapavements.org/stormwater.html

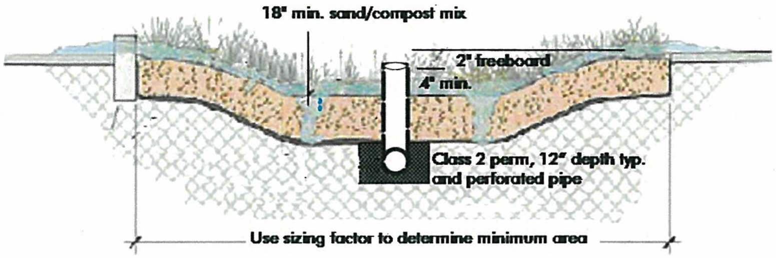
Interlocking Concrete Pavement Institute
http://www.icpi.org/

Start at the Source Design Manual for Water Quality Protection, pp. 47-53. www.basmaa.org

Porous Pavements, by Bruce K. Ferguson. 2005. ISBN 0-8493-2670-2.

This page intentionally left blank.

Bioretention Facilities



Bioretention facility configured for treatment-only requirements. Bioretention facilities can rectangular, linear, or nearly any shape.

Bioretention detains runoff in a surface reservoir, filters it through plant roots and a biologically active soil mix, and then infiltrates it into the ground. Where native soils are less permeable, an underdrain conveys treated runoff to storm drain or surface drainage.

Bioretention facilities can be configured in nearly any shape. When configured as linear **swales**, they can convey high flows while percolating and treating lower flows.

Bioretention facilities can be configured as in-ground or above-ground planter boxes, with the bottom open to allow infiltration to native soils underneath. If infiltration cannot be allowed, use the sizing factors and criteria for the Flow-Through Planter.

CRITERIA

For development projects subject only to runoff treatment requirements, the following criteria apply:

Parameter	Criterion
Soil mix depth	18 inches minimum
Soil mix minimum percolation rate	5 inches per hour minimum sustained (10 inches per hour initial rate recommended)
Soil mix surface area	0.04 times tributary impervious area (or equivalent)

Best Uses

- Commercial areas
- Residential subdivisions
- Industrial developments
- Roadways
- Parking lots
- Fit in setbacks, medians, and other landscaped areas

Advantages

- Can be any shape
- Low maintenance
- Can be landscaped

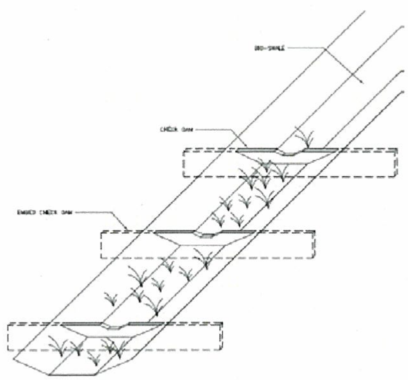
Limitations

- Require 4% of tributary impervious square footage
- Typically requires 3-4 feet of head
- Irrigation typically required

Parameter	Criterion
Surface reservoir depth	6 inches minimum; may be sloped to 4 inches where adjoining walkways.
Underdrain	Required in Group "C" and "D" soils. Perforated pipe embedded in gravel ("Class 2 permeable" recommended), connected to storm drain or other accepted discharge point.

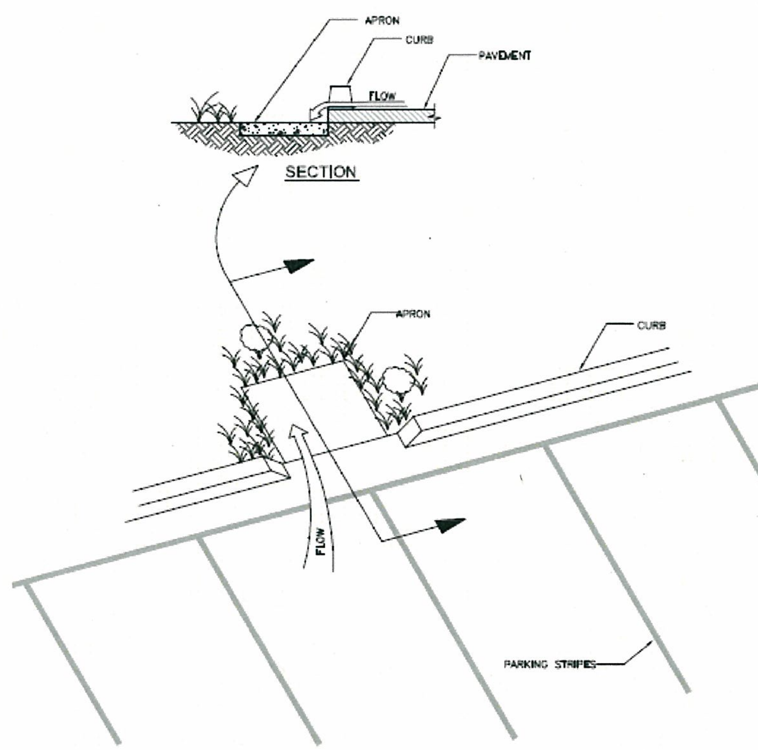
▶ DETAILS

Plan. On the surface, a bioretention facility should be one level, shallow basin—or a series of basins. As runoff enters each basin, it should flood and fill throughout before runoff overflows to the outlet or to the next downstream basin. This will help prevent movement of surface mulch and soil mix.



Use check dams for linear bioretention facilities (swales) on a slope.

In a linear swale, check dams should be placed so that the lip of each dam is at least as high as the toe of the next upstream dam. A similar principle applies to bioretention facilities built as terraced roadway shoulders.



Recommended design details for bioretention facility inlets (see text).

Inlets. Paved areas draining to the facility should be graded, and inlets should be placed, so that runoff remains as sheet flow or as dispersed as possible. Curb cuts should be wide (12" is recommended) to avoid clogging with leaves or debris. Allow for a minimum reveal of 4"-6" between the inlet and soil mix elevations to ensure turf or mulch buildup does not block the inlet. In addition, place an apron of stone or concrete, a foot square or larger, inside each inlet to prevent vegetation from growing up and blocking the inlet.

Where runoff is collected in pipes or gutters and conveyed to the facility, protect the landscaping from high-velocity flows with energy-dissipating rocks. In larger installations, provide cobble-lined channels to better distribute flows throughout the facility.

Upturned pipe outlets can be used to dissipate energy when runoff is piped from roofs and upgradient paved areas.

Soil mix. The required soil mix is similar to a loamy sand. It must maintain a minimum percolation rate of 5" per hour throughout the life of the facility, and it must be suitable for maintaining plant life. Typically, on-site soils will not be suitable due to clay content.

Storage and drainage layer. "Class 2 permeable," Caltrans specification 68-1.025, is recommended. Open-graded crushed rock, washed, may be used, but requires 4"-6" washed pea gravel be substituted at the top of the crushed rock gravel layers. **Do not use filter fabric** to separate the soil mix from the gravel drainage layer or the gravel drainage layer from the native soil.

Underdrains. No underdrain is required where native soils beneath the facility are Hydrologic Soil Group A or B. For treatment-only facilities where native soils are Group C or D, a perforated pipe must be bedded in the gravel layer and must terminate at a storm drain or other approved discharge point.

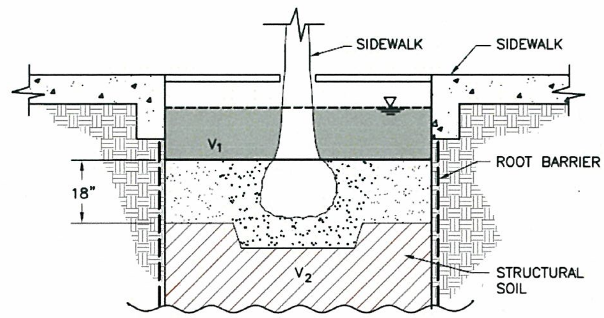
Outlets. In treatment-only facilities, outlets must be set high enough to ensure the surface reservoir fills and the entire surface area of soil mix is flooded before the outlet elevation is reached. In swales, this can be achieved with appropriately placed check dams.

The outlet should be designed to exclude floating mulch and debris.

Vaults, utility boxes and light standards. It is best to locate utilities outside the bioretention facility—in adjacent walkways or in a separate area set aside for this purpose. If utility structures are to be placed within the facility, the locations should be anticipated and adjustments made to ensure the minimum bioretention surface area and volumes are achieved. Leaving the final locations to each individual utility can produce a haphazard, unaesthetic appearance and make the bioretention facility more difficult to maintain.

Emergency overflow. The site grading plan should anticipate extreme events and potential clogging of the overflow and route emergency overflows safely.

Trees. Bioretention areas can accommodate small or large trees. There is no need to subtract the area taken up by roots from the effective area of the facility. Extensive tree roots maintain soil permeability and help retain runoff. Normal maintenance of a bioretention facility should not affect tree lifespan.

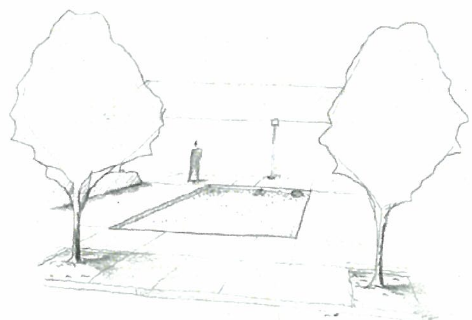


Bioretention facility configured as a tree well. The root barrier is optional.

The bioretention facility can be integrated with a tree pit of the required depth and filled with structural soil. If a root barrier is used, it can be located to allow tree roots to spread throughout the bioretention facility while protecting adjacent pavement. Locations and planting elevations should be selected to avoid blocking the facility's inlets and outlets.

APPLICATIONS

Multi-purpose l andscaped ar eas. Biore–tention facilities are easily adapted to serve multiple purposes. The loamy sand soil mix will support turf or a plant palette suitable to the location and a well-drained soil.



Bioretention facility configured as a recessed decorative lawn with hardscaped edge.

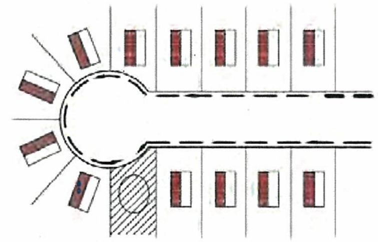
Example landscape treatments:

- Lawn with sloped transition to adjacent landscaping.
- Swale in setback area
- Swale in parking median
- Lawn with hardscaped edge treatment
- Decorative garden with formal or informal plantings
- Traffic island with low-maintenance landscaping

Bioretention facility configured and planted as a lawn/ play area.

- Raised planter with seating
- Bioretention on a terraced slope

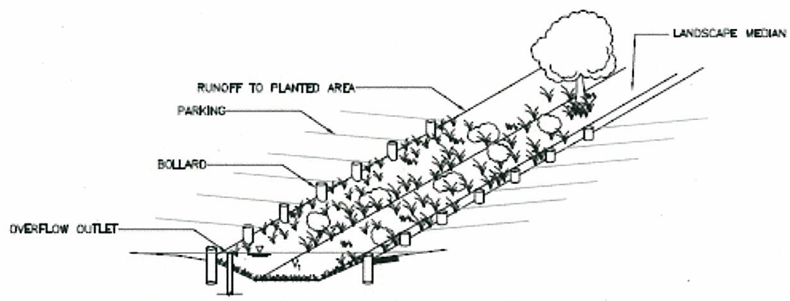
Residential subdivisions. Some subdivisions are designed to drain roofs and driveways to the streets (in the conventional manner) and then drain the streets to bioretention areas, with one bioretention area for each 1 to 6 lots, depending on subdivision layout and topography.



Bioretention facility receiving drainage from individual lots and the street in a residential subdivision.

If allowed by the local jurisdiction, bioretention areas can be placed on a separate, dedicated parcel with joint ownership.

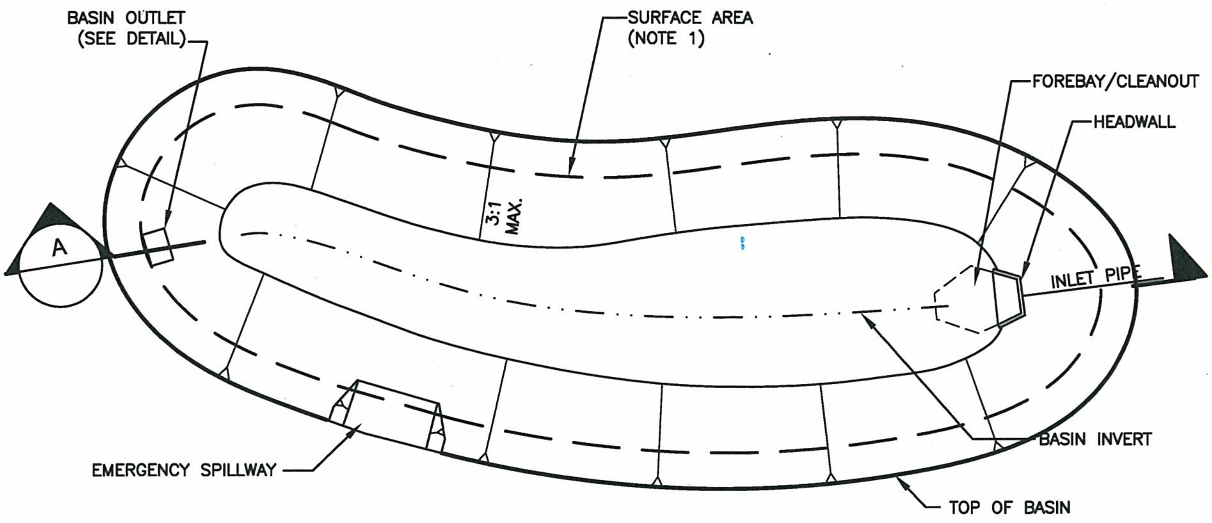
Sloped sites. Bioretention facilities must be constructed as a basin, or series of basins, with the circumference of each basin set level. It may be necessary to add curbs or low retaining walls.



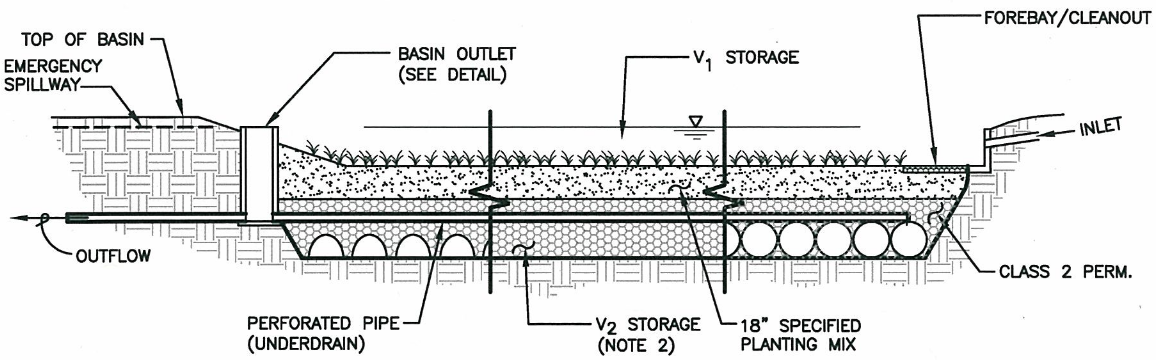
Bioretention facility configured as a parking median.
Note use of bollards in place of curbs, eliminating the need for curb cuts.

Design Checklist for Bioretention

- ❒ Volume or depth of surface reservoir meets or exceeds minimum.
- ❒ 18" depth "loamy sand" soil mix with minimum long-term percolation rate of 5"/hour.
- ❒ Area of soil mix meets or exceeds minimum.
- ❒ Perforated pipe underdrain bedded in "Class 2 perm" with connection and sufficient head to storm drain or discharge point (except in "A" or "B" soils).
- ❒ No filter fabric.
- ❒ Underdrain has a clean-out port consisting of a vertical, rigid, non-perforated PVC pipe, with a minimum diameter of 6 inches and a watertight cap.
- ❒ Location and footprint of facility are shown on site plan and landscaping plan.
- ❒ Bioretention area is designed as a basin (level edges) or a series of basins, and grading plan is consistent with these elevations. If facility is designed as a swale, check dams are set so the lip of each dam is at least as high as the toe of the next upstream dam.
- ❒ Inlets are 12" wide, have 4"-6" reveal and an apron or other provision to prevent blockage when vegetation grows in, and energy dissipation as needed.
- ❒ Overflow connected to a downstream storm drain or approved discharge point.
- ❒ Emergency spillage will be safely conveyed overland.
- ❒ Plantings are suitable to the climate and a well-drained soil.
- ❒ Irrigation system with connection to water supply.
- ❒ Vaults, utility boxes, and light standards are located outside the minimum soil mix surface area.
- ❒ When excavating, avoid smearing of the soils on bottom and side slopes. Minimize compaction of native soils and "rip" soils if clayey and/or compacted. Protect the area from construction site runoff.



PLAN VIEW
NOT TO SCALE



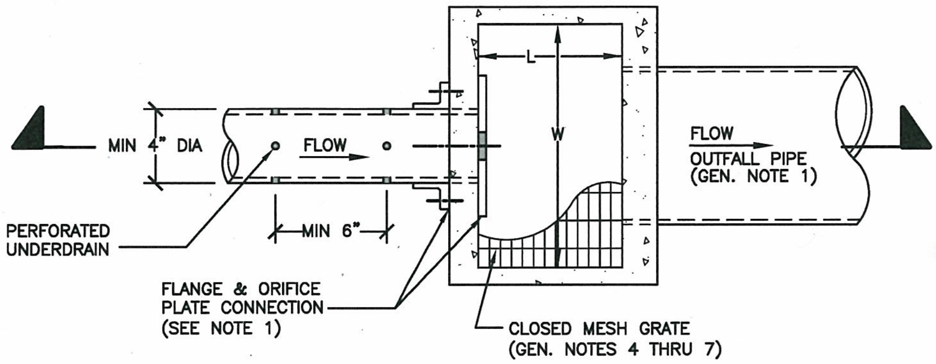
A SECTION
NOT TO SCALE

NOTE

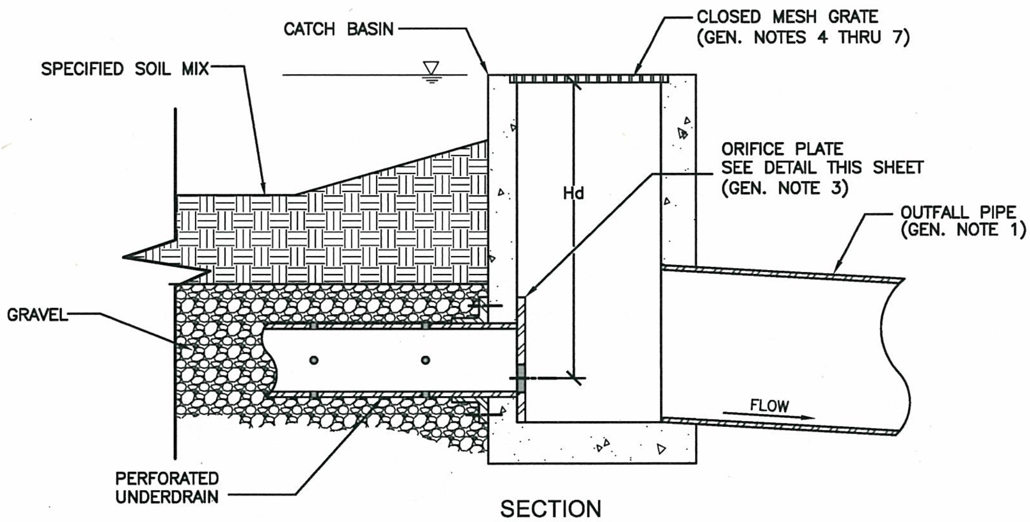
1. SURFACE AREA LIMIT DETERMINED BY EXTENT OF SPECIFIED PLANTING MIX, WHICH IS GOVERNED BY THE OUTLET SPILL ELEVATION. FOR REQUIRED SURFACE AREA REFER TO THE FACTORS AND EQUATIONS IN THE STORMWATER C.3 GUIDEBOOK.

2. V_2 STORAGE ACCOMPLISHED WITH INFILTRATION ARCHES, PERFORATED PIPES, CLASS 2 PERM OR OTHER AT THE DESIGNERS DISCRETION.

Bioretention Facility



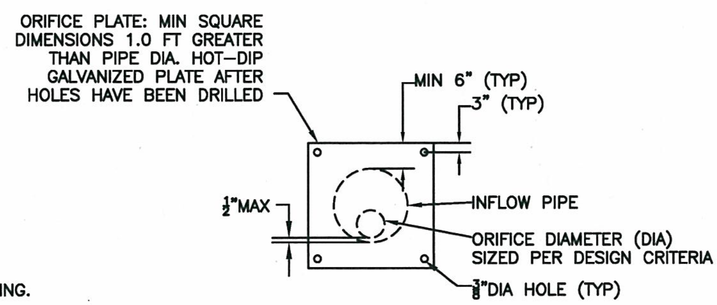
PLAN
N.T.S.



SECTION
N.T.S.

NOTE

1. ORIFICE PLATE & FLANGE CONNECTION TO CONCRETE SHALL BE FITTED WITH 30 DUROMETER NEOPRENE RING.



FLOW CONTROL ORIFICE PLATE

Bioretention Facility Outlet Detail - A

Flow-through Planter

Portland 2004 Stormwater Manual

Flow-through planters treat and detain runoff without allowing seepage into the underlying soil. They can be used next to buildings and on slopes where stability might be affected by adding soil moisture.

Flow-through planters typically receive runoff via downspouts leading from the roofs of adjacent buildings. However, they can also be set in-ground and receive sheet flow from adjacent paved areas.

Pollutants are removed as runoff passes through the soil layer and is collected in an underlying layer of gravel or drain rock. A perforated-pipe underdrain is typically connected to a storm drain or other discharge point. An overflow inlet conveys flows which exceed the capacity of the planter.

Best Uses

- Management of roof runoff
- Next to buildings
- Dense urban areas
- Where infiltration is not desired

Advantages

- Can be used next to structures
- Versatile
- Can be any shape
- Low maintenance

Limitations

- Can be used for flow-control only on sites with "C" and "D" soils
- Requires underdrain
- Requires 3-4 feet of head

► CRITERIA

Treatment only. For development projects subject only to runoff treatment requirements, the following criteria apply:

Parameter	Criterion
Soil mix depth	18 inches minimum
Soil mix minimum percolation rate	5 inches per hour minimum sustained (10 inches per hour initial rate recommended)
Soil mix surface area	0.04 times tributary impervious area (or equivalent)
Surface reservoir depth	6" minimum; may be sloped to 4" where adjoining walkways.
Underdrain	Typically used. Perforated pipe embedded in gravel ("Class 2 permeable" recommended), connected to storm drain or other accepted discharge point.

► DETAILS

Configuration. The planter must be level. To avoid standing water in the subsurface layer, set the perforated pipe underdrain and orifice as nearly flush with the planter bottom as possible.

Inlets. Protect plantings from high-velocity flows by adding rocks or other energy-dissipating structures at downspouts and other inlets.

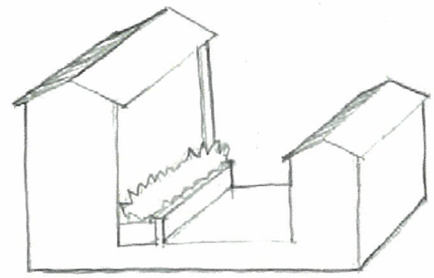
Soil mix. The required soil mix is similar to a loamy sand. It must maintain a minimum percolation rate of 5" per hour throughout the life of the facility, and it must be suitable for maintaining plant life. Typically, on-site soils will not be suitable due to clay content.

Gravel storage and drainage lay er. "Class 2 permeable," Caltrans specification 68-1.025, is recommended. Open-graded crushed rock, washed, may be used, but requires 4"-6" of washed pea gravel be substituted at the top of the crushed rock layer. **Do not use filter fabric** to separate the soil mix from the gravel drainage layer.

Emergency ov erflow. The planter design and installation should anticipate extreme events and potential clogging of the overflow and route emergency overflows safely.

► APPLICATIONS

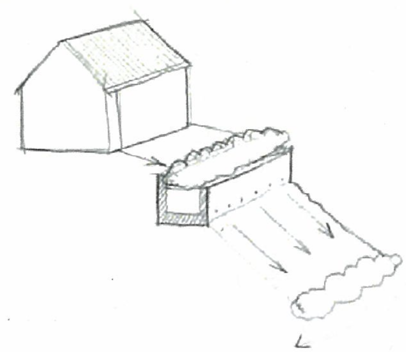
Adjacent to buildings. Flow-through planters may be located adjacent to buildings, where the planter vegetation can soften the visual effect of the building wall. A setback with a raised planter box may be appropriate even in some neo-traditional pedestrian-oriented urban streetscapes.



Flow-through planter on the plaza level of a podium-style development.

At plaza level. Flow-through planters have been successfully incorporated into podium-style developments, with the planters placed on the plaza level and receiving runoff from the tower roofs above. Runoff from the plaza level is typically managed separately by additional flow-through planters or bioretention facilities located at street level.

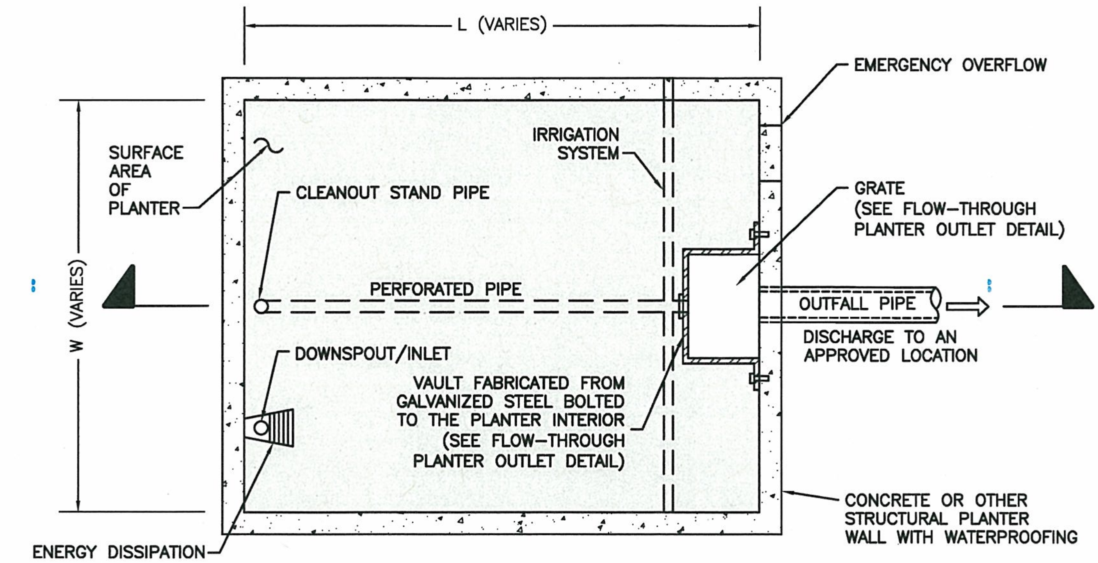
Steep s lopes. Flow-through planters provide a means to detain and treat runoff on slopes that cannot accept infiltration from a bioretention facility. The planter can be built into the slope similar to a retaining wall. The design should consider the need to access the planter for periodic maintenance. Flows from the planter underdrain and overflow must be directed in accordance with local requirements. It is sometimes possible to disperse these flows to the downgradient hillside.



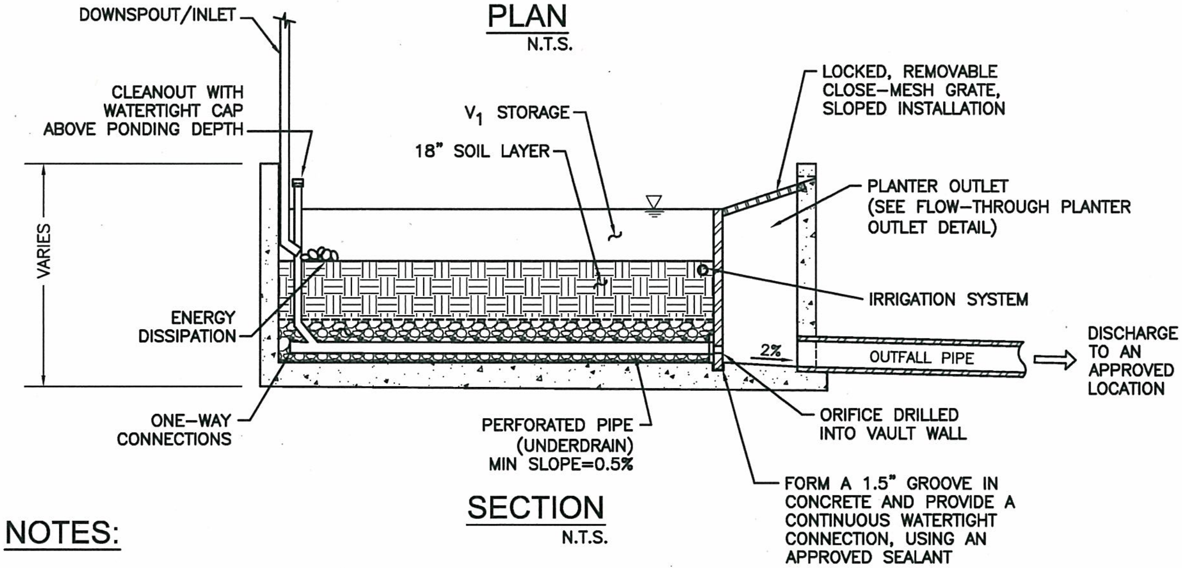
Flow-through planter built into a hillside. Flows from the underdrain and overflow must be directed in accordance with local requirements.

Design Checklist for Flow-through Planter

- ❐ Reservoir depth is 4-6" minimum.
- ❐ 18" depth "loamy sand" soil mix with minimum long-term infiltration rate of 5"/hour.
- ❐ Area of soil mix meets or exceeds minimum.
- ❐ "Class 2 perm" drainage layer.
- ❐ No filter fabric.
- ❐ Perforated pipe underdrain with outlet located flush or nearly flush with planter bottom. Connection with sufficient head to storm drain or discharge point.
- ❐ Underdrain has a clean-out port consisting of a vertical, rigid, non-perforated PVC pipe, with a minimum diameter of 6 inches and a watertight cap.
- ❐ Overflow connected to a downstream storm drain or approved discharge point.
- ❐ Location and footprint of facility are shown on site plan and landscaping plan.
- ❐ Planter is set level.
- ❐ Emergency spillage will be safely conveyed overland.
- ❐ Plantings are suitable to the climate and a well-drained soil.
- ❐ Irrigation system with connection to water supply.



PLAN
N.T.S.



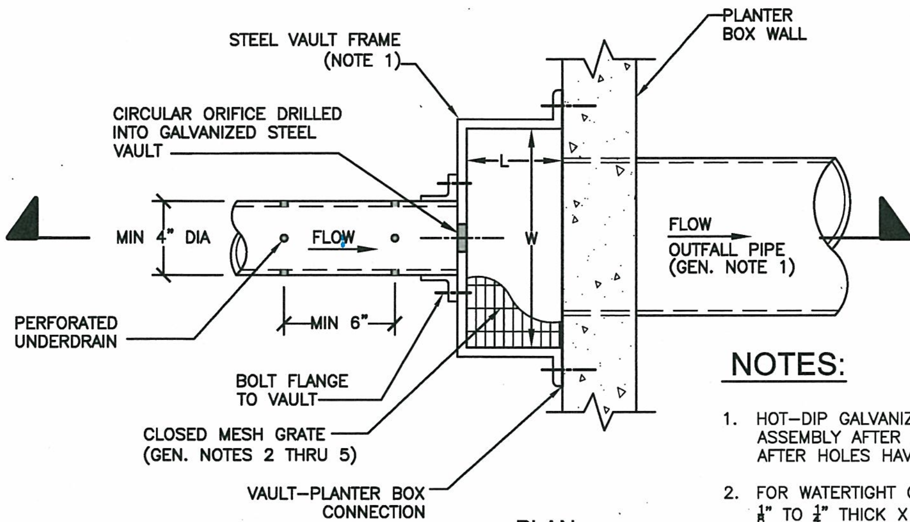
SECTION
N.T.S.

NOTES:

1. FLOW-THROUGH PLANTER SHALL BE SIZED TO MEET CCCWP CRITERIA FOR TREATMENT AND/OR FLOW CONTROL.
2. MINIMUM SURFACE AREA OF PLANTER IS 4% OF TRIBUTARY IMPERVIOUS AREA FOR TREATMENT ONLY DESIGN. FOR FLOW CONTROL AND TREATMENT, REFER TO CCCWP SIZING TOOL CRITERIA.
3. SHAPE OF PLANTER CAN VARY TO MEET PROJECT DESIGN REQUIREMENTS AND LOCATION.
4. CLASS 2 PERMEABLE MATERIAL
5. DOWNSPOUTS/INLET PIPES REQUIRE ENERGY DISSIPATION.
6. USE COUNTY APPROVED ADDITIVE MIXTURE FOR WATERPROOFING CONCRETE.
7. PLANTINGS: SEE CCCWP RECOMMENDED PLANT LIST AND GUIDELINES.
8. PLANTER DESIGN MAY REQUIRE STRUCTURAL ENGINEERING DESIGN.
9. AREA = W x L (ABOVE). EXCLUDES AREA OF VAULT

Flow-Through Planter Detail

P:\Projects\San Diego County\133904 - SDCo Hydromod Management Plan\CAD\ES\CCCP_FlowThruPlanter.dwg 6-09-08 06:58:44 PM estiles

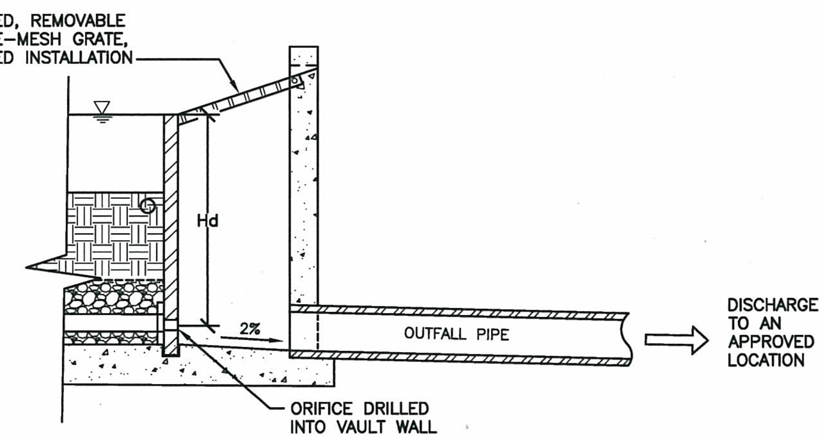


PLAN

N.T.S.

NOTES:

1. HOT–DIP GALVANIZE ENTIRE FRAME ASSEMBLY AFTER FABRICATION AND AFTER HOLES HAVE BEEN DRILLED.
2. FOR WATERTIGHT CONNECTION, INSTALL $\frac{1}{8}$" TO $\frac{1}{4}$" THICK X 2" WIDE CONTINUOUS 30 DUROMETER NEOPRENE GASKET, ALL AROUND VAULT FRAME.



SECTION

N.T.S.

GENERAL OUTLET DETAIL NOTES:

1. OUTFALL PIPE SHALL BE SIZED TO CONVEY DESIGN STORM PER CCCWP DESIGN CRITERIA.
2. GRATE SHALL BE MOUNTED USING STAINLESS STEEL HARDWARE AND PROVIDED WITH HINGED AND LOCKABLE OR BOLTABLE ACCESS PANELS.
3. GRATE SHALL BE STAINLESS STEEL, ALUMINUM OR STEEL. STEEL GRATES SHALL BE HOT DIP GALVANIZED AND MAY BE HOT POWDER PAINTED AFTER GALVANIZING.
4. GRATE SHALL BE DESIGNED SUCH THAT THE DIAGONAL DIMENSION OF EACH OPENING IS SMALLER THAN THE DIAMETER OF THE OUTLET PIPE.
5. STRUCTURAL DESIGN OF GRATE SHALL BE BASED ON FULL HYDROSTATIC HEAD WITH ZERO HEAD DOWNSTREAM OF GRATE.

Flow-Through Planter Outlet Detail

P:\Projects\San Diego County\133904 – SDCo Hydromod Management Plan\CAD\ES\CCCCP_OutletDetails.dwg 6–09–08 07:17:22 PM estiles

Dry Wells and Infiltration Basins

The typical dry well is a prefabricated structure, such as an open-bottomed vault or box, placed in an excavation or boring. The vault may be empty, which provides maximum space efficiency, or may be filled in rock.

An infiltration basin has the same functional components—a volume to store runoff and sufficient area to infiltrate that volume into the native soil—but is open rather than covered.

▶ CRITERIA

Dry wells and infiltration basins must be designed with the minimum volume calculated by Equation 4-8 using a unit volume based on the County of San Diego's 85th Percentile Isopluvial Map.

Consult with the local jurisdiction engineer regarding the need to verify soil permeability and other site conditions are suitable for dry wells and infiltration basins. Some proposed criteria are on Page 5-12 of Caltrans' 2004 *BMP Retrofit Pilot Study Final Report* (CTSW-RT-01-050).

The infiltration rate and infiltrative area must be sufficient to drain a full facility within 72 hours.

▶ DETAILS

Dry wells should be sited to allow for the potential future need for removal and replacement.

In locations where native soils are coarser than a medium sand, the area directly beneath the facility should be over-excavated by two feet and backfilled with sand as a groundwater protection measure.

Best Uses

- Alternative to bioretention in areas with permeable soils

Advantages

- Compact footprint
- Can be installed in paved areas

Limitations

- Can be used only on sites with "A" and "B" soils
- Requires minimum of 10' from bottom of facility to seasonal high groundwater
- Not suitable for drainage from some industrial areas or arterial roads
- Must be maintained to prevent clogging.

Design Checklist for Dry Well

- ❐ Volume and infiltrative area meet or exceed minimum.
- ❐ Overflow connected to a downstream storm drain or approved discharge point.
- ❐ Emergency spillage will be safely conveyed overland.
- ❐ Depth from bottom of the facility to seasonally high groundwater elevation is ≥10'.
- ❐ Areas tributary to the facility do not include automotive repair shops; car washes; fleet storage areas (Bus, truck, etc.); nurseries, or other uses that may present an exceptional threat to groundwater quality.
- ❐ Underlying soils are in Hydrologic Soil Group A or B. Infiltration rate is sufficient to ensure a full basin will drain completely within 72 hours. Soil infiltration rate has been confirmed.
- ❐ Set back from structures 10' or as recommended by structural or geotechnical engineer

Cistern with Bioretention Facility

A cistern in series with a bioretention facility can meet treatment requirements where space is limited. In this configuration, the cistern is equipped with a flow-control orifice and the bioretention facility is sized to treat a trickle outflow from the cistern.

▶ CRITERIA

Cistern. The cistern must detain the volume calculated by Equation 4-8 and must include an orifice or other device designed for a 24-hour drawdown time.

Bioretention facility. See the design sheet for bioretention facilities. The area of the bioretention facility must be sized to treat the maximum discharge flow, assuming a percolation rate of 5" per hour through the engineered soil.

Use with sand filter. A cistern in series with a sand filter can meet treatment requirements. See the discussion of treatment facility selection in Chapter 2 and the design guidance for sand filters in Chapter 4.

▶ DETAILS

Flow-control orifice. The cistern must be equipped with an orifice plate or other device to limit flow to the bioretention area.

Preventing mosquito harborage. Cisterns should be designed to drain completely, leaving no standing water. Drains should be located flush with the bottom of the cistern. Alternatively—or in addition—all entry and exit points, should be provided with traps or sealed or screened to prevent mosquito entry. Note mosquitoes can enter through openings 1/16" or larger and will fly for many feet through pipes as small as ¼".

Exclude debris. Provide leaf guards and/or screens to prevent debris from accumulating in the cistern.

Ensure access for maintenance. Design the cistern to allow for cleanout. Avoid creating the need for maintenance workers to enter a confined space. Ensure the outlet orifice can be easily accessed for cleaning and maintenance.

Best Uses

- In series with a bioretention facility to meet treatment requirement in limited space.
- Management of roof runoff
- Dense urban areas

Advantages

- Storage volume can be in any configuration

Limitations

- Somewhat complex to design, build, and operate
- Requires head for both cistern and bioretention facility

▶ APPLICATIONS

Shallow ponding on a flat roof. The "cistern" storage volume can be designed in any configuration, including simply storing rainfall on the roof where it falls and draining it away slowly. See the County of San Diego's 85th percentile isopluvial diagrams for required average depths.

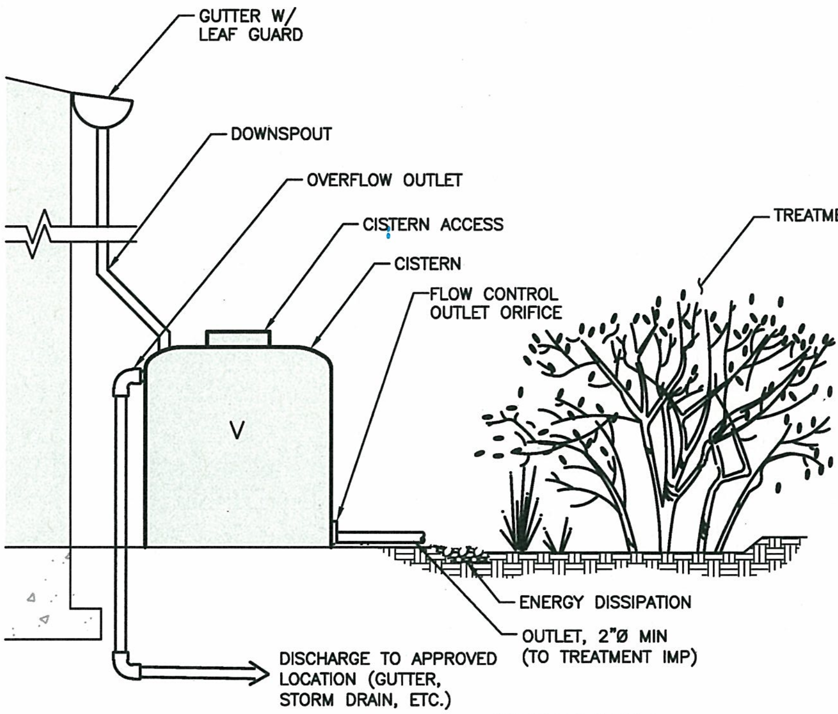
Cistern attached to a building and draining to a planter. This arrangement allows a planter box to be constructed with a smaller area.

Vault with pumped discharge to bioretention facility. In this arrangement, runoff from a parking lot and/or building roofs can be captured and detained underground and then pumped to a bioretention facility on the surface. Alternatively, treatment can be accomplished with a sand filter. See the discussion of selection of stormwater treatment facilities in Chapter 2.

Water harvesting or graywater reuse. It may be possible to create a site-specific design that uses cisterns to achieve stormwater flow control, stormwater treatment, and rainwater reuse for irrigation or indoor uses (**water harvesting**). Facilities must meet criteria for capturing and treating the volume specified by Equation 4-8. This volume must be allowed to empty within 24 hours so runoff from additional storms, which may follow, is also captured and treated. Additional volume may be required if the system also stores runoff for longer periods for reuse. Indoor uses of non-potable water may be restricted or prohibited. Check with municipal staff.

Design Checklist for Cistern

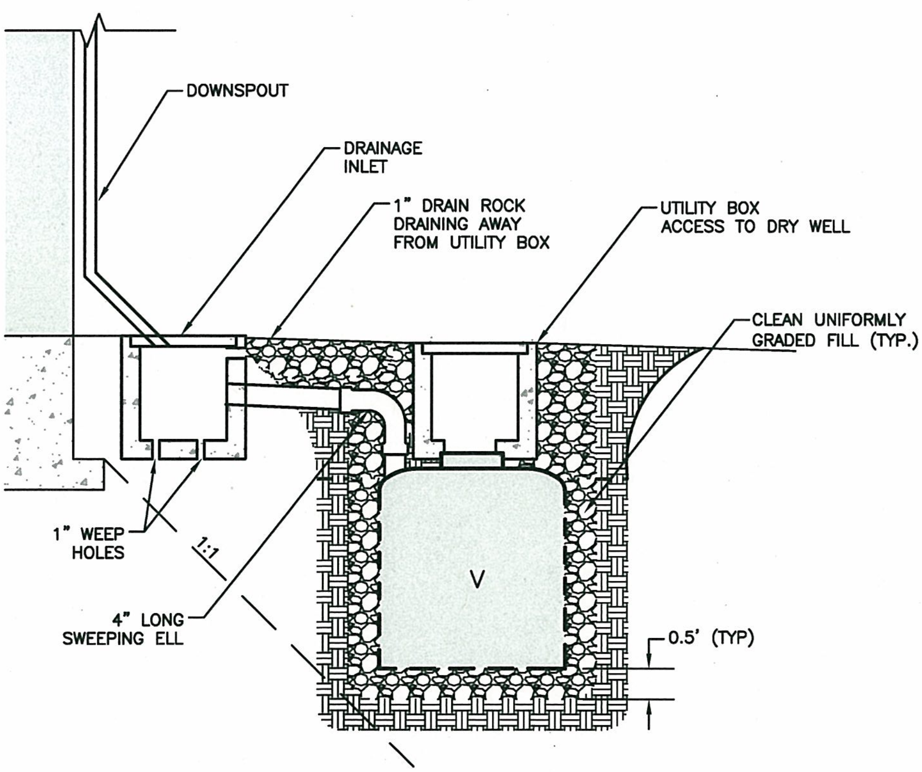
- ❒ Volume meets or exceeds minimum.
- ❒ Outlet with orifice or other flow-control device restricts flow and is designed to provide a 24-hour drawdown time.
- ❒ Outlet is piped to a bioretention facility designed to treat the maximum discharge from the cistern orifice.
- ❒ Cistern is designed to drain completely and/or sealed to prevent mosquito harborage.
- ❒ Design provides for exclusion of debris and accessibility for maintenance.
- ❒ Overflow connected to a downstream storm drain or approved discharge point.
- ❒ Emergency spillage will be safely conveyed overland.



NOTES:

1. DESIGNER SHALL ACCOUNT FOR AND ACCOMODATE FOR POSSIBLE OVERFLOW.
2. OVERFLOW OUTLET CAPACITY SHALL EQUAL OR EXCEED POTENTIAL RUNOFF VOLUME AND RATE.
3. CISTERN PROVIDES FLOW CONTROL ONLY. USE IN COMBINATION WITH TREATMENT IMP.
4. PROVIDE ACCESS FOR CLEAN OUT OF OUTLET ORIFICE. SEE FLOW-THROUGH PLANTER OUTLET DETAIL.
5. PREVENT MOSQUITO BREEDING BY SEALING OR SCREENING ALL OPENINGS TO THE WATER SURFACE AND/OR ENSURE COMPLETE DRAINAGE.

CISTERN



DRY WELL

P:\Projects\San Diego County\133904 - SDCo Hydromod Management Plan\CAD\ES\Originals\CCCP_Cistern.dwg 6-09-08 03:25:35 PM estiles

Chapter

5

Operation & Maintenance of Stormwater Facilities

How to prepare a customized Stormwater Maintenance Plan for the treatment BMPs on your site.

The stormwater NPDES Permit requires each Copermittee to verify all treatment and flow-control facilities are adequately maintained. Facilities you install as part of your project will be verified for effectiveness and proper performance. Some municipalities also verify the ongoing function of stormwater management features that are not treatment or flow control facilities, such as permeable pavements and limitations on impervious area.

Operation and maintenance of stormwater facilities is a six-stage process:

1. Determine **who will own** the facility and be responsible for the maintenance of treatment facilities. Identify the means by which ongoing maintenance will be assured (for example, a maintenance agreement that runs with the land).

2. Identify typical maintenance requirements, and allow for these requirements in your project planning and preliminary design.

3. Prepare a **maintenance plan** for the site incorporating detailed requirements for **each treatment and flow-control facility**.

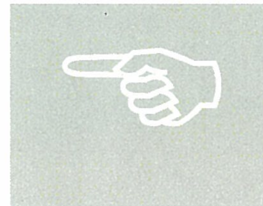
4. **Maintain** the facilities from the time they are constructed until ownership and maintenance responsibility is formally transferred.

5. **Formally transfer** operation and maintenance **responsibility** to the site owner or occupant. A warranty, secured by a bond, or other financial instrument, may be required to secure against lack of performance due to flaws in design or construction.

6. Maintain the facilities in perpetuity and comply with your municipality's self-inspection, reporting, and verification requirements.

See the schedule for these stages in Table 5-1.

Stage 1: Ownership and Responsibility



You must specify a means to **ensure maintenance** of treatment and flow-control facilities **in perpetuity.**

Depending on the intended use of your site and the policies of your municipality, this may require one or more of the following:

- Execution of a maintenance agreement that "runs with the land."
- Creation of a homeowners association (HOA) and execution of an agreement by the HOA to maintain the facilities as well as an annual inspection fee.
- Formation of a new community facilities district or other special district, or addition of the properties to an existing special district.
- Dedication of fee title or easement transferring ownership of the facility (and the land under it) to the municipality.

Ownership and maintenance responsibility for treatment and flow-control facilities should be discussed at the **beginning of project planning**, typically at the pre-application meeting for planning and zoning review. Experience has shown provisions to finance and implement maintenance of treatment and flow-control facilities can be a major stumbling block to project approval, particularly for **small residential subdivisions**. (See "New Subdivisions" in Chapter 1.)

► PRIVATE OWNERSHIP AND MAINTENANCE

The municipality may require—as a condition of project approval—that a maintenance agreement be executed.

TABLE 5-1. SCHEDULE for planning operation and maintenance of stormwater treatment BMPs

Stage	*Description*	*Schedule*
1	Determine facility ownership and maintenance responsibility	Discuss with planning staff at pre-application meeting
2	Identify typical maintenance requirements	In initial submittal, coordinate with planning & zoning application
3	Develop detailed operation and maintenance plan	As required by municipality
4	Interim operation and maintenance of facilities	During and following construction including warranty period
5	Formal transfer of operation & maintenance responsibility	On sale and transfer of property or permanent occupancy
6	Ongoing maintenance and compliance with inspection & reporting requirements	In perpetuity

Typically, these agreements provide that your municipality may collect a management and/or inspection fee established by a standard fee schedule. In addition, the agreement may provide that, if the property owner fails to maintain the stormwater facility, the municipality may enter the property, restore the stormwater facility to good working order and obtain reimbursement, including administrative costs, from the property owner. To augment and enforce these requirements, some municipalities have established Community Facilities Districts (Mello-Roos) to cover the costs of inspections and, if necessary, maintenance and repair of individual facilities.

Local Requirements

Cities or the County may have requirements that differ from, or are in addition to, this countywide model SUSMP. Check with local planning and community development staff.

ICON KEY

- ☞ Helpful Tip
- Submittal Requirement
- Terms to Look Up
- 🕮 References & Resources

► TRANSFER TO PUBLIC OWNERSHIP

Municipalities may sometimes choose to have a treatment and flow-control facility deeded to the public in fee or as an easement and maintain the facility as part of the municipal storm drain system. The municipality may recoup the costs of maintenance through a special tax, assessment district, or similar mechanism.

Locating an IMP in a public right-of-way or easement creates an additional design constraint—along with hydraulic grade, aesthetics, landscaping, and circulation.

However, because sites typically drain to the street, it may be possible to locate a bioretention swale parallel with the edge of the parcel. The facility may complement, or substitute for, an underground storm drain system.

Even if the facility is to be conveyed to the municipality after construction is complete, it is still the responsibility of the builder to identify general operation and maintenance requirements, prepare a detailed operation and maintenance plan, and to maintain the facility until that responsibility is formally transferred.

Local Requirements

Cities or the County may have requirements that differ from, or are in addition to, this countywide model SUSMP. Check with local planning and community development staff.

Stage 2: General Maintenance Requirements

Include in your Project Submittal a general description of anticipated facility maintenance requirements. This will help ensure that:

- Ongoing costs of maintenance have been considered in your facility selection and design.
- Site and landscaping plans provide for access for inspections and by maintenance equipment.
- Landscaping plans incorporate irrigation requirements for facility plantings.
- Initial maintenance and replacement of facility plantings is incorporated into landscaping contracts and guarantees.

Fact sheets available on the Project Clean Water web page describe general maintenance requirements for the types of stormwater facilities featured in the LID Design Guide (Chapter 4). You can use this information to specify general maintenance requirements in your Project Submittal.

Maintenance fact sheets for conventional stormwater facilities are available in the California Stormwater BMP Handbooks.

Stage 3: Detailed Maintenance Plan

Prepare a detailed maintenance plan and submit it as required by your municipality. Some municipalities may require a detailed maintenance plan be included with the initial Project Submittal; others may wish that the detailed maintenance plan incorporate solutions to any problems or changes that occurred during project construction.

Your detailed maintenance plan should be kept on-site for use by maintenance personnel and during site inspections. It is also recommended that a copy of your initial Project Submittal be kept onsite as a reference.

► YOUR DETAILED MAINTENANCE PLAN: STEP BY STEP

The following step-by-step guidance will help you prepare your detailed maintenance plan.

Preparation of the plan will require familiarity with your stormwater facilities as they have been or will be constructed and a fair amount of "thinking through" plans for their operation and maintenance.

► STEP 1: DESIGNATE RESPONSIBLE INDIVIDUALS

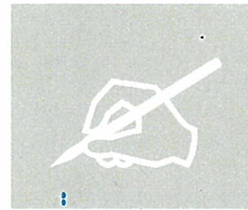
To begin creating your detailed maintenance plan, designate and identify:

- The individual who will have direct responsibility for the maintenance of stormwater controls. This individual should be the designated contact with municipal inspectors and should sign self-inspection reports and any correspondence with the municipality regarding verification inspections.

- Employees or contractors who will report to the designated contact and are responsible for carrying out BMP operation and maintenance.

- The corporate officer authorized to negotiate and execute any contracts that might be necessary for future changes to operation and maintenance or to implement remedial measures if problems occur.

- Your designated respondent to problems, such as clogged drains or broken irrigation mains, that would require immediate response should they occur during off-hours.



Updated contact information must be provided to the municipality immediately w henever a pr operty is s old and w henever designated individuals or contractors change.

Draw or sketch an **organization chart** to show the relationships of authority and responsibility between the individuals responsible for maintenance. This need not be elaborate, particularly for smaller organizations.

Describe how **funding for BMP operation and maintenance** will be assured, including sources of funds, budget category for expenditures, process for establishing the annual maintenance budget, and process for obtaining authority should unexpected expenditures for major corrective maintenance be required.

Describe how your organization will accommodate initial **training** of staff or contractors regarding the purpose, mode of operation, and maintenance requirements for the stormwater facilities on your site. Also, describe how your organization will ensure ongoing training as needed and in response to staff changes.

► STEP 2: SUMMARIZE DRAINAGE AND BMPS

Incorporate the following information from your Project Submittal into your maintenance plan:

- Figures delineating and designating pervious and impervious areas.
- Figures showing locations of stormwater facilities on the site.
- Tables of pervious and impervious areas served by each facility.

Review the Project Submittal narrative, if any, that describes each facility and its tributary drainage area and update the text to incorporate any changes that may have occurred during planning and zoning review, building permit review, or construction. Incorporate the updated text into your maintenance plan.

► STEP 3: DOCUMENT FACILITIES "AS BUILT"

Include the following information from final construction drawings:

- Plans, elevations, and details of all facilities. Annotate if necessary with designations used in the initial Project Submittal.
- Design information or calculations submitted in the detailed design phase (i.e., not included in the initial Project Submittal.)
- Specifications of construction for facilities, including sand or soil, compaction, pipe materials and bedding.

In the maintenance plan, note field changes to design drawings, including changes to any of the following:

- Location and layouts of inflow piping, flow splitter boxes, and piping to off-site discharge
- Depths and layering of soil, sand, or gravel
- Placement of filter fabric or geotextiles
- Changes or substitutions in soil or other materials.
- Natural soils encountered (e.g. sand or clay lenses)

► STEP 4: PREPARE MAINTENANCE PLANS FOR EACH FACILITY

Prepare a maintenance plan, schedule, and inspection checklists (routine, annual, and after major storms) for each facility. Plans and schedules for two or more similar facilities on the same site may be combined.

Use the following resources to prepare your customized maintenance plan, schedule, and checklists.

- Specific information noted in Steps 2 and 3, above.
- Other input from the facility designer, municipal staff, or other sources.
- Operation and Maintenance Fact Sheets (available on the Project Clean Water website).

Note any particular characteristics or circumstances that could require attention in the future, and include any troubleshooting advice.

Also include manufacturer's data, operating manuals, and maintenance requirements for any:

- Pumps or other mechanical equipment.
- Proprietary devices used as BMPs.

Manufacturers' publications should be referenced in the text (including models and serial numbers where available). Copies of the manufacturers' publications should be included as an attachment in the back of your maintenance plan or as a separate document.

► STEP 5: COMPILE MAINTENANCE PLAN

The following general outline is provided as an example. Check with your municipality for specific requirements.

I. Inspection and Maintenance Log

II. Updates, Revisions and Errata

III. Introduction

- A. Narrative overview describing the site; drainage areas, routing, and discharge points; and treatment facilities.

IV. Responsibility for Maintenance

- A. General
  - (1) Name and contact information for responsible individual(s).
  - (2) Organization chart or charts showing organization of the maintenance function and location within the overall organization.
  - (3) Reference to Operation and Maintenance Agreement (if any). A copy of the agreement should be attached.
  - (4) Maintenance Funding
    - (1) Sources of funds for maintenance
    - (2) Budget category or line item
    - (3) Description of procedure and process for ensuring adequate funding for maintenance
- B. Staff Training Program
- C. Records
- D. Safety

V. Summary of Drainage Areas and Stormwater Facilities

- A. Drainage Areas
  - (1) Drawings showing pervious and impervious areas (copied or adapted from initial Project Submittal).

(2) Designation and description of each drainage area and how flow is routed to the corresponding facility.

B. Treatment and Flow-Control Facilities

(1) Drawings showing location and type of each facility

(2) General description of each facility (Consider a table if more than two facilities)

(1) Area drained and routing of discharge.

(2) Facility type and size

VI. Facility Documentation

A. "As-built" drawings of each facility (design drawings in the draft Plan)

B. Manufacturer's data, manuals, and maintenance requirements for pumps, mechanical or electrical equipment, and proprietary facilities (include a "placeholder" in the draft plan for information not yet available).

C. Specific operation and maintenance concerns and troubleshooting

VII. Maintenance Schedule or Matrix

A. Maintenance Schedule for each facility with specific requirements for:

(1) Routine inspection and maintenance

(2) Annual inspection and maintenance

(3) Inspection and maintenance after major storms

B. Service Agreement Information

Assemble and make copies of your maintenance plan. One copy must be submitted to the municipality, and at least one copy kept on-site. Here are some suggestions for formatting the maintenance plan:

- Format plans to 8½" x 11" to facilitate duplication, filing, and handling.
- Include the revision date in the footer on each page.

- Scan graphics and incorporate with text into a single electronic file. Keep the electronic file backed-up so that copies of the maintenance plan can be made if the hard copy is lost or damaged.

▶ STEP 6: UPDATES

Your maintenance plan will be **a living document**.

Operation and maintenance personnel may change; mechanical equipment may be replaced, and additional maintenance procedures may be needed. Throughout these changes, the maintenance plan must be kept up-to-date.

Updates may be transmitted to the local municipality at any time. However, at a minimum, updates to the maintenance plan must accompany the annual inspection report.

Stage 4: Interim Maintenance

Applicants will typically be required to warranty stormwater facilities against lack of performance due to flaws in design or construction. The warranty may need to be secured by a bond or other financial instrument.

Stage 5: Transfer Responsibility

As part of the detailed maintenance plan, note the expected date when responsibility for operation and maintenance will be transferred. Notify the municipality when this transfer of responsibility takes place.

Stage 6: Operation & Maintenance Verification

Each municipality implements an operation and maintenance verification program, including periodic site inspections.

Contact municipal staff to determine the frequency of inspections, whether self-inspections are allowed, and applicable fees, if any.

References and Resources

- *Urban Runoff Quality Management* (WEF/ASCE, 1998). pp 186-189.
- *Stormwater Management Manual* (Portland, 2004). Chapter 3.
- *California Storm Water Best Management Practice Handbooks* (CASQA, 2003).
- *Best Management Practices Guide* (Public Telecommunications Center for Hampton Roads, 2002).
- Operation, Maintenance, and Management of Stormwater Management Systems (Watershed Management Institute, 1997)

Bibliography

BASMAA. 1999. Bay Area Stormwater Management Agencies Association. *Start at the Source: Design Guidance Manual for Stormwater Quality.* Tom Richman and Associates. 154 pp. plus appendix.

BASMAA. 2003. *Using Site Design Techniques to Meet Development Standards for Stormwater Quality.* www.basmaa.org

CASQA. 2003. California Stormwater Quality Association. *California Stormwater BMP Handbooks.* Four Handbooks: *New Development and Redevelopment, Construction, Municipal, and Industrial/Commercial.* www.cabmphandbooks.org

County of San Diego. 2007. *Low Impact Development Handbook: Stormwater Management Strategies.*

Federal Interagency Stream Restoration Working Group. 1998. *Stream Restoration: Principles, Processes, and Practices.* http://www.nrcs.usda.gov/technical/stream_restoration/

Hampton Roads, VA. 2002. *Best Management Practices Guide.* Public Telecommunications Center. http://www.hrstorm.org/BMP.shtml

Low Impact Development Center. 2006. *LID for Big-Box Retailers.* 75 pp. http://lowimpactdevelopment.org/bigbox/

Maryland. 2000. State of Maryland. *Maryland Stormwater Design Manual.* www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater/stormwater_design/index.asp

Portland. City of Portland, OR. *2004 Stormwater Management Manual.* http://www.portlandonline.com/bes/index.cfm?c=35117

Prince George's County, Maryland. 1999. *Low-Impact Development Design Strategies: An Integrated Design Approach.* Department of Environmental Resources, Programs and Planning Division. June 1999. 150 pp. http://www.epa.gov/owow/nps/lid/

Prince George's County, Maryland. 2002. *Bioretention Manual.* Department of Environmental Resources, Programs and Planning Division. http://www.goprincegeorgescounty.com/Government/AgencyIndex/DER/ESD/Bioretention/bioretention.asp

Puget Sound Action Team. 2005. Low Impact Development Technical Guidance Manual for Puget Sound. http://www.psat.wa.gov/Publications/LID_tech_manual05/lid_index.htm

Riley, Ann. 1998. *Restoring Streams in Cities.* Island Press, Washington, DC. 425 pp. www.islandpress.org/books/detail.html?SKU=1-55963-042-6

RWQCB. 2007. California Regional Water Quality Control Board for the San Diego Region. Order R9-2007-0001 (Stormwater NPDES Permit) www.waterboards.ca.gov/sandiego/

Salvia, Samantha. 2000. "Application of Water-Quality Engineering Fundamentals to the Assessment of Stormwater Treatment Devices." Santa Clara Valley Urban Runoff Pollution Prevention Program. Tech. Memo, 15 pp. www.scvurppp-w2k.com/pdfs/9798/SC18.02finalTM.pdf

Schueler, Tom. 1995. *Site Planning for Urban Stream Protection.* Environmental Land Planning Series. Metropolitan Washington Council of Governments. 232 pp. www.cwp.org/SPSP/TOC.htm

Washington Department of Ecology. 2001. Stormwater Management Manual for Western Washington. www.ecy.wa.gov/biblio/9911.html

Watershed Management Institute. 1997. *Operation, Maintenance, and Management of Stormwater Management Systems.*

WEF/ASCE. 1998. Water Environment Foundation/American Society of Civil Engineers. Urban Runoff Quality Management. WEF Manual of Practice No. 23, ASCE Manual and Report on Engineering Practice No. 87. ISBN 1-57278-039-8 ISBN 0-7844-0174-8. 259 pp. Access: Order from WEF or ASCE, www.wef.org or www.asce.org.

APPENDIX—STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

How to use this worksheet (also see instructions on pages ___ of the *Countywide Model SUSMP*):

1. Review Column 1 and identify which of these potential sources of stormwater pollutants apply to your site. Check each box that applies.
2. Review Column 2 and incorporate all of the corresponding applicable BMPs in your Project-Specific SUSMP drawings.
3. Review Columns 3 and 4 and incorporate all of the corresponding applicable permanent controls and operational BMPs in a table in your Project-Specific SUSMP. Use the format shown in Table 3-1 on page __ of the *Countywide Model SUSMP*. Describe your specific BMPs in an accompanying narrative, and explain any special conditions or situations that required omitting BMPs or substituting alternatives.

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR STORMWATER CONTROL PLAN SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 **Potential Sources of Runoff Pollutants**	**2** **Permanent Controls—Show on SUSMP Drawings**	**3** **Permanent Controls—List in SUSMP Table and Narrative**	**4** **Operational BMPs—Include in SUSMP Table and Narrative**
❑ **A.** On-site storm drain inlets	❑ Locations of inlets.	❑ Mark all inlets with the words "No Dumping! Flows to Bay" or similar.	❑ Maintain and periodically repaint or replace inlet markings. ❑ Provide stormwater pollution prevention information to new site owners, lessees, or operators. ❑ See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com ❑ Include the following in lease agreements: "Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains."
❑ **B.** Interior floor drains and elevator shaft sump pumps		❑ State that interior floor drains and elevator shaft sump pumps will be plumbed to sanitary sewer.	❑ Inspect and maintain drains to prevent blockages and overflow.

APPENDIX—STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR STORMWATER CONTROL PLAN SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 **Potential Sources of Runoff Pollutants**	**2** **Permanent Controls—Show on SUSMP Drawings**	**3** **Permanent Controls—List in SUSMP Table and Narrative**	**4** **Operational BMPs—Include in SUSMP Table and Narrative**
❑ **C.** Interior parking garages		❑ State that parking garage floor drains will be plumbed to the sanitary sewer.	❑ Inspect and maintain drains to prevent blockages and overflow.
❑ **D1.** Need for future indoor & structural pest control		❑ Note building design features that discourage entry of pests.	❑ Provide Integrated Pest Management information to owners, lessees, and operators.
❑ **D2.** Landscape/ Outdoor Pesticide Use	❑ Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained. ❑ Show self-retaining landscape areas, if any. ❑ Show stormwater treatment facilities.	State that final landscape plans will accomplish all of the following. ❑ Preserve existing native trees, shrubs, and ground cover to the maximum extent possible. ❑ Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution. ❑ Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions. ❑ Consider using pest-resistant plants, especially adjacent to hardscape. ❑ To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.	❑ Maintain landscaping using minimum or no pesticides. ❑ See applicable operational BMPs in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com ❑ Provide IPM information to new owners, lessees and operators.

APPENDIX—STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR STORMWATER CONTROL PLAN SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 **Potential Sources of Runoff Pollutants**	**2** **Permanent Controls—Show on SUSMP Drawings**	**3** **Permanent Controls—List in SUSMP Table and Narrative**	**4** **Operational BMPs—Include in SUSMP Table and Narrative**
❑ **E.** Pools, spas, ponds, decorative fountains, and other water features.	❑ Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet.	❑ If the local municipality requires pools to be plumbed to the sanitary sewer, place a note on the plans and state in the narrative that this connection will be made according to local requirements.	❑ See applicable operational BMPs in Fact Sheet SC-72, "Fountain and Pool Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com
❑ **F.** Food service	❑ For restaurants, grocery stores, and other food service operations, show location (indoors or in a covered area outdoors) of a floor sink or other area for cleaning floor mats, containers, and equipment. ❑ On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.	❑ Describe the location and features of the designated cleaning area. ❑ Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.	❑

APPENDIX—STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR STORMWATER CONTROL PLAN SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 **Potential Sources of Runoff Pollutants**	**2** **Permanent Controls—Show on SUSMP Drawings**	**3** **Permanent Controls—List in SUSMP Table and Narrative**	**4** **Operational BMPs—Include in SUSMP Table and Narrative**
❑ **G.** Refuse areas	❑ Show where site refuse and recycled materials will be handled and stored for pickup. See local municipal requirements for sizes and other details of refuse areas. ❑ If dumpsters or other receptacles are outdoors, show how the designated area will be covered, graded, and paved to prevent run-on and show locations of berms to prevent runoff from the area. ❑ Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer.	❑ State how site refuse will be handled and provide supporting detail to what is shown on plans. ❑ State that signs will be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar.	❑ State how the following will be implemented: Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post "no hazardous materials" signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See Fact Sheet SC-34, "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com
❑ **H.** Industrial processes.	❑ Show process area.	❑ If industrial processes are to be located on site, state: "All process activities to be performed indoors. No processes to drain to exterior or to storm drain system."	❑ See Fact Sheet SC-10, "Non-Stormwater Discharges" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

APPENDIX—STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR STORMWATER CONTROL PLAN SHOULD INCLUDE THESE SOURCE CONTROL BMPs		
1 **Potential Sources of Runoff Pollutants**	**2** **Permanent Controls—Show on SUSMP Drawings**	**3** **Permanent Controls—List in SUSMP Table and Narrative**	**4** **Operational BMPs—Include in SUSMP Table and Narrative**
❑ **I.** Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)	❑ Show any outdoor storage areas, including how materials will be covered. Show how areas will be graded and bermed to prevent run-on or run-off from area. ❑ Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults. ❑ Storage of hazardous materials and wastes must be in compliance with the local hazardous materials ordinance and a Hazardous Materials Management Plan for the site.	❑ Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains. Where appropriate, reference documentation of compliance with the requirements of local Hazardous Materials Programs for: ▪ Hazardous Waste Generation ▪ Hazardous Materials Release Response and Inventory ▪ California Accidental Release (CalARP) ▪ Aboveground Storage Tank ▪ Uniform Fire Code Article 80 Section 103(b) & (c) 1991 ▪ Underground Storage Tank	❑ See the Fact Sheets SC-31, "Outdoor Liquid Container Storage" and SC-33, "Outdoor Storage of Raw Materials " in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

☐ **J.** Vehicle and Equipment Cleaning	☐ Show on drawings as appropriate: (1) Commercial/industrial facilities having vehicle /equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses. (2) Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited on-site and hoses are provided with an automatic shut-off to discourage such use). (3) Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area, and plumbed to drain to the sanitary sewer. (4) Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer, or a wastewater reclamation system shall be installed.	☐ If a car wash area is not provided, describe measures taken to discourage on-site car washing and explain how these will be enforced.	Describe operational measures to implement the following (if applicable): ☐ Washwater from vehicle and equipment washing operations shall not be discharged to the storm drain system. ☐ Car dealerships and similar may rinse cars with water only. ☐ See Fact Sheet SC-21, "Vehicle and Equipment Cleaning," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

❑ **K.** Vehicle/Equipment Repair and Maintenance	❑ Accommodate all vehicle equipment repair and maintenance indoors. Or designate an outdoor work area and design the area to prevent run-on and runoff of stormwater. ❑ Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas. ❑ Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained.	❑ State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area. ❑ State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements. ❑ State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.	In the SUSMP report, note that all of the following restrictions apply to use the site: ❑ No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinsewater from parts cleaning into storm drains. ❑ No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately. ❑ No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment.

❑ **L.** Fuel Dispensing Areas	❑ Fueling areas[1] shall have impermeable floors (i.e., portland cement concrete or equivalent smooth impervious surface) that are: a) graded at the minimum slope necessary to prevent ponding; and b) separated from the rest of the site by a grade break that prevents run-on of stormwater to the maximum extent practicable. ❑ Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area[1].] The canopy [or cover] shall not drain onto the fueling area.		❑ The property owner shall dry sweep the fueling area routinely. ❑ See the Business Guide Sheet, "Automotive Service—Service Stations" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

[1] The fueling area shall be defined as the area extending a minimum of 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus a minimum of one foot, whichever is greater.

❑ **M.** Loading Docks	❑ Show a preliminary design for the loading dock area, including roofing and drainage. Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct stormwater away from the loading area. Water from loading dock areas should be drained to the sanitary sewer where feasible. Direct connections to storm drains from depressed loading docks are prohibited. ❑ Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation. ❑ Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.		❑ Move loaded and unloaded items indoors as soon as possible. ❑ See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com
❑ **N.** Fire Sprinkler Test Water		❑ Provide a means to drain fire sprinkler test water to the sanitary sewer.	❑ See the note in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

O. Miscellaneous Drain or Wash Water ❑ Boiler drain lines ❑ Condensate drain lines ❑ Rooftop equipment ❑ Drainage sumps ❑ Roofing, gutters, and trim.		❑ Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system. ❑ Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system. ❑ Rooftop mounted equipment with potential to produce pollutants shall be roofed and/or have secondary containment. ❑ Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water. ❑ Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff.	
❑ **P.** Plazas, sidewalks, and parking lots.			❑ Plazas, sidewalks, and parking lots shall be swept regularly to prevent the accumulation of litter and debris. Debris from pressure washing shall be collected to prevent entry into the storm drain system. Washwater containing any cleaning agent or degreaser shall be collected and discharged to the sanitary sewer and not discharged to a storm drain.

Comment and Response Table for San Diego County Model SUSMP Update
Changes Made for the 2 January 2009 Version Noted in Italics

Comment	Response
Comments Submitted by NRDC/Coastkeeper	
I. Alternative Treatment Facilities	
The Model SUSMP on page 62 mentions that alternative treatment facilities are limited to certain circumstances and selection criteria, but this is an inadequate statement because there is no such discussion on the cross-referenced page 30, and the rest of the document does not identify any particular circumstances necessitating – or criteria for – alternative treatment options. It is critical that the Model SUSMP set forth specific and appropriate requirements for alternative compliance because this currently vague exception could become a massive loophole and defeat meaningful implementation of LID. Any alternative compliance options allowed by the Model SUSMP should ensure equivalent results in stormwater pollution reduction, and the process for determining the applicability of alternative compliance provisions should be clearly outlined.	The page reference in the Model SUSMP is in error. It should have been page 23, not page 30. See the section "Selection of Stormwater Treatment Facilities." *Corrected.*
The Model SUSMP should also be revised to include restrictive criteria for ensuring that alternative compliance is allowed only in situations of true infeasibility.	Decisions about the infeasibility of using LID facilities are made project-by-project by the individual Co-permittees. The Model SUSMP provides detailed guidance identifying project types that present special challenges to implementing LID (see p. 25) and a process for evaluating alternatives. *Section on waivers in Chapter 1 has been revised per follow-up discussion with NRDC/Coastkeeper.*
II. Water Harvesting and Reuse	
Throughout the Model SUSMP, water harvesting and reuse techniques receive scant attention and are inadequately described. Their potential for reducing stormwater runoff and pollutant loading, however, especially in areas with high impervious cover and/or significant concentrations of non-infiltrative soils, is enormous and should be highlighted. Overall, the Model SUSMP	Water harvesting and reuse goes beyond the mandate of the NPDES permit, and it may not be possible to incorporate development of standards, drawings, criteria, and specifications for water harvesting and reuse within the SUSMP. General ideas, examples, and references regarding water

Comment	Response
should mention such techniques much more frequently and emphasize their many beneficial applications in San Diego County.	harvesting and reuse can be added to the SUSMP. *Added to Chapter Four.*
Besides the Model SUSMP's general failure to promote water harvesting and reuse practices, the Model SUSMP's existing treatment of water harvesting is insufficient in two principal respects. First, the document provides specifications and drawings for relatively small-scale cisterns, neglecting the applicability of larger-scale water storage structures for larger buildings and developments. (See, e.g., Model SUSMP at 89-91). Examples like the King Street Center and Santa Monica Public Library, described below, demonstrate how stormwater runoff can be reduced very effectively through the use of water harvesting at sizeable sites. The Model SUSMP's criteria do not preclude the large-scale application of water harvesting, but the Model SUSMP does not indicate that such application is possible. This deficiency could be remedied by describing and providing drawings for (or at least examples of) larger cistern systems.	The cistern drawing on page 91 shows no scale. The required minimum cistern size is determined by the calculation specified in Equation 4-8, which is applicable to small and large systems.
Second, the document entirely neglects the possibility of designing water harvesting systems to reuse stormwater onsite and thereby significantly recue or even eliminate stormwater pollutant loading and offsite runoff. Many developers have installed rainwater recycling systems of this sort at various building scales. Santa Monica Public Library's main branch, for example, contains an underground reservoir that collects rainwater and can store 200,000 gallons for later reuse on the Library's landscaped areas. The King Street Center in downtown Seattle uses water captured from roof runoff to supply over 60 percent of the building's landscape irrigation and toilet flushing needs, saving approximately 1.4 million gallons of potable water per year. On a much smaller scale, NRDC's Southern California office drains roof runoff into two 1500-gallon cisterns that help us reduce our building's water	The NPDES permit does not mention water harvesting and reuse as an option for compliance. Also, and unfortunately, the stringent NPDES permit requirements for treatment and flow control severely constrain options for creating multiple-use facilities. The commenter may be underestimating the complexity and expense of designing, building, and operating reliable systems that will meet the stringent NPDES criteria for treatment and flow control and also provide water harvesting. The model SUSMP can incorporate mention the potential for water harvesting and reuse and refer the user to municipal staff for further information on local requirements. *Mention added to Chapter Four and Cistern Design Sheet.*

Comment	Response
consumption by about 60 percent through a graywater recycling system. The Carkeek Environmental Learning Center in Seattle similarly drains roof runoff into a 3500-gallon cistern for toilets. Even single-family homes can recycle graywater or, for far less cost, connect rain barrels to garden watering systems.	
The Model SUSMP's failure to describe water reuse opportunities is most apparent in the Design Sheets portion of Chapter 4, where the Model SUSMP provides detailed specifications for LID designs, including a "Cistern with Bioretention Facility," but does not mention the possibility of combining a cistern with a graywater recycling and/or landscape irrigation system. Instead, the design specifications state that "[a] cistern in series with a bioretention facility can meet treatment requirements where space is limited," and the Model SUSMP implies that this combination is the only suitable method for reducing polluted runoff (Model SUSMP at 89). However, for two reasons, a cistern linked to a graywater recycling system can function better in the dense urban areas for which the cistern-with-bioretention combination is apparently intended: (1) graywater recycling systems do not require the same landscaped areas as other LID practices and can be contained within structures, thus making them especially amenable to high-density/vertical developments and locations with high groundwater tables where other LID practices may be difficult to implement; and (2) cisterns linked to graywater recycling systems remove potential runoff from contact with any surface that could conceivably drain to receiving waters without adequate treatment.	The Model SUSMP could include mention of graywater recycling systems as a potential adjunct to the use of cisterns-plus-bioretention facilities for treatment and flow control. Implementation of graywater recycling would be subject to local requirements for approval, construction, operation, and maintenance of graywater facilities. *Included in concept in Chapter Four but avoided the use of the term "graywater" because it is easily confused with recycling of washwaters.*
For the preceding reasons, the Model SUSMP should be revised to place more emphasis on combining rainwater storage devices with onsite reuse systems. This requires adding specifications (or at least descriptions) for connecting cisterns to water reuse systems and not only to bioretention facilities. To this end, the Design Sheet on pages 89 to 91 should detail both such uses of harvested	Onsite reuse is a potential enhancement to facilities designed primarily for treatment and runoff control. However, implementation of onsite reuse systems goes beyond the mandate of the NPDES permit. General ideas, examples, and references regarding water harvesting and reuse can be added to the SUSMP. *Added to Chapter Four.*

Comment	Response
rainwater, and all references to this Design Sheet should indicate that water reuse is a viable option, in addition to bioretention. The Model SUSMP should also mention specifically that in areas with high concentrations of non-infiltrative soils, adopting stormwater capture and reuse designs enables developments to reduce or even eliminate polluted stormwater runoff. Such references could be inserted, for example, on page 36 (the description of soil types should mention that onsite water reuse is an option where soils are not amenable to infiltration), page 46 (stormwater capture and reuse should be listed within one of the "four LID strategies" for managing runoff), page 47 (Table 4.1 should describe a "stormwater capture and reuse system"), pages 48 to 51 (stormwater capture and reuse systems should be included in the analysis of optimizing site layout), and pages 51 to 60 (Capture and reuse systems should be described and accounted for in the section on developing and documenting drainage design).	
Table 2-1	
Based on our research and experience, virtually all urban runoff contains elevated levels of heavy metals, bacteria, and viruses, regardless of its source. We feel it is particularly unjustifiable to omit heavy metals from commercial land use and bacteria and viruses from streets, highways, and freeways. Additionally, runoff from landscaping generally contains pesticides, and restaurants and roadways often include landscaping. The table is missing an explanation of what the numerals 1 to 5 and letters "P" and "X" mean.	The footnotes were inadvertently left off the table. "X"s can be added where suggested. As noted on page 23, except in rare circumstances, the use of the LID Design Guide and Pollutant Sources/Source Control Checklist will ensure specific projects comply with all stormwater requirements. *Added as noted.*
Table 2-3	
We believe that dry ponds should not be rated "high" in any category of pollutant removal and that media filters should not be rated "high" for fine particles. Bioretention units can be "high" for removing dissolved pollutants if they infiltrate or evapotranspirate all or the vast majority of runoff. We are not sure what the table	Settling basins (dry ponds) are generally regarded as effective in removing fine sediments if they are properly designed. Available data on performance of facilities tends to back this view. Although bioretention facilities can sometimes infiltrate or evapotranspirate most runoff, their overall application in San

Comment	Response
means by "high-rate" biofilter or media filter, and these should be more concretely defined in order to distinguish them from standard biofilters and media filters.	Diego County will be in clay soils with limited surface area, in which case underdrain flows will carry some dissolved pollutants. Table 2-3 can include a cross-reference to the list on page 26 and make it more clear that "higher rate" (rather than "high-rate") filters and biofilters are those with a surface loading rate much greater than the 5 inches per hour design criterion. *Cross reference added.*
Proprietary Devices	
The Model SUSMP leaves the status of proprietary devices too loose and ill-defined. On page 26, the Model SUSMP simply directs developers to "[c]onsult with municipal staff before proposing these devices." Rather than providing such vague guidance, the Model SUSMP could list proprietary devices that have been shown – by rigorous, independent testing – to meet the objectives of municipally approved practices, if any such devices exist. This exercise would involve some research and coordination and would likely not lead to much benefit, so recommend instead that the Model SUSMP limit the use of proprietary devices to pretreatment alone, unless a proponent submits complete documentation proving that a selected device can meet the objectives of the Permit and Model SUSMP.	The section on the "Selection of Stormwater Treatment Facilities," beginning on page 23, includes criteria to ensure the use of the most effective treatment facilities practicable on a given project. The mention of proprietary devices on page 26 is intended to direct applicants to check with municipal staff and not rely on the representation of company sales representatives regarding the acceptability of their product to meet NPDES and local requirements.
Rational Method	
On page 27, the Model SUSMP describes the rational method as the means of calculating peak runoff flow and total runoff volume. However, the rational method is a very poor basis for the design of flow-through systems. Although computerized continuous simulation hydrologic modeling may not be financially feasible everywhere, there are better methods (e.g., the Santa Barbara Urban Hydrograph).	The rational method is mentioned on page 27 only to illustrate the relationship between imperviousness and peak runoff flow. The NPDES permit specifies the rainfall intensity to be used in calculating runoff flows for flow-based treatment controls.
Limitations on Infiltration	
The Model SUSMP (pages 30 to 31) perpetuates limitations on infiltration that hydrologists have questioned for years, specifically	The section "Criteria for Infiltration Devices" reflects the restrictions of the NPDES Permit section "Infiltration and

Comment	Response
the notions that certain land uses should not be allowed to infiltrate stormwater and that there must be a 10-foot minimum spacing to seasonal high groundwater. Such blanket statements take no account of site-specific hydrogeologic factors. The key factors are the depth and characteristics of the soil medium before it reaches groundwater. Regarding land uses, a recent study of six sites in Southern California has shown that, in most cases, all land uses – even polluted industrial facilities – can safely infiltrate stormwater without polluting local groundwater supplies. Regarding the issue of spacing, the infiltration facility is safe if there are reliable, site-specific data demonstrating that the seasonal high water table approaches no closer than four feet. Ultimately, these limitations matter much less in this context than they have in other contexts because the Model SUSMP defines many LID designs as non-infiltration-based and therefore not subject to the land use and spacing restrictions, but we believe that the Model SUSMP should, nevertheless, reflect the current understanding of limitations on infiltration.	Groundwater Protection."
Soils and Hydrogeological Information	
Chapter 3, particularly Steps 1 and 2 (pages 35 to 37), fails to place enough emphasis on obtaining thorough, site-specific soils and hydrogeological information as a basis for selecting and designing LID features. The City of Santa Barbara's *Post-Construction Stormwater Best Management Practices (BMP) Manual*, Chapter 3, provides an excellent reference for soil and infiltration assessment, as well as for other stormwater management issues.	The referenced material includes typical procedures, which can also be found elsewhere, for measuring infiltration rates of soils. The Model SUSMP guides applicants to lay out the site to: "Concentrate development on portions of the site with less permeable soils, and preserve areas that can promote infiltration," as well as minimizing grading, preserving vegetation, and setting back development from creeks, wetlands, and riparian habitats. In practice, most small development and redevelopment sites have been previously graded and compacted, or are to be graded and compacted in connection with the project. The Model SUSMP emphasizes the use of underdrained bioretention facilities and planter boxes. These facilities work by allowing infiltration to occur, but also

Comment	Response
	ensuring remaining runoff is detained and treated prior to outflow via the underdrain. This approach ensures compliance with NPDES treatment and flow-control requirements using conservative assumptions about how much infiltration will actually occur.
"Self-Retaining" and "Self-Treating" Areas	
The Model SUSMP characterizes turf, gravel, and vegetated roofs as "self-retaining," which is defined as retaining the first one inch of rainfall without producing any runoff (Model SUSMP at page 53). We agree that under such conditions, turf and vegetated roofs could be "self-retaining." However, the "Analyze Your Project for LID" section on page 46 should cross-reference the definition of "self-retaining" so that its meaning is clear in this context. Additionally, turf and vegetated roofs must be properly designed, constructed, operated, and maintained in order to be and to remain self-retaining. The Model SUSMP needs tighter specifications in this respect – although Chapter 5 discusses operation and maintenance requirements, it includes no detail regarding specific LID features. Gravel, on the other hand, tends to become highly compacted with any substantial weight loading, and thus no gravel area with vehicle traffic would remain self-retaining unless it were excavated an replaced periodically, which would likely not be economically feasible for many property owners.	A note can be added on page 46 to cross-reference the explanation of "self-retaining" on page 53. *Added.* Maintenance fact sheets have yet to be prepared and added to the Project Clean Water web site. For green roofs, maintenance recommendations will defer to the manufacturer's or installer's instructions. If properly designed and installed, gravel (crushed aggregate) retains its permeability when compacted. In general, a gravel section properly designed to withstand vehicle loading will be more than 2.5 inches deep and will retain more than an inch of rainfall. Among the Copermittees, current policies vary regarding verification of operation and maintenance of stormwater management features that are not treatment facilities (for example, reducing runoff by limiting paved area and using permeable pavements, as opposed to treatment facilities such as bioretention areas and sand filters). This variation in policy will be noted in the forthcoming model SUSMP, and Copermittees will discuss whether it is possible to develop more consistent policies to be incorporated in a future revision to the SUSMP. *Variation in policy noted in the introductory paragraph in Chapter Five.*
The "self-treating" concept (page 52) is more problematic than the	Criteria for self-treating areas are provided on pages 65-66. A

Comment	Response
"self-retaining" concept because the Model SUSMP provides no criteria for ensuring that "self-treating" areas will result in pollution reduction equivalent to retaining the first one inch of rainfall, as required for "self-retaining" areas. In fact, the description of "self-treating" areas includes no specification at all, and thus there is nothing to guide developers in deciding what qualifies as a self-treating area and how well that area must perform in mitigating stormwater pollution and runoff. To ensure the desired (and legally required) benefits of LID implementation, the Model SUSMP should include design criteria for self-treating areas akin to the design criteria for self-retaining areas.	cross-reference can be added to page 52. *Cross-reference added.* The concept of self-treating area is important to LID design and implementation. Drainage from roofed and paved areas needs to be routed through treatment and flow-control facilities such as bioretention, but drainage from pervious landscaped areas does not need to be so managed if it is kept separate.
Runoff Factors	
In Table 4-2, it does not make sense that amended, mulched soil and landscaping should both have runoff factors of 0.1. Landscaping can be on poor, highly compacted soil and thus generate significantly more runoff than properly amended, mulched soil. These factors probably result from the rational method and incorporate its over-simplicity.	The runoff factors are specific for surfaces draining to treatment facilities. These facilities are designed to handle runoff from small storms, in which case the 0.1 runoff factor is appropriate for landscape generally. When the SUSMP is updated to incorporate flow-control (HMP) requirements, which address larger storms as well as small storms, it may be necessary to develop separate runoff factors for different types of soils.
Underdrains	
Although the Model SUSMP would require underdrains on Group "C" soils (page 74), Group "C" soils do not always necessitate underdrains for two reasons: 1) site-specific soils are frequently very different from the soils shown on soil classification maps; and 2) bioretention systems with properly constructed, amended soils have performed well on ostensibly C soils. This problem highlights the lack of appropriate soil and hydrogeological information-gathering requirements identified above.	Underdrains are recommended for facilities built on "C" soils to ensure against standing water, which could result in boggy conditions and mosquito harborage. If infiltration to native soils turns out to be at a higher rate, the underdrains will simply flow less often.
Comments Submitted by the San Diego Regional Water Quality Control Board	
1. The Draft does not emphasize avoidance of receiving waters,	The language in Section E.10 of the NPDES Permit can be

Comment	Response
nor does it explicitly prohibit the use of receiving waters for urban runoff treatment. Section E.10 of the MS4 permit provides that "[u]rban runoff treatment and/or mitigation must occur prior to the discharge of urban runoff into a receiving water." The draft should be modified accordingly, to reflect this requirement.	added to the SUSMP. *Added.*
2. Maintenance of treatment control BMPs is not specified in the Draft. Sections D.1.d(6)(d) and D.1.e(2)(d) of the MS4 permit require the Copermittees to ensure approved treatment control BMPs are effectively operated and maintained by a responsible party. The Draft should be modified to incorporate these requirements.	See Chapter 5, beginning on page 93 of the SUSMP.
3. The Copermittees use the word "may" throughout the Draft when a requirement is needed for compliance with the MS4 permit. For example, on page 40, the "municipality may require that the applicant submit financial assurances, acceptance of responsibility, and an outline of general maintenance or a detailed maintenance plan and schedule." In this instance the Regional Board considers assurances and plans as necessary to evaluate compliance with the MS4 permit. The Draft should clearly identify that actions mandated for MS4 permit compliance are required actions that "must" be done.	The section on page 40 will be edited to clarify what is required by the permit, what options the Copermittees may use to meet those requirements, and the options regarding the form and timing of submittal requirements different Copermittees may choose to employ. The draft will be reviewed for other instances where these distinctions can be clarified. *Section edited as described.*
4. The Priority Development Projects listed on Table 1-1 of the Draft need to be modified to include pollutant generating projects that result in the disturbance of one acre or more of land (within three years of the adoption of the MS4 permit), as required by Section D.1.d.(1)(b) of the MS4 permit.	As the permit section cited notes, the Copermittees may collectively identify a different threshold. This can be addressed in an update to the model SUSMP or a revised SUSMP to be published by January 2010.
5. Additionally, Table 1-1, Section I, should be clarified to include driveways in addition to "streets, roads, highways, and freeways."	Table 1-1 reflects the language in the NPDES permit.
6. The text on page 4 states, "See Selection of Treatment Facilities on page 30." However, page 30 does not include the reference title or related information. It appears that reference is incorrect and should refer the reader to page 23, "Selection of Stormwater	The reference will be corrected. *Corrected.*

Comment	Response
Treatment Facilities."	
7. The hydromodification management exemption conditions on page 12 are taken from Section D.1.g.(3) of the MS4 permit. In number 3, modify "watershed" to "sub-watersheds" and include the language "and the potential for single project and/or cumulative impacts is minimal." Modifying the text in this manner will make the Draft consistent with the MS4 permit, and will help clarify which locations apply.	This language can be added. *Added.*
8. The hydromodification management exemption conditions should also include the final sentence of Section D.1.g.(3) of the MS4 permit, which states "[h]owever, plans to restore a channel reach may re-introduce the applicability of HMP controls, and would need to be addressed in the HMP." The inclusion of this language will clarify when the exemption applies, and prompt the applicant and the Copermittees to investigate channel restoration activities that are planned or in progress, to apply HMP controls accordingly.	This language can be added. *Added.*
9. Table 2-1, on page 21 does not define the variables used inside the table. Definition of the variables P, X, P(1), P(2), P(3), P(5), X(4), and X(4)(5) is needed to understand the table.	The footnotes were inadvertently omitted and can be restored. As noted on page 23, except in rare circumstances, the use of the LID Design Guide and Pollutant Sources/Source Control Checklist will ensure specific projects comply with all stormwater requirements. *Corrected as noted.*
10. Also in Table 2-1, the Copermittees should consider inclusion of heavy metals from commercial land uses; bacteria and viruses from streets, highways and freeways; and pesticides from restaurant landscaping. The rationale and selection process should be evident to ensure that all anticipated and potential pollutants by land use are being addressed.	"X"s can be added where suggested. *Added, except noted the potential for pesticides is related to whether or not landscaping is part of the project.*
11. Page 45 instructs the reader to analyze their project and select options for implementing LID techniques to "meet runoff treatment	At present flow-control requirements apply only to projects 50 acres and larger. SUSMP references to flow control

Comment	Response
requirements-and flow control requirements; if they apply." Modification of the language from "if they apply" to "unless exempted", and referencing the page where the exemptions and criteria are located (e.g. page 12) will emphasize that LID techniques always apply unless the specific criteria for exemption are met.	requirements will be updated following approval of the HMP by the Regional Water Board.
12. The numbered list on page 48 indicates the order of impacting and conserving natural areas. This list does not take into account that nun1ber 2 can occur in areas that may be delineated as wetlands and may also be the habitat of sensitive species. For clarification, number 2 should be modified to include "where receiving waters are not present."	The language can be added. *Added.*
13. The last bullet on page 50 states: "Planter boxes and bioretention areas must be level or nearly level all the way around." Modification of the language to remove "or nearly level" will add consistency to the level requirement found on page 41 for the top edge of bioretention facilities.	As a practical matter, the top edge needs only be nearly level. There needs to be some flexibility in design criteria. As noted, swales may be gently sloped in the linear direction. Bioretention areas may also be gently sloped in the direction of flow.
14. The title of Step 7 in Chapter 4, page 59 states: "Determine If Available Space For IMP Is Adequate." Modification of the language to change "If" to "Where" will add emphasis that space cannot be a limiting factor in determining the type of treatment facilities to be utilized. As stated on page 25, "lack of space, in itself, is not a suitable justification for using a less-effective treatment on a development site... "	The design process involves developing a site plan with IMPs, checking to see if the IMP area is sufficient, and iterating until an acceptable plan is achieved. This is detailed in the text.
15. Page 12 contains Option 3: Exemption From Hydromodification Management. Clarification is needed to further define what is covered under a channel that is concrete lined or significantly hardened. It is not clear whether this exemption includes channels that are over 90 percent concrete lined or hardened, but contain earthen banks and/or bottoms in one or more portions. It is also unclear whether this exemption includes channels that have hardened banks in their entirety, but have	As noted in the earlier comment, the language here is taken from permit section D.1.g.(3).

Comment	Response
earthen bottoms in their entirety. As mentioned previously, channels and creeks that have restoration plans will reintroduce the applicability of HMP controls.	
16. Clarification as to what is meant by "wetlands" in column four of Table 2-3 and the third bullet of page 24 is needed. It is anticipated that these wetlands are artificial and/or constructed. Clarification in the table and in the bullet item provides another opportunity to emphasize that receiving waters cannot be used as treatment facilities and that runoff entering those waters must first be treated. Also note that in the title of Table 2-3, the font size of the last four words does not match the all caps format.	The heading can be changed to read "constructed wetlands." *Changed as noted.*
17. A reference for the determination of the effectiveness of the treatment facilities in Table 2-3 on page 24 is needed to understand how each facility received its rating.	See Salvia, Samantha (2000), referenced and hyperlinked in the Bibliography. This reference can be included in a "References and Resources" section that could be added to Chapter 2. *Added*
18. Page 36/37, Step 2: Identify Constraints and Opportunities needs clarification on what is meant by "open space and buffers (which can double as locations for bioretention facilities)." Natural buffers are essential to the health of wetlands and stream corridors and should be avoided as locations for concentrated pollution assimilation. The Draft should either remove reference to buffers altogether, or prioritize opportunities in a manner that would deter applicants from using natural buffers where other opportunities are present.	The text states: "…easements and landscape amenities including open space and buffers (which can double as locations for bioretention facilities)…" The text can be revised to note explicitly that this does not included protected riparian areas. In some cases, setbacks from riparian areas are appropriate locations for bioretention facilities. *Revised as noted.*
19. The adopted TMDL list on page 22 does not include the recently adopted Bacteria TMDL for Beaches and Creeks. The inclusion of this TMDL will provide a more accurate and up to date list of adopted TMDLs in the San Diego area.	The recently adopted TMDL can be added to the list. *Added.*
20. In consideration of San Diego's climate and water shortage, the Draft should promote the use of water harvesting, even when not required, for reuse by providing additional information about existing collection alternatives; both large, and small-scale. Chapter 4 provides an opportunity to expand on these techniques.	The NPDES permit does not mention water harvesting and reuse as an option for compliance. Also, and unfortunately, the stringent NPDES permit requirements for treatment and flow control severely constrain options for creating multiple-use facilities. The model SUSMP could incorporate mention the

Comment	Response
	potential for water harvesting and reuse while noting the difficulties involved and referring the user to municipal staff for further information on local requirements. *Done – Chapter Four and Cistern Fact Sheet.*
21. A definition of high-rate biofilters, referenced in Table 2-3, is not provided in the Draft or the Glossary. Providing a definition of this type of treatment BMP will provide clarity as to what constitutes a high-rate biofilter.	This can be added. As may be clear from the prioritized list on page 26, this refers to a filter with a surface loading rate greater than the criteria provided for bioretention areas and sand or media filters. *Added.*
22. The concept of self-treating areas should be defined in the Glossary.	Self-treating areas are natural, landscaped, or turf areas that drain directly off site or to the public storm drain system. This definition can be added to the glossary. *Added.*
23. The definition of "entire project area", which is bolded and emphasized on page 52, should be included in the Glossary.	The entire project area comprises all areas to be altered or developed by the project, plus any additional areas that drain on to areas to be altered or developed. This definition can be added to the glossary. *Added.*
24. "Proprietary storm water treatment facilities" are not defined in the Glossary or the Draft. A definition of this term would provide clarity.	A proprietary device is one marketed under legal right of the manufacturer. "Proprietary" can be defined in the glossary. *Added.*
25. The Glossary is lacking the definitions of multiple terms used throughout the Draft. Including the aforementioned examples, the Glossary should contain the definitions of all terms in the Draft that are bolded, emphasized, or used frequently in the document in order to provide consistency throughout the document.	In many cases, commonly used terms are bolded for emphasis. If there are additional terms the reviewer believes require further definition, these can be added to the glossary.
Comments Submitted by Vaikko Allen, Contech Stormwater Solutions	
Glossary - Impracticable. Either remove this definition or disclose the "set criteria" referenced. This definition mentions "set criteria" to determine if an onsite treatment facility is infeasible. These criteria are not established in the manual. They should either be established with adequate justification or this phrase should be	Did not find the term "impracticable" in a search of the document.

Comment	Response
removed.	
Glossary - Indirect Infiltration. Remove this term. This is a misleading term. Passage of water through a soil medium and subsequent collection and discharge of that water is more accurately termed filtration. To emphasize the biological component it could also be called biofiltration. The term infiltration is conventionally reserved for water entering soil that is dispersed in the interstitial pore spaces of that soil, and is thereby removed from the storm runoff volume.	Did not find the term "indirect infiltration" in a search of the document.
Glossary – Infiltration Device. Change to " Any BMP that is designed to infiltrate stormwater into the subsurface such that the volume of infiltrated water is prevented from entering a downstream conveyance system or groundwater table prior to travel through at least 10' of soil. Self retaining areas with a drainage area less than 2x the infiltrating area are not considered infiltration devices." The definition given makes a distinction between the "natural groundwater protection" afforded by surface or near-surface soils and subsurface soils. There is no basis given for this distinction. On the contrary, it has been demonstrated that percolation of stormwater through subsurface soil is cleansing and generally results in satisfactory water quality. The final report of the Water Augmentation Study initiated by the Los Angeles and San Gabriel Watershed Council is a good reference on the subject. http://www.lasgrwc.org/WAS/Documents/WAS%20Phase%20II%20Final%20Report%20Summary.pdf	The proposed revised definition seems inconsistent with the requirements in Provision D.1.d.(12) of the permit.
Glossary – Retention. Add "within berms or depressed areas" to the definition after "basins". By the existing definition, bioretention would not be retention. The proposed definition is more consistent with the definition of "Detention."	This language can be added to the definition. *Added.*
Glossary – general. Clarify the role of conventional water quality swale as described in most BMP manuals and the CASQA Handbook for New Development and Redevelopment. The term	A brief discussion of conventional vs. bioretention swales can be added to Chapter 4. Bioretention swales have generally supplanted conventional swales because (1) conventional swale

Comment	Response
swale appears several times in this manual, yet it is not defined. As conventionally designed to convey flow at a depth slightly lower than the vegetation length and with a residence time of 7+ minutes, it appears to have no role. It would not be considered a self treating or self retaining area. It seems that its role would be limited to conveying water to bioretention areas or flow through planters. This should be clarified.	design has resulted in standing water and associated nuisances, (2) conventional swales often don't obtain the required residence time and length because runoff must enter the swale at the upstream end, and (3) a bioretention swale provides more flexible drainage design and more effective treatment within the same footprint. *Discussion added to Chapter Four.*
Page 2, Bullet 2. Change to "Assuming exclusive use of BMPs providing no runoff reduction will be adequate for compliance." To suggest that a BMP is inadequate simply because it is proprietary ignores more relevant factors like its runoff reduction and quality improvement capabilities. Permeable pavements, green roofs and other LID IMPs could be considered to be proprietary and would seem to be discouraged. I assume that the intent here is to get designers to focus on runoff reduction rather than the exclusive use of treatment controls.	The existing language is needed to counter inaccurate information delivered to developers by purveyors of proprietary stormwater treatment facilities. The language is intended to convey to applicants that they should check the salesperson's claims with municipal staff rather than assuming those claims are correct.
Page 7, bold text. Change to "stormwater treatment, detention and infiltration facilities..." I assume that the intent here is to put controls that need maintenance in an area where they can be accessed and are not prone to disruption (regrading, removal, fertilization etc.) by land owners. If so, the same logic should apply to all IMPs and BMPs.	The reviewer may be commenting on a draft previous to the 24 July 2008 submittal. Could not find the referenced language on page 7. The bolded language on p. 9 can be changed to "stormwater treatment, infiltration, and flow-control facilities should not be located on individual single-family residential lots."
Page 11 - Waiver section. Either remove entire paragraph starting "Experience has shown..." or change to "Chapter 4, or other on site BMPs are feasible..." LID BMPs listed in chapter 4 are not the only means of treating stormwater to the MEP. Where LID options are not feasible, alternative treatment controls may be used that provide sufficient treatment to avoid the requirement of a waiver.	(Page 13). The countywide SUSMP reflects the policy that LID facilities are to be used for stormwater treatment wherever feasible. The section "Selection of Stormwater Treatment Facilities," which is referenced here, provides instructions for evaluating the use of other options in specified circumstances where it may be infeasible to implement LID facilities.
Page 14 - Water Quality Regulations section. Check grammar on the fourth bulleted item.	(Page 16). Grammar seems OK, but we are open to suggestions.
Page 15 – Maximum Extent Practicable section. Add "including	This change can be made. *Done.*

Comment	Response
LID facilities, have proven..." This addition is needed to distinguish between structural LID elements and non-structural planning and design elements.	
Page 15 – Maximum Extent Practicable section. This section states: "The NPDES permit includes various standards, including hydrologic criteria, which have been found to comprise maximum extent practicable". Please list these criteria. No performance criteria are given in this section. Instead, manual users are directed to follow the SUSMP design procedures in chapter 4 which include only select LID facilities. This approach does not promote innovation and unnecessarily constricts design options. This section should clarify what runoff reduction and water quality goals must be met for a site to meet the MEP standard. This manual seems to interpret MEP based on whether or not the specific LID framework presented in chapter 4 is followed. This framework may be preferred by the writers of this manual, but there are other methods of controlling runoff volumes and improving water quality that may be preferable to design engineers. This section should make it clear that any option that meets specific performance criteria are acceptable. Such performance criteria may include meeting interim and final hydromodification criteria and providing medium to high reduction in loads of pollutants of concern.	The quoted statement reflects a legal opinion provided to the State Water Board which states the hydraulic sizing criteria for treatment facilities in the NPDES permit constitute "maximum extent practicable."
Page 21 - Table 2-2. This table should be removed and replaced with a unit process based BMP matrix. At least, tables 2-2 and 2-3 should be replaced by table 4.3 from the former SUSMP. This table is far too general. For example, treatment may mean screening, filtration, gravitoidal separation, chemical treatment or biological treatment. This table doesn't distinguish between those unit processes which all have different effects on different pollutants. It also does not differentiate between forms of pollutants. For example, particulate metals and particulate organic	The comment seems to state that particulate pollutants associate with small particles and dissolved pollutants do not. This is self-evident. More to the point is that some stormwater pollutants tend to associate with small particles during treatment. The ability of a process to remove small particles is a good predictor of whether that same process will be effective in removing those pollutants. This is what is conveyed in Table 2-2. As stated elsewhere, the need for this simple analysis is obviated

Comment	Response
matter may be adequately removed by sedimentation or filtration. The dissolved forms of these pollutants may persistent after treatment by those means, but may be removed through chemical and/or biological means. A thorough discussion of a unit process based design approach which would be consistent with the San Diego permit requirements can be found in the 2005 WERF publication "Critical Assessment of Stormwater Treatment and Control Issues" by Strecker et al.	by the requirement to use LID facilities where feasible and by the requirement to implement the source controls in the Appendix. Presentation of a more thorough analysis does not seem warranted.
Page 22 - Table 2-3. This table should be removed and replaced with a matrix that includes various BMPs and their unit process. Or, alternately it can table 2-2 should be removed and replaced by table 4.3 from the previous SUSMP. There are several problems with this table. The treatment facility types are undefined. High, Medium and low performance levels are not defined and there is no documentation of BMPs ability to meet these goals. The last column groups trash racks and hydrodynamic devices (HDS) together which are two fundamentally different processes. HDS units may be sized to have a significant impact on sediment as fine as about 50 microns and associated pollutants. They can also be designed to remove oil and grease with high efficiency. A trash rack has neither of these capabilities.	Tables 2-2 and 2-3 are taken from the updated model SUSMP submitted in January 2008 in accordance with Provisions D.1.d.(7) and (8) of the NPDES permit. Although simple in concept, the tables provide sufficient rationale for the Copermittee's determination regarding the selection of stormwater treatment facilities.
Page 22 - Research and regulatory paragraph. Remove this section. The determination of MEP is to be made on a case by case basis. If there is a performance threshold that has been determined to be less than MEP, it should be noted. It is conceivable that some hydrodynamic separators (HDS) may be suitable where coarse sediment, trash, debris and oil and grease are the only primary pollutants of concern. Effectiveness for these units is primarily a function of sizing, which should be scrutinized. It would be appropriate to say that HDS systems are not suitable for the removal of fine sediment, dissolved pollutants, bacteria, organic compounds etc., however the information in tables 2-2 and 2-3	Again, the reviewer may be referring to an earlier draft of the model SUSMP. It may be conceivable, but seems rather unlikely, that it would be appropriate to discharge urban runoff to receiving waters without consideration of the need to reduce, to the maximum extent practicable, heavy metals and bioaccumulative pollutants.

Comment	Response
should make this point obvious. Especially if these tables are revised to relate unit processes to the various pollutants, it will be clear that HDS units are not adequate stand alone treatment on nearly all sites. Catch basin inserts are a different type of technology from HDS systems that should be treated separately. Some include filters and can be effective at very low loading rates and with very low pollutant loads. However they are rarely sized to operate in this effective range and present an onerous maintenance burden that is rarely met. Based on repeated observations of performance and operational failures, and lack of adequate maintenance, it is more appropriate to categorically reject these BMPs for stand alone use. I am not aware of similar endemic performance and operational failures for HDS units.	
Page 22 - "Underground Vault" paragraph. Remove the sentence: "Because vaults may be "out of sight, out of mind"…. This problem is not unique to underground vaults. A lack of maintenance across all BMP types is observed throughout California and is noted in the 2006 blue ribbon panel report on the feasibility of numeric limits as a primary cause of persistent water quality degradation. New tracking and Reporting criteria in the NPDES permit are designed to address this issue.	The sentence reflects reported experience in Denver, CO, Prince Georges County, MD, and elsewhere. Although the maintenance verification program required by the permit will no doubt reduce the incidence of unmaintained facilities overall, there will still be substantial maintenance verification advantage to having facilities on the surface and visible.
Page 24 – Proprietary Devices note. Change to read "…proprietary treatment devices do not meet…" The recommendation that design engineers consult with municipal staff is not practical since most staff will not review the use of a product without seeing how it will be used on a site. As written, this paragraph would also encourage design engineers to consult with staff where any proprietary device will be used. Some instances where that is not necessary include but are not limited to the use of proprietary infiltration BMPs, alternative paving materials and HDS units as pretreatment for	The existing language is needed to counter inaccurate information delivered to developers by purveyors of proprietary stormwater treatment facilities. The language is intended to convey to applicants that they should check the salesperson's claims with municipal staff rather than assuming those claims are correct.

Comment	Response
landscape based IMPs.	
Page 26 - "The 0.2 inches" paragraph. Details regarding verification of the 5"/hr infiltration rate are needed. Whose responsibility is it to verify that the 5"/hr infiltration rate is met? Is it enough to call for "engineered soil with 5"/hr infiltration capacity" on a set of plans or does that rate have to be measured prior to the completion of the construction phase? Is there a soil infiltration rate inspection protocol that can be referenced? Without requiring some quality control check at some point, a contractor is likely to import soil with unknown chemical and physical properties and compact it to a point where it loses its permittivity. Since the effectiveness of both IMPs currently listed in this manual hinge on this property, it must be verified. Ability to control construction material quality, compaction and proper design should be required where these BMPs are specified.	The reference here is to a maximum design surface loading rate, not an infiltration rate. The commenter is correct that the quality of the soil mix supplied must be subject to verification during construction.
Additional Comments and Responses Developed in a 4 December 2008 Conference Call with NRDC and Coastkeeper including discussion and resolution of comments in the NRDC/Coastkeeper 7 November 2008 letter and attachments.	
On page 13, under the heading "Waivers from Treatment Requirements," change "stormwater treatment requirements" to "numeric sizing requirements" to be consistent with the NPDES permit.	*Change made.*
On page 13, bring forward some of the discussion from Chapter 2 regarding selection of stormwater treatment facilities.	*Discussion on page 13 revised to clarify that applicants should first consider LID, then, in the specified special situations, consider the options listed in Chapter 2.*
Add within the SUSMP a recommendation that municipalities review their codes for possible revisions that would remove barriers to implementing LID.	*Bullet added in Chapter 3, Step 1.*