STORMWATER TECHNICAL GUIDE FOR LOW IMPACT DEVELOPMENT

Compliance with

Stormwater

Post-Construction

Requirements for the

Monterey Regional Stormwater Management Program (MRSWMP)

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PREFACE

In 1987, Congress amended the Clean Water Act to mandate controls on discharges from municipal separate storm sewer systems (MS4s). Acting under the Federal mandate and the California Water Code, California Water Boards issue National Pollutant Discharge Elimination System (NPDES) permits that require cities, towns, and counties to regulate activities which can result in pollutants entering their storm drains.

Municipalities implement comprehensive stormwater pollution-prevention programs. Municipal staff uses Best Management Practices (BMPs) when maintaining their own streets, storm drains, and municipal buildings. They inspect businesses and construction sites, enforce when pollutant discharges are found, educate the public, and monitor the storm drain system and receiving waters.

The comprehensive municipal programs have long included controls on new development projects. As conditions of municipal approvals and permits, development projects must control pollutant sources and reduce detain, retain, and treat specified amounts of runoff.

In July 2013, the Central Coast Water Board adopted Order R3-2013-0032, with new, more stringent Post-Construction Requirements (PCRs). Projects that receive their first discretionary approval for design elements (for example, building footprints, drainage features) after March 6, 2014—or if no discretionary approval is required, receive their first ministerial permit after that date—are subject to the PCRs, if they create or replace 2,500 square feet or more of impervious area.

The PCRs mandate that development projects use Low Impact Development (LID) to detain, retain, and treat runoff. LID incorporates and conserves on-site natural features, together with constructed hydrologic controls to more closely mimic pre-development hydrology and watershed processes.

The process of designing, checking, and building LID features and facilities into development projects can be complicated. In particular, it can be difficult to quantify the amount of runoff proposed features and facilities can detain, infiltrate, or treat and to show the LID design meets the criteria in the PCRs.

The Monterey Regional Stormwater Management Program (MRSWMP) would like to thank and recognize the County of Santa Barbara who obtained a grant, funded by Proposition 84 and administered through the State Water Resources Control Board, to facilitate implementation of the PCRs. The grant funds enabled preparation of this *Stormwater Technical Guide*, a sizing calculator, templates, and other associated tools.

Applicants for development approvals in the jurisdictions on the previous page should use this *Guide* when preparing Stormwater Control Plans. However, local requirements vary. Check with staff in the jurisdiction where your project is located to identify differences that may apply. A pre-application meeting is recommended for all projects subject to the PCRs.

Links

Monterey Regional Stormwater Management Program http://www.montereySEA.org

Central Coast Regional Water Quality Control Board www.waterboards.ca.gov/centralcoast

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B. Bioretention Construction Inspection Checklist

C. Technical Criteria for Non-LID Treatment Facilities

Resources

Available at *www.montereySEA.org*

Stormwater Control Plan Template and Directions for Tier 1 Projects

Stormwater Control Plan Template for Tier 2 and Tier 3 Projects

Stormwater Control Measure Sizing Calculator

Operation and Maintenance Forms

Acronyms

APN	Assessor's Parcel Number
BMP	Best Management Practice
CCRs	Covenants, Conditions, and Restrictions
CDP	Census-Designated Place
DMA	Drainage Management Area (see Chapter 4)
EISA	Equivalent Impervious Surface Area, as defined in the PCRs
HOA	Home Owners Association
HSG	Hydrologic Soils Group (A, B, C, or D, as defined by NRCS)
LID	Low Impact Development
MRSV	Minimum Required Storage Volume for a Stormwater Control Measure
MS4	Municipal Separate Storm Sewer System, as defined in the Clean Water Act
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service (US Department of Agriculture)
O&M	Operation and Maintenance
PCRs	Post-Construction Requirements, adopted by the Central Coast Water Board in July 2013
SCM	Stormwater Control Measure, as defined in the PCRs
SFH	Single-Family Home that is not part of a larger plan of development, as defined in the PCRs
USA	Urban Sustainability Area, as defined in the PCRs

THE POST-CONSTRUCTION REQUIREMENTS

The California Regional Water Quality Control Board for the Central Coast Region (Water Board) adopted the Post-Construction Requirements (PCRs) in July 2013. The PCRs apply in urbanized areas, including many unincorporated census-designated places (CDPs), throughout the Central Coast Region.

This *Stormwater Technical Guide* (*Guide*) details requirements for the jurisdictions listed on the inside cover. The *Guide* is designed to ensure compliance with the PCRs, facilitate review of applications, and promote integrated Low Impact Development (LID) design. The *Guide* interprets, clarifies, and adds to the PCR requirements. It is important to reference the PCRs, in addition to this Guide, to ensure your project complies with applicable requirements.

What Projects Must Comply?

Projects that are located within the NPDES permit boundaries defined by the Central Coast Regional Water Quality Control Board, including cities, certain institutions, and unincorporated urban areas are subject to the PCRs. Exemptions apply to specific project types, such as second story additions, underground utilities, and trails and bike paths that direct runoff to vegetation. Exemptions also apply to maintenance of existing pavement and concrete. Refer to the PCRs Section B.1 for further information as given in Table 1-2.

Requirements at a Glance

Table 1-1 summarizes the minimum requirements. Development projects in Tier 2 must incorporate the requirements in Tiers 1 and 2. Projects in Tier 3 must incorporate the requirements of Tiers 1, 2, and 3. Projects in Tier 4 must incorporate the requirements of Tiers 1, 2, 3, and 4.

The PCRs Tier 4 requirements specify peak flow control for the 2-year through 10-year storms. Additional peak-flow management based on different criteria may be required by the permitting municipality or local flood control agency.

"Low Impact Development is a stormwater management and land development strategy applied at the parcel and subdivision scale that emphasizes conservation and the use of on-site natural features integrated with engineered, small-scale hydrologic controls to more closely mimic pre-development hydrology.

— Puget Sound

Table 1-1. Requirements at a Glance

Type of Project	Requirements	Watershed Management Zone (WMZ)
Tier 1 (Performance Requirement #1) Projects, including single-family homes that are not part of a larger plan of development (SFHs), that create or replace 2,500 square feet or more of impervious surface.	**Implement LID Measures:** • Limit disturbance of natural drainage features. • Limit clearing, grading, and soil compaction. • Minimize impervious surfaces. • Minimize runoff by dispersing runoff to landscape or using permeable pavements. • Minimize runoff by capturing runoff in cisterns or rain barrels	All
Tier 2 (Performance Requirement #2) Projects, other than SFHs, that create or replace 5,000 SF or more net impervious surface.*	**Tier 1 requirements, plus:** • Treat runoff with an approved and appropriately sized LID treatment system prior to discharge from the site.	All
Tier 3 (Performance Requirement #3) Projects, other than SFHs, that create or replace 15,000 SF or more of impervious surface. SFHs that create or replace 15,000 SF or more net impervious surface.*	**Tier 2 requirements, plus:** • Prevent offsite discharge from events up to the 85th percentile rainfall event using Stormwater Control Measures.	5,6,8, and 9
	Tier 2 requirements, plus: • Prevent offsite discharge from events up to the 95th percentile rainfall event using Stormwater Control Measures.	1 and 2, and 4,7, and 10 if over a designated groundwater basin
Tier 4 (Performance Requirement #4) Projects that create or replace 22,500 square feet of impervious surface.	**Tier 3 requirements, plus:** • Control peak flows to not exceed pre-project flows for the 2-year through 10-year events.	3
	Tier 3 requirements, plus: • Control peak flows to not exceed pre-project flows for the 2-year through 10-year events.	1, 2, 6, and 9

* Net impervious surface equals new plus replaced impervious area, minus the total pre-project-to-post-project reduction in impervious area (if any). See the accompanying Stormwater Control Plan template.

Table 1-2 - Exempt Projects

i) Road and Parking Lot Maintenance:
   (1) Road surface repair including slurry sealing, fog sealing, and pothole and square cut patching
   (2) Overlaying existing asphalt or concrete pavement with asphalt or concrete without expanding the area of coverage
   (3) Shoulder grading
   (4) Cleaning, repairing, maintaining, reshaping, or regrading drainage systems
   (5) Crack sealing
   (6) Resurfacing with in-kind material without expanding the road or parking lot
   (7) Practices to maintain original line and grade, hydraulic capacity, and overall footprint of the road or parking lot
   (8) Repair or reconstruction of the road because of slope failures, natural disasters, acts of God or other man-made disaster

ii) Sidewalk and bicycle path or lane projects, where no other impervious surfaces are created or replaced, built to direct stormwater runoff to adjacent vegetated areas.

iii) Trails and pathways, where no other impervious surfaces are replaced or created, and built to direct stormwater runoff to adjacent vegetated areas.

iv) Underground utility projects that replace the ground surface with in-kind material or materials with similar runoff characteristics

v) Curb and gutter improvement or replacement projects that are not part of any additional creation or replacement of impervious surface area (e.g., sidewalks, roadway)

vi) Second-story additions that do not increase the building footprint.

vii) Raised (not built directly on the ground) decks, stairs, or walkways designed with spaces to allow for water drainage

viii) Photovoltaic systems installed on/over existing roof or other impervious surfaces, and panels located over pervious surfaces with well-maintained grass or vegetated groundcover, or panel arrays with a buffer strip at the most down gradient row of panels

ix) Temporary structures (in place for less than six months)

x) Electrical and utility vaults, sewer and water lift stations, backflows and other utility devices

xi) Above-ground fuel storage tanks and fuel farms with spill containment system

All projects must also conserve natural areas,protect slopes and channels against erosion, and comply with local stream setback and tree-preservation policies as determined by local planning departments.

Watershed Management Zones

Watershed Management Zones, or WMZs, are geographic boundaries defined by the Water Board, based on watershed processes and receiving water types (stream, river, lake, etc). The WMZ designation for your project area will primarily define which requirements apply to your project. Maps of the various WMZs in the permit area can be accessed through the following websites:

Region 3 Water Quality Control Board
http://www.waterboards.ca.gov/centralcoast/water_issues/programs/stormwater/docs/lid/lid_hydromod_charette_index.shtml

County of Monterey:

https://www.co.monterey.ca.us/government/departments-i-z/information-technology/gis-mapping-data

City of Monterey:

http://gisags8.ci.monterey.ca.us/pub/engr/

Special Circumstances

The PCRs identify special circumstances which modify the runoff retention (Tier 3) and/or Peak Flow Management (Tier 4) requirements based on existing site conditions. The special circumstances include:

- Highly Altered Channels: If the project drains to a continuous concrete lined channel or underground storm drain system that discharges directly to a lake, large river or the ocean, Tier 4 requirements may not apply.
- Intermediate Flow Control: If the project drains to an existing flow control facility such as a detention or retention basin, Tier 4 requirements may not apply.
- Historic Lake and Wetland: If the project site is located within a historic lake or wetland, Tier 3 requirements may not apply.

PCRs Section B.6. provides the criteria which a project must meet in order to utilize one of the Special Circumstances, and also outlines documentation requirements.

If you believe one of the special circumstances applies to your project site, begin by contacting municipal staff for further guidance.

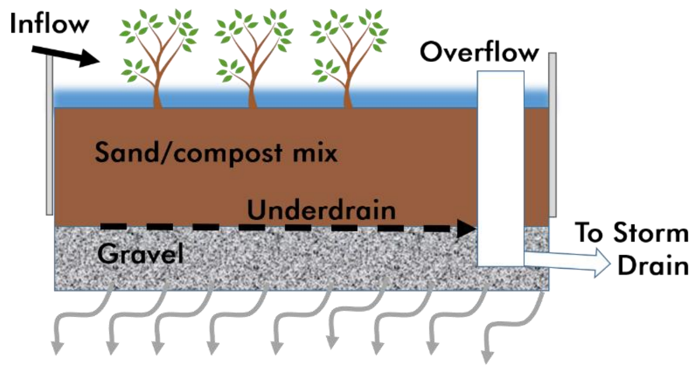
What is Low Impact Development?

LID design aims to mimic pre-development site hydrology as well as protect water quality. Runoff from roofs and paved areas is dispersed to landscaped areas or routed to LID facilities distributed throughout the site. These LID facilities—typically bioretention—infiltrate most runoff. During long and intense storms, underdrains convey treated stormwater to storm drains. During exceptionally large events, overflows are safely conveyed off-site. See Figure 1-1.

Some of the advantages of LID are:

- Provides effective stormwater treatment by filtration and sequestration of pollutants within soils.
- Processes pollutants through biological action in the soil, rendering some pollutants less toxic.
- Facilities can be an attractive landscape amenity.
- Quick-draining bioretention facilities do not harbor mosquitoes or other vectors.
- Maintains the natural hydrologic condition, including recharge to groundwater and contribution to stream flows.
- Requires maintenance similar to landscaped areas of similar size; no special equipment is needed.
- Above-ground, visible facilities are easy to monitor and inspect.

Figure 1-1. Bioretention facilities infiltrate most runoff (top) and can be an attractive landscape amenity (bottom).



CHAPTER 2

THE PATH TO STORMWATER COMPLIANCE

Start Early

LID features and facilities must be integrated into the planning, design, construction, operation, and maintenance of your development project.

Your LID strategy should be an integral part of the earliest decisions about how the site will be developed. Once subdivision lot lines have been sketched, or buildings and parking have been arranged on a commercial site, the LID design may already be constrained—often unnecessarily.

At this earliest stage, also consider who will be responsible for maintaining bioretention or other LID facilities in perpetuity.

The PCRs require the local municipality to maintain a database of LID facilities and ensure the facilities are operating as designed. The site layout, drainage and LID facilities are all conditions of project approval; as such, they may not be removed or rendered ineffective without the permitting agency's approval.

In most cases, the municipality will require the property owner, by agreement, to regularly inspect the facilities, allow access for municipal inspections, and give the municipality the right to conduct remedial maintenance and recover costs if facilities are not properly maintained.

In residential subdivisions, the need to provide for maintenance of stormwater treatment facilities can affect the layout of streets and lots, decisions whether to incorporate a homeowner's association (HOA), liability, insurance, and capital considerations, and the value of the individual built lots. In addition, municipalities may require the builder provide an extended maintenance and warranty period for the facilities before turning them over to an HOA or other entity for maintenance in perpetuity. Again, it's best to start early!

Here are some of the key stormwater compliance milestones as you manage your development project:

1: Pre-Application Meeting

2: Follow the Guide

3: Preliminary Project Design – Preliminary Stormwater Control Plan

4: Detailed Project Design – Final Stormwater Control Plan

5: Draft Stormwater Facilities Operation and Maintenance Plan

6: Construct the Project

7: Final Stormwater Facilities Operation and Maintenance Plan

8: Transfer Maintenance Responsibility (if applicable)

"Your LID strategy should be an integral part of the earliest decisions about how the site will be developed."

1: Pre-Application Meeting

Discuss stormwater requirements for your project at a pre-application meeting with planning and development staff. Their experience with similar projects and with local procedures, requirements, and community plans can provide invaluable insights. Staff will work with you to identify the Watershed Management Zone for your project, which will assist in determining project requirements.

You should also discuss with staff the right timing for completing your Stormwater Control Plan. Often, site designs take a few iterative reviews (by staff and/or by a Design Review Committee) before a satisfactory site layout is achieved. It is important to consider site drainage and locations for bioretention facilities throughout this iterative process. However, it may make sense to delay compilation and formal submittal of your Stormwater Control Plan until the site layout is fairly well set.

2: Follow the Guide

Read this *Guide* all the way through and understand the principles and design procedures before beginning to design your project. Then, follow the steps in Chapter 3 as you lay out the site.

3: Preliminary Stormwater Control Plan

Projects in Tier 1 may use the simple, abbreviated Stormwater Control Plan format and instructions in a template available on the MRSWMP website at http://www.montereySEA.org.

For projects in Tiers 2, 3, and 4, prepare and submit a complete Preliminary Stormwater Control Plan with your application for a land use permit. Skip to Item 4 below "Detailed Project Design" if planning and zoning approval is not required. The Preliminary Stormwater Control Plan will demonstrate that adequate LID features and facilities can be accommodated within your site and landscape design.

Be sure the LID facilities shown on your Preliminary Stormwater Control Plan Exhibits are also shown, as appropriate, on your preliminary site design, architectural design, and landscape designs.

Your Preliminary Stormwater Control Plan may also be used in supporting a Negative Declaration or may be referenced in an Environmental Impact Report. In general, for most projects, implementing the techniques and criteria in this Guide will be considered to mitigate the project's potential impacts on stormwater runoff.

If your project receives planning and zoning discretionary approval, a Condition of Approval will specify the project be constructed consistent with the Preliminary Stormwater Control Plan.

Your Preliminary Stormwater Control Plan must also include a commitment to 1) maintain the stormwater treatment facilities for the life of the project, or until that responsibility is transferred (sold) to another owner or another responsible party, and 2) a commitment to execute a maintenance agreement.

4: Detailed Project Design – Final Stormwater Control Plan

For projects in Tiers 2, 3, and 4, prepare and submit a complete Final Stormwater Control Plan with your application for a grading and/or building permit. The Final Stormwater Control Plan will comprehensively document the design of LID features and facilities, in conjunction with the construction documents.

If the SCMs proposed in the Final Stormwater Control Plan are substantially different than what was previously approved in the Preliminary Stormwater Control Plan, then additional project approvals at the planning level may be required.

It is important to refer to the permitting municipality's project application requirements while preparing the Final Stormwater Control Plan, as there may be other stormwater requirements that apply to your project, such as flood control requirements.

Chapter 4 includes design suggestions and tips. As a possible starting point for preparing construction drawings, see the drawings available (in .pdf and .dwg formats) by the Central Coast Low Impact Development Initiative, www.centralcoastlidi.org.

5: Draft Stormwater Facilities Operation and Maintenance Plan

The LID Facilities Operation and Maintenance Plan (O&M Plan) is a living document used to plan, direct, and record maintenance of stormwater treatment facilities. It identifies the individuals responsible for maintenance, who must keep an up-to-date copy and file periodic updates with the municipality.

If significant facility changes were made after approval of the Draft O&M Plan (i.e., during construction), as-built plans should be prepared and the O&M plan may need to be updated to reflect the actual (as-built) facilities.

6: Construct the Project

Careful construction of LID facilities, coordinated with the building of the development, will help ensure the facilities function as intended and will also minimize future maintenance problems.

During construction, the facility designer (or another person if approved by the municipality) is required to inspect the construction of structural SCMs. Appendix B contains an inspection schedule and checklist for construction of bioretention facilities. During and/or following construction, a licensed engineer is required to prepare a construction inspection checklist and certify that the stormwater facilities were constructed as designed.

7: Final Stormwater Facilities Operation and Maintenance Plan

Following construction, update the Draft Stormwater Facilities Operation and Maintenance Plan with as-built documentation of how the facilities were constructed.

8: Transfer of Maintenance Responsibility

Following construction—or perhaps following a maintenance and warranty period—formally transfer maintenance responsibility to the owner or operator of the project, who will maintain the facilities in perpetuity. In the case of a residential subdivision, this may be a homeowners association, if that arrangement has been approved by your municipality. The Maintenance Agreement shall be filed with the County Recorder and attached to the property deed so that future owners will assume legal responsibility.

"Grade parking lots, driveways and streets to promote evenly distributed sheet flow into self-retaining landscaped areas or bioretention facilities."

CHAPTER 3

PREPARING A STORMWATER CONTROL PLAN

Objectives

Projects in Tier 1 may use the simple, abbreviated Stormwater Control Plan format and instructions in a template available on the MRSWMP website.

Your Stormwater Control Plan for a Tier 2, Tier 3, or Tier 4 project must demonstrate your project incorporates site design characteristics, landscape features, and engineered facilities that will:

- Minimize imperviousness.
- Detain and treat, and/or retain, the specified amounts of runoff.
- Slow runoff rates.
- Reduce pollutants in post-development runoff.

You will need to show that all runoff from new and replaced impervious areas is either dispersed to pervious areas or is routed to a properly designed LID facility.

A complete and thorough Stormwater Control Plan will enable municipal development review staff to verify your project complies with these requirements. It is strongly recommended you retain a design professional familiar with the requirements. Stormwater Control Plans that include hydraulic and/or hydrologic calculations must be prepared by a licensed civil engineer.

Your Stormwater Control Plan will consist of a report and exhibits. Municipal staff will use the Stormwater Control Plan Checklist (page 3-2) to evaluate the completeness of your Plan.

Step by Step

Plan and design your stormwater controls integrally with the site plan and landscaping for your project. This strategy requires you to invest in early and ongoing coordination among project architects, landscape architects, geotechnical engineers, and civil engineers. However, it can pay big dividends in a cost-effective, aesthetically pleasing design—and in avoiding design conflicts later.

"Plan and design your stormwater controls integrally with the site and landscaping for your project."

Your initial, conceptual design for the project should include site drainage. This should include identifying areas where runoff can be dispersed and/or the location and approximate size of stormwater treatment and flow-control facilities.

Follow these eight steps to complete your design and your Stormwater Control Plan.

Step 1: Project Information

Step 2: Opportunities and Constraints

Step 3: Conceptual Site Design

Step 4: Calculations and Documentation

Step 5: Design of LID Facilities

Step 6: Source Controls

Step 7: Stormwater Facility Maintenance

Step 8: Certification

Contents

A Stormwater Control Plan template containing an example outline can be downloaded from the MRSWMP website at www.montereysea.org/job-site/.

Table 3–1. Stormwater Control Plan Checklist

Contents of Existing Conditions Exhibit

- ❒ Topographic information
- ❒ property lines and easements.
- ❒ Natural hydrologic features (depressions, watercourses, relatively undisturbed areas) and significant natural resources.
- ❒ Improvements (buildings, paving, utilities, etc.) both above and below grade.
- ❒ Drainage network including connections to drainage off-site.
- ❒ Entire site divided into existing drainage subareas (if applicable).

Contents of Proposed Conditions Exhibit

- ❒ Existing and proposed topography, limits of grading, and property lines.
- ❒ Proposed buildings and other impervious surfaces, along with existing buildings and impervious surfaces to remain.
- ❒ Proposed site drainage network including connections to drainage off-site
- ❒ Entire site divided into separate Drainage Management Areas (DMAs). Each DMA has a unique identifier and is characterized as self-retaining (zero-discharge), self-treating, or draining to a LID facility.
- ❒ Proposed design features and surface treatments used to minimize imperviousness and reduce runoff.
- ❒ Proposed locations and footprints of Stormwater Control Measures (SCMs). Include setback dimensions from SCMs to adjacent structures, utilities, property lines, slopes, water wells, etc. (as applicable).
- ❒ All proposed underground utilities and existing underground utilities to remain.
- ❒ Potential pollutant source areas, including loading docks, food service areas, refuse areas, outdoor processes and storage, vehicle cleaning, repair or maintenance, fuel dispensing, equipment washing, etc. listed in Appendix A.

Contents of Report

- ❒ Project information including project name; application number; location; parcel numbers; applicant contact information; land use information; site area; existing, new, and replaced impervious area, and applicable PCR requirements and exceptions.
- ❒ Narrative analysis or description of site features and conditions, and opportunities and constraints for stormwater control.
- ❒ Narrative description of site design characteristics that protect natural resources including endangered species habitat, protected vegetation, and archaeological resources, and preserve natural drainage features, minimize imperviousness, and disperse runoff from impervious areas.
- ❒ Tabulation of proposed pervious and impervious DMAs, showing self-treating areas, self-retaining areas, areas draining to self-retaining areas, and areas tributary to each LID facility.
- ❒ Proposed sizes, including supporting calculations, for each LID facility.
- ❒ Narrative description of each DMA and explanation of how runoff is routed from each impervious DMA to a self-retaining DMA or LID facility.
- ❒ Description of site activities and potential sources of pollutants.
- ❒ Table of pollutant sources identified from the list in Appendix A and for each source, the source control measure(s) used to reduce pollutants to the maximum extent practicable.
- ❒ Description of signage for bioretention facilities.
- ❒ General maintenance requirements for bioretention facilities and site design features.
- ❒ Means by which facility maintenance will be financed and implemented in perpetuity.
- ❒ Statement accepting responsibility for interim operation & maintenance of facilities.
- ❒ Certification by a professional civil engineer, architect, or landscape architect.

1: Project Information

Enter the following into the Project Data Form in the Stormwater Control Plan Template:

- Project Name/Number
- Application Submittal Date
- Project Location
- Applicant Contact Information
- Project Phase
- Project Type and Description
- Project Site Area (square feet)
- Total Pre-Project Impervious Surface Area
- Total Post-Project Impervious Surface Area
- Total New Impervious Surface Area
- Total Replaced Impervious Surface Area within an Urban Sustainability Area (USA)
- Total Replaced Impervious Area not within a USA
- Watershed Management Zone
- Design Storm Frequency and Depth

To determine replaced impervious surface area, it is necessary to overlay a drawing of the existing, pre-project impervious areas with the proposed site plan and evaluate which portions of the existing impervious areas will be covered with new impervious surfaces. See the example in Figure 3-1.

Urban Sustainability Areas are areas, approved by Water Board staff, where municipalities seek to preserve or enhance an existing pedestrian and/or public-transit-oriented urban design through high-density infill and redevelopment.

2: Opportunities and Constraints

Review the following information before developing your stormwater control design:

- Existing natural hydrologic features, including natural areas, wetlands, watercourses, seeps, springs, and areas with significant trees.
- Site constraints such as endangered species habitat, protected vegetation, and archaeological resources.
- Site topography and drainage, including the contours of slopes, the general direction of surface drainage, local high or low points or depressions, and any outcrops or other significant geologic features.
- Zoning, including setbacks and minimum landscaping requirements and open space.
- Soil types—including NRCS Hydrologic Soil Groups—and depth to groundwater.

Prepare a brief narrative describing site opportunities and constraints.

Opportunities might include low areas, oddly configured or otherwise unbuildable areas, setbacks, easements, or buffers (which can double as locations for bioretention facilities), differences in elevation (which can provide hydraulic head needed to move runoff to LID facilities), and soils favorable to infiltration.

Constraints might include impermeable soils, near-surface bedrock, high groundwater, groundwater pollution or contaminated soils, steep slopes, geotechnical instability (for example, coastal bluffs), high-intensity land use, heavy pedestrian or vehicle traffic, endangered species habitat, protected vegetation, archaeological resources, or safety concerns.

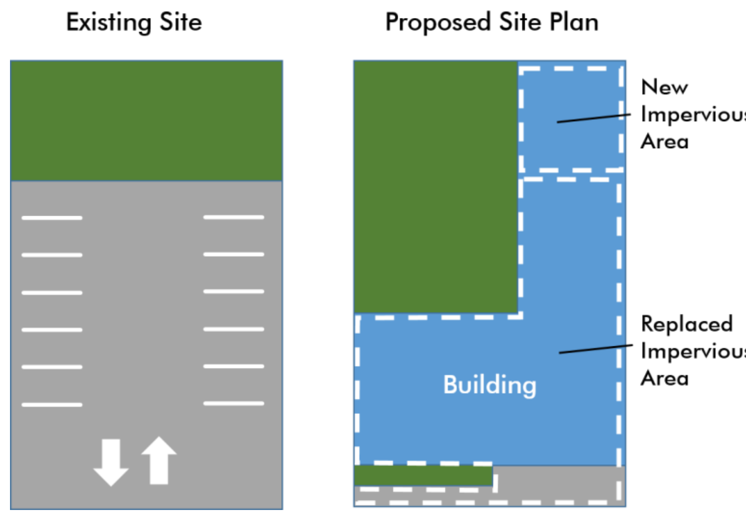


Figure 3-1. Illustration of Replaced Impervious Area.

3: Conceptual Site Design

Begin by applying runoff reduction measures.

Optimize the site layout. Apply the following design principles:

- Define the development envelope and protected areas, identifying areas that are most suitable for development and areas that should be left undisturbed.
- Limit grading; preserve natural landforms and drainage patterns.
- Set back development from creeks, wetlands, and riparian habitats to the maximum degree practical and at minimum, as required by local policies.
- Preserve significant trees.

Limit paving and roofs. Where possible and consistent with zoning, design 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 the site layout and circulation patterns and identify areas where landscaping or planter boxes can be substituted for pavement.

Use pervious pavements where possible. Inventory paved areas and identify locations where permeable pavements, such as crushed aggregate, turf block, unit pavers with permeable joints, pervious concrete, or pervious asphalt can be substituted for impervious concrete or asphalt paving. Pervious pavements are most applicable where native soils are permeable. On sites with clay soils, it may still be possible to use unit pavers or pervious pavement with a sufficiently deep and well-drained base course. Pervious pavements such as turf block can sometimes be used for overflow parking or for emergency access lanes (check with the local fire department).

Direct drainage to landscaped areas. There are two options for handling runoff from impervious areas:

- Disperse runoff to lawns or landscaping. Limit the ratio of impervious to pervious area to 2:1 maximum. Pervious areas must be relatively flat, and the surface should be graded to a slightly concave surface to create a "self-retaining" area. Sites in densely urbanized areas are often too constrained to implement this option.
- Route runoff to Stormwater Control Measures (SCMs). SCMs detain and infiltrate runoff. For rough site layout, consider that the surface area of a bioretention facility will be between 4% and 10% of tributary impervious area.

See Chapter 4 for design criteria for self-retaining areas and bioretention facilities.

Tips for Conceptual Drainage Design.

Most LID facilities are bioretention facilities and may include underdrains. A bioretention facility requires two to four feet of head from the inlet to the underdrain outlet, which can be the connected to an underground storm drain or daylighted.

On flat sites, it usually works best to intersperse self-retaining areas and bioretention facilities throughout the site. Grade parking lots, and driveways to sheet flow runoff directly into the landscaped areas. Use valley gutters or trench drains, rather than underground pipes, to convey runoff longer distances.

On sloped sites, it may work better to collect upslope runoff in conventional catch basins and pipe it to downslope bioretention facilities.

Use the head from roof downspouts by connecting leaders all the way to landscaping or bioretention facilities. Where necessary, bubble-ups can be used to disperse piped runoff.

Siting LID facilities/SCMs. Facilities should be easily accessible for inspection and maintenance.

In commercial, mixed-use, and multi-family developments, facilities can be located in parking medians, parking islands, street setbacks, side and rear setbacks, and other landscaped areas.

In residential subdivisions, the most practical strategy may be to drain the lots to the street in the conventional manner, and then drain the street to a bioretention area. It is most advantageous to create a separate parcel or parcels owned in common, which can double as a landscape amenity or a park. (This is one reason why it is important to plan stormwater treatment and flow-control before drawing subdivision lot lines.) Facilities in back or side yards should be avoided. If facilities are located on individual lots, prospective buyers may find undesirable the necessary legal restrictions on what they can do with those facilities.

It is important to consider larger storm events when siting SCMs. Bioretention areas and other facilities that are in the direct flow path of stormwater runoff will need to be designed to withstand the depth and velocity of flow resulting from larger storm events. For example, high flow bypass structures may be necessary, and surface treatments such as woodchips can float and be washed away with higher flows. It is therefore generally preferable to implement SCMs in an off-line configuration so that high flows are able to bypass the SCM, rather than flow through the SCM. It is also generally preferable to line any high-flow paths within an SCM with cobble to reduce erosion potential.

"Setbacks, easements, and buffers can double as locations for bioretention facilities."

When selecting locations for infiltration based SCMs it is also important to consider the distance to structures and other surface and subsurface improvements. A general rule of thumb is to maintain at least 10-feet horizontal separation between infiltration facilities and improvements such as foundations and structural road sections. In the case that an L is in close proximity to structures or roadways a subsurface vertical barrier may be required to prevent soil saturation below foundations and roads. Setbacks should also be considered from other features such as septic systems, groundwater wells, underground storage tanks, and steep slopes. Please consult your geotechnical engineer for the appropriate setbacks for SCMs on your project site. Some projects such as infill projects or smaller densely developed sites may be constrained by setbacks to proposed improvements or setbacks to existing improvements on neighboring properties. Under certain circumstances this could result in technical infeasibility for onsite retention. Refer to the "Alternative Compliance Options" section within this Chapter for further information.

Other types of treatment facilities. Bioretention facilities can typically be fit into parking medians, street setbacks, foundation plantings, and other landscaping features without significantly affecting the uses or layout of the site.

Further, bioretention facilities are relatively easy to maintain, provide aesthetic appeal, attenuate peak flows, and are quite effective at removing pollutants, including pollutants associated with very fine particulates in rain and atmospheric dust.

Alternative designs should provide equal or greater protection against shock loadings and spills, and equal or greater accessibility and ease of inspection and maintenance.

In some cases, it is very difficult to accommodate bioretention facilities on smaller, densely developed sites and on redevelopment sites. Tree-box-type biofilters or in-vault media filters may be used to meet Tier 2 (treatment) requirements in such circumstances. If non-LID facilities are proposed, you should discuss their use with municipal staff at the pre-application meeting

The proposed tree-box-type biofilters or in-vault media filters must meet the criteria in Appendix C.

4. Calculations and Documentation

Your Stormwater Control Plan must include Exhibits showing existing and proposed site conditions, including the entire project area divided into Drainage Management Areas (DMAs) and the locations and approximate sizes of LID facilities. Each LID facility should be clearly labeled so the Exhibit can be cross-referenced to the text and tables in the report. Refer to Table 3-1 for the items to include on the exhibits.

The report will include a brief description of each DMA, including self-treating and self-retaining areas, and of each LID facility—along with tabulated calculations.

Chapter 4 includes a detailed procedure for documenting your site design and showing your LID facilities meet the minimum sizing requirements. The Central Coast Stormwater Control Measure Sizing Calculator, available on the MRSWMP website, facilitates calculations. If used, the calculator MS Excel file should be submitted with your Stormwater Control Plan.

5. Design of LID Facilities

Design criteria in Chapter 4 will assist you to plan for construction of LID facilities as part of your project. The criteria that apply to your planned facilities should be summarized in your Stormwater Control Plan. Anticipated exceptions to the design criteria should be noted.

6. Source Controls

Your Stormwater Control Plan must identify and describe any potential pollutant sources that will be created or expanded as part of the development project.

Review the Pollutant Sources/Source Control Checklist (Appendix A). Begin by identifying which of the listed potential sources are associated with your project.

Then, create a table in the format shown in Table 3-2. Enter each identified source in the left-hand column. Then add the corresponding permanent, structural source controls from the Pollutant Sources/Source Control Checklist into the center column of your table.

In a narrative, explain any special features, materials, or methods of construction that will be used to implement these permanent, structural source controls.

To complete your table, refer once again to the Pollutant Sources/Source Control Checklist (Appendix A, Column 4). List the operational source controls corresponding to the sources you've identified into the right-hand column of your table. These controls should be implemented as long as the identified activities (sources) continue at the site. These controls may be required as a condition of a land use permit or other discretionary approval for specific uses of the site.

Table 3-2. Format for Source Control Table

Potential Source of Runoff Pollutants	Permanent/Structural Source Control BMPs	Operational/Pollution Prevention BMPs

7. Stormwater Facility Maintenance

For Tier 2, 3, and 4 Projects, your Stormwater Control Plan will describe maintenance needs of your LID facilities and source control measures. The maintenance plan will identify the location of the facilities to be inspected, the frequency of periodic inspections, and maintenance responsibilities. Maintenance records must be retained by the owner.

For residential subdivisions, consult with municipal staff, then detail the planned arrangements in your Stormwater Control Plan. Include, as available and applicable, information about joint ownership of parcels where bioretention or other LID facilities are to be located, about incorporating a homeowners association, about provisions to be incorporated in Codes, Covenants, and Restrictions, and other relevant information.

Include in your Stormwater Control Plan a summary of the general maintenance requirements for your bioretention and other LID facilities. You will find a discussion of maintenance requirements in Chapter 5.

A complete and detailed list of maintenance and inspection requirements, including inspection frequencies, will be required in your Stormwater Facilities Operation and Maintenance Plan (O&M Plan). Your O&M plan must also include detailed documentation of how your facilities are constructed. The O&M plan will be linked to a legally binding Maintenance Agreement executed between the owner and the municipality. That agreement identifies the legally responsible person charged with implementing the O&M Plan over the life of the project. This agreement is a covenant running with the land, so that transfer to a new owner will transfer the responsibility for O&M.

8. Certification

Include the following statement by a licensed civil engineer, architect, or landscape architect. Modify the statement to reflect the requirements applicable to your project:

"The stormwater control facilities described in this Stormwater Control Plan have been designed to meet the Site Design and Runoff Reduction, Water Quality Treatment, Runoff Retention and Peak Management measures in accordance with Central Coast Regional Water Quality Control Board Resolution No. R3-2013-0032, Attachment 1, Post-Construction Stormwater Management Requirements for Development Projects in the Central Coast Region."

Alternative Compliance Options

The PCRs allow two options for alternative compliance in the event compliance with Tiers 3 or 4 cannot be met on-site. Both alternatives require a demonstration that on-site compliance, as described above, is technically infeasible. Tier 2 (treatment) requirements must still be met on-site.

To propose alternative compliance, first prepare a complete Stormwater Control Plan as described in this chapter. Prepare your design as described in Chapter 4. The Stormwater Control Plan should show a complete and thorough implementation of opportunities for implementing LID, including delineation of DMAs and sizing of LID facilities. Show clearly in the plan the extent to which compliance can and will be achieved on-site and explain why further on-site compliance is infeasible.

Potential causes of infeasibility include:

- High seasonal groundwater limits infiltration and/or prevents construction of subgrade stormwater control measures
- Near-surface bedrock or other impermeable conditions limit infiltration
- Soil types significantly limit or preclude infiltration
- Pollutant mobilization in soil or groundwater is a documented concern
- Space constraints imposed by infill projects, some redevelopment, and high density development, etc.
- Geotechnical hazards
- Proximity to drinking water wells (within 100')
- Incompatibility with connections to the municipal storm drain system (for example, a project drains to an existing stormwater collection system, the elevation of which precludes connections to a properly functioning treatment or flow control facility).

Ten Percent Adjustment. If your project site qualifies for alternative compliance, compliance with the criterion to prevent offsite discharge from events up to the 95th percentile rainfall event can be waived if stormwater control measures occupy an area equivalent to no less than 10% of the project's "Equivalent Impervious Surface Area."

Tabulate "Equivalent Impervious Surface Area" and the area of stormwater control measures and show totals for each; then divide the area of stormwater control measures by the Equivalent Impervious Surface Area to show the 10% criterion is met or exceeded.

Formats and instructions for this tabulation are in Chapter 4.

Off-site compliance. Projects should strive to achieve compliance on-site using the instructions and criteria in the *Guide.*

If you believe on-site compliance is infeasible for your site, and you wish to propose an off-site mitigation project, begin by contacting municipal staff for further guidance

Refer to the PCRs Section C for additional information regarding alternative compliance.

CHAPTER 4

DOCUMENTING YOUR LID DESIGN

LID and Compliance with the PCRs

Projects in Tier 1 may use the simple, abbreviated Stormwater Control Plan format and instructions in a template available on the MRSWMP website.

For projects in Tier 2, Tier 3, and Tier 4, the following design and documentation procedure facilitates rapid and thorough evaluation of a LID design for compliance with the Post-Construction Requirements.

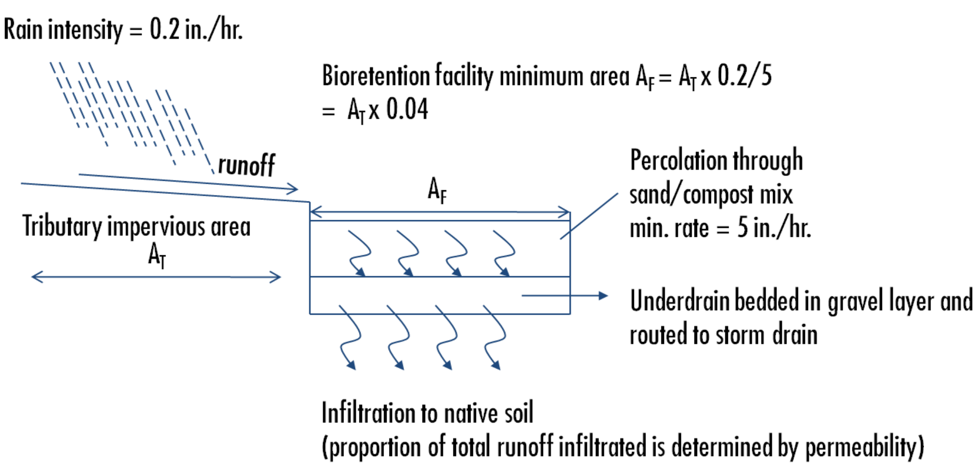
The procedure involves dividing the entire site into Drainage Management Areas (DMAs) and tracking the drainage from each DMA. The procedure accounts for pervious areas and dispersal of runoff from impervious area to landscape. The procedure is iterated until LID facilities are adequately sized to treat runoff (Tier 2), infiltrate runoff (Tier 3), and detain runoff (Tier 4), as applicable.

For Tier 2 projects, LID facilities are designed to detain and treat runoff produced by a rainfall intensity of 0.2 inches per hour. A sizing factor of 0.04 is used for bioretention, which greatly simplifies calculations. See Figure 4-1.

For Tier 3 projects, LID facilities are sized according to the design storm depth and soil type, which vary with location. LID facilities

Figure 4-1. Derivation of Sizing Factor of 0.04 for Tier 2 Bioretention Facilities

As specified in the PCRs, bioretention facilities for Tier 2 are designed to detain and treat runoff produced by a rainfall intensity equal to 0.2 inches per hour. Measured over years, these low-intensity storms produce most of the total volume of runoff (80% or more). The planting medium (sand/compost mix) specified in this Guide is designed to filter runoff at a rate of at least 5 inches per hour. If 100% of rainfall ends up as inflow to the bioretention facility (a conservative assumption), then the ratio of tributary impervious area to bioretention surface area needs to be: 0.2 inches/hour ÷ 5 inches/hour = 0.04.



may be sized with a volume equal to the runoff volume produced by the design storm (simple method) or by iterative calculations routing the design storm hydrograph through the facility. These calculations account for infiltration that occurs simultaneously with inflow (routing method). The routing method typically results in a smaller facility; the volume and footprint vary with the characteristics of the underlying soils as well as the design storm depth.

An MS-Excel-based calculator accompanying this *Guide* facilitates tracking of DMAs and sizing calculations for Tier 2 and Tier 3 projects. It is recommended that the calculator be used to perform the required Tier 2 and Tier 3 calculations. The "Simple Method" may also be used to calculate the required retention volume (Tier 3).

As a runoff reduction measure, runoff from impervious areas, such as roofs, can be managed by routing it to self-retaining pervious areas. The maximum ratio is 2 parts impervious area for every 1 part pervious area.

For Tier 4 projects, LID facilities can provide some or all of the onsite storage needed to meet peak flow requirements. In some cases more traditional flood control facilities such as detention basins may be needed in addition to LID facilities. Peak flow facilities are typically designed using conventional flood control type calculations.

The Stormwater Control Plan template provides example tables and additional guidance on the information that should be provided within your Stormwater Control Plan to document facility design.

Tier 2 and Tier 3 Step-by-Step

The procedure requires the following steps:

1. Delineate entire site into DMAs.
2. Categorize and tabulate DMAs. Reduce runoff by minimizing the amount of impervious area draining to bioretention facilities.
3. Select and lay out LID facilities.
4. Use the Central Coast SCM Sizing Calculator or other approved method to evaluate LID facility footprints.
5. Compare the required footprint to the area available. Iterate until all bioretention facilities meet or exceed the minimum required area.

1: Delineate entire site into DMAs

Drainage Management Areas (DMAs) are portions of a project site that drain to a common point. Delineate the entire site into DMAs[1]. Where feasible, each DMA should contain only one type of surface (e.g., landscaped, impervious, or pervious pavement). The Excel-based calculator evaluates DMAs based on a single surface type only. Therefore, DMAs that contain multiple surface types are not compatible with the calculator.

Some projects may also require the delineation of DMAs over existing impervious surfaces to remain. For example, the PCRs require that runoff from existing surfaces must be treated to Tier 2 requirements when the runoff cannot be separated from new or replaced impervious surfaces. Refer to PCRs Section B.3.b.

Lines delineating DMAs will generally follow roof ridges and grade breaks. It is advantageous to first prepare a base map using the project grading plan and roof plan,

[1] See the JERT's Implementation Guidance Series Issue #2, "Decentralized Stormwater Management to Comply with Runoff Retention Post-Construction Stormwater Control Requirements"

and then delineate the DMAs. This helps ensure your Stormwater Control Plan is consistent with the site plan, landscaping plan, and architectural plans.

There are four types of DMAs:

- Self-treating areas
- Self-retaining areas
- Areas draining to self-retaining areas
- Areas draining to a LID facility

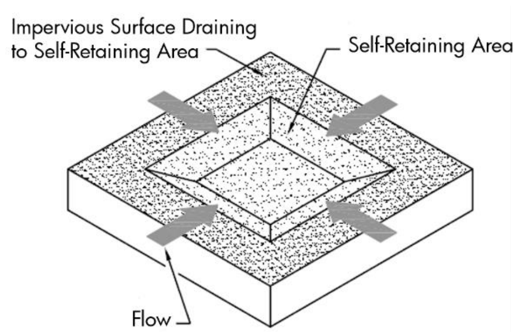
Self-treating areas are undisturbed areas, or areas planted with native, drought-tolerant, or LID-appropriate vegetation, that do not receive runoff from other areas. Self-treating areas do not drain to bioretention facilities, but rather drain directly off site or to the storm drain system. Examples include upslope undeveloped areas which are ditched and drained around a development and grassed slopes which drain directly 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) relative to the receiving pervious area, and slopes are gentle enough to ensure runoff will be absorbed into the vegetation and soil.

Self-retaining areas are areas that retain the 85th or 95th percentile design storm and can also retain runoff from adjoining areas. Self-retaining areas may have natural vegetation, or be landscaped, or may be green roofs or pervious pavement, if the pervious pavement is designed to produce no runoff during the design storm. When their capacity is exceeded, self-retaining areas overflow to another DMA onsite.

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. Inlets of area drains, if any, should be set 3 inches or more above the low point to allow ponding.

Areas draining to self-retaining areas. Runoff from impervious areas, such as roofs,

Figure 4-2. Ratio of impervious area draining to a self-retaining area shall be no more than 2:1.



driveways, parking, and sidewalks, can be managed by routing it to self-retaining areas. The maximum ratio is 2 parts impervious area for every 1 part pervious area. The runoff from the impervious area must be directed to and dispersed within the pervious area, and the pervious area must hold a volume equal to both areas times a 1-inch depth. For example, if the maximum ratio of two parts impervious area to one part pervious area is used, then the self-retaining pervious area must be graded concave or bermed so that three inches of water over its surface are retained and infiltrated.

In some cases, such as high rainfall depth or very low infiltration rates, additional depth may be required.[2] Prolonged ponding is a potential problem at higher

[2] See the JERT's Implementation Guidance Series Issue #1, "The Use of Self-Retaining Areas to Support Post Construction Stormwater Control Compliance"

impervious/pervious ratios. In your design, ensure that the pervious area soils infiltrate well enough to handle the additional run-on.

Areas draining to a LID facility. The square footage of these areas is used to calculate the required footprint and volume of the LID facility. More than one drainage area (DMA) can drain to the same LID facility. However, any one DMA can only drain to one LID facility.

Where possible, design site drainage so only impervious roofs and pavement (not landscaped areas) drain to LID facilities. This yields a simpler, more efficient design and also helps protect SCMs from becoming clogged by sediment.

2. Categorize and Tabulate DMAs

For each DMA, determine whether it will be self-treating, self-retaining, drains to a self-retaining area, or drains to a SCM. For each DMA, tabulate the square footage and the post-project surface. Surface types and associated runoff factors are in Table 4-1.

3. Select and Lay Out SCMs

From your conceptual drainage design (see Chapter 3) identify the locations and footprint of SCMs.

Design criteria for SCMs are at the end of this chapter. Once you have laid out the SCMs, calculate the square footage you have set aside for each SCM.

Then, recalculate the square footage of your DMAs to omit the square footage now dedicated to SCMs. The area of your SCMs should be included in your DMAs; the runoff factor for the SCMs should be C = 1.0.

4. SCM Sizing

For Tier 2 projects, the minimum area for a biofiltration facility can be found by summing up the contributions of each surface type within the SCM's tributary DMA:

$\sum$ (square footage × runoff factor)

and multiplying by the result by the sizing factor of 0.04. This sizing factor is used by the Central Coast Region SCM Sizing Calculator that accompanies this *Guide*.The minimum area for other flow-through treatment facilities will be based on site specific factors such as land slope and swale length, along with area of tributary DMAs. For Tier 3 projects, you may use either of two methods: the "simple method" or the "routing method". The routing method is facilitated by the Central Coast Region SCM Sizing Calculator.

To use either method, first find the applicable storm depth based on location. Use the maps and instructions on the Central Coast Water Board website (search for "Central Coast percentile rainfall depth maps").

Next, determine any adjustments allowed for previously existing development, as follows.

Table 4-1. Runoff Factors for Small Storms (for LID design)

Roofs and paving	1.0
Landscaped areas	0.1
Bricks or solid pavers on sand base	0.5
Pervious concrete or asphalt	0.0
Turfblock or gravel—total section min. 6"	0.0

These adjustments only apply to the runoff retention (Tier 3) calculations .

- From your project data form, identify impervious square footage located within an Urban Sustainability Area (USA) and not within a USA.
- Replaced impervious square footage within a USA may be omitted from your LID facility sizing calculations (that is, multiply by zero).
- Replaced impervious square footage not within a USA may be multiplied by 0.5 before entering it into your LID facility sizing calculations.

Note that square footage omitted or halved may be applied, at your discretion, to any DMA, thereby reducing the required size of the LID facility to which that DMA is tributary.

To size facilities using the simple method: Determine the required minimum volume V (in cubic feet) for each facility by multiplying as follows:

V =
Σ [DMA SF × runoff factor] × storm depth

For bioretention facilities, divide the calculated minimum storage volume by 0.4 (porosity) to determine the volume of gravel required.

To size facilities using the routing method: The steps provided below assume the routing method calculations will be performed using the excel calculator accompanying this Guide. If you choose to use an alternative method it is the designer's responsibility to ensure that documentation of calculations equivalent to the excel calculator is provided within the Stormwater Control Plan. For alternate calculations, refer to the PCRs Attachment D for guidance.

First, enter the following information into the Excel calculator:

- Name and location of project
- Applicability (Tier 2, 3, or 4)
- Design rainfall depth (85^{th} or 95^{th} percentile storm)
- Total new impervious area
- Total replaced impervious area in a USA
- Total replaced impervious area not in a USA
- Total pervious or landscaped area

Then for each, DMA, enter the following:

- Name of DMA and type (self-treating, self-retaining, drains to self-retaining, or drains to Stormwater Control Measure)
- DMA area in square feet
- Type of surface (roof, landscape, etc.)
- New or replaced and whether in a USA
- For DMAs that are not self-treating or self-retaining, the connection to a self-retaining area or Stormwater Control Measure

For each LID Facility/SCM, enter:

- Name of SCM and type (bioretention or direct infiltration; see discussion below)
- Hydrologic Soil Group or design infiltration rate for subsurface soils (see discussion below)
- Surface reservoir volume (may be entered as an average depth if reservoir area is the same as facility infiltration area)
- Facility infiltration area (area in contact with subsurface soils)

The calculator performs the following based on the Santa Barbara Unit Hydrograph (SBUH) method:

- Distributes the design storm depth over time increments (Type 1 unit hydrograph)
- Calculates facility inflow rate and volume for each time increment
- Calculates facility infiltration rate and, for each time increment, the corresponding infiltration volume
- Calculates incremental increase or decrease in storage and cumulative storage for each time increment
- Tracks and outputs time for facility to drain fully

The calculator outputs the maximum cumulative storage volume required to retain the design storm. As required by the PCRs, the calculator multiplies this volume by 1.2 when the drawdown time exceeds 48 hours (the likely condition when facilities are located in lower-permeability soils).

This is the Minimum Required Storage Volume to be used for your design.

Infiltration rate for routing method: You may use the default option or, alternatively, submit data from on-site testing.

The default option is to use the Hydrologic Soil Group (HSG) that best characterizes site soils. To support your selection of an HSG, attach to your Stormwater Control Plan on-site boring logs, geotechnical report, USDA Soil Survey information, or other available information. In the calculator, HSG A/B soils (soils with no significant clay component) are assigned an infiltration rate of 0.75 in/hr. and HSG C/D soils are assigned an infiltration rate of 0.25 in/hr. Should you wish to submit data from on-site testing, consult in advance with municipal staff regarding acceptable test methods.[3]

Most test methods, such as the borehole-type percolation testing described in the reference footnoted below, require that test results be converted to "field saturated hydraulic conductivity". Engineering judgement and a safety factor are then applied to determine the design infiltration rate(s). It is the responsibility of the designer to verify that testing data has been converted from the tested "percolation rate" to a design hydraulic conductivity, as this conversion is frequently not done by the professional performing the test. Refer to the "Porchet Method" as described in the Orange County Stormwater Technical Guidance Document as an example. The permeability values provided in Table 7 of the "Soil Survey for Monterey County" (USDA, 1972) are also a useful check.

Should you wish to submit data from on-site testing, consult in advance with municipal staff regarding acceptable test methods.[3]

For direct infiltration SCMs—such as dry wells, infiltration trenches, or infiltration basins—the calculator divides the infiltration rate by a safety factor of 2 to account for potential reductions in infiltration rates over time. (This factor may be waived by local staff if an adequately designed and maintained treatment system is installed upstream of the infiltration facility.) Note that direct

[3] The publication "Native Soil Assessment for Small Infiltration-Based Stormwater Control Measures," prepared for by the Central Coast Low Impact Development Initiative and available at the Central Coast Water Board website, outlines some test methods

infiltration SCMs that rely on underground storage, such as dry wells and underground chambers, require an upstream treatment system. Refer to Appendix C for further information.

For bioretention SCMs, the Minimum Required Storage Volume is the volume of the voids in the gravel layer up to the invert elevation of the perforated pipe at the drain inlet. If there is no underdrain, in addition to the volume in the gravel layer, the volume stored in the BSM and ponded up to the first orifice or other outlet is counted. It is assumed the porosity Φ of the gravel layer and BSM is equal to 0.4

Flow-control orifice on underdrain: Ordinarily, the volume of the surface reservoir and the volume of pore spaces in the planting soil are not credited toward the Minimum Required Storage Volume.

However, if a flow restrictor is placed on the underdrain outlet, once the gravel layer fills, additional inflows can be made to back up into the soil layer and the reservoir rather than immediately exiting the underdrain. By increasing the volume detained by the facility and prolonging the detention time, additional volumes are infiltrated during the largest 5% of storms. Consequently, the volume of storage beneath the underdrain can be reduced in some cases up to 20%. An orifice can only be used if the designer uses the sizing calculator or equivalent calculation method that estimates, using a long-term continuous simulation, that the SCM will retain an equivalent volume of water as an SCM without the orifice.

When using this option, consider the potential effect of prolonged inundation on the vegetation in the bioretention facility, and select the plant palette accordingly. Also consider the need to access the orifice for maintenance. See the schematic and criteria in Figure 4-4 on page 4-11.

To use this option, select "yes" to the option provided in the calculator. The calculator provides the diameter of the orifice. See the bioretention facility design criteria in this chapter for details on the orifice design.

Combining with an onsite downstream basin or vault. If a bioretention facility discharges to an on-site downstream detention basin or vault (for example, a basin used for flood control detention), then the bottom surface area of the basin, and the "dead storage" volume of the basin, may be applied toward meeting the Minimum Required Storage Volume. See Figure 4-3.

To do so, add the surface area of the basin "dead storage" to the area of the bioretention subsurface gravel storage, and enter the result as the SCM in the calculator. After launching the SBUH model, the volume of the basin "dead storage" may be credited toward the minimum required storage volume.

5. Repeat until facility area is acceptable

If the routing method is used, then the minimum storage volume required changes as the facility infiltration area (this is usually, but not always, the same as the footprint) is adjusted. Try entering different facility infiltration areas into the calculator, finding the resulting minimum storage volume, and determining the resulting gravel layer depth.

The calculator is set up to track DMAs and the routing of drainage from DMAs to LID facilities/SCMs. The calculator facilitates exploration of options to delineate DMAs differently and associate DMAs with different LID facilities and calculates the Minimum

Review the site plan to determine if, for each LID facility, the square footage reserved is sufficient to accommodate the minimum footprint, plus any additional area for side slopes to match the surrounding grade.

Required Storage Volume that results. Iterate (repeat) this process to develop your design.

Review the site plan to determine if, for each LID facility, the square footage reserved is sufficient to accommodate the minimum footprint, plus any additional area for side slopes to match surrounding grade. Also consider if the resulting gravel depth is constructible.

If necessary, revise your site plan, facility designs, or both. Revisions may include:

- Reducing the overall imperviousness of the project site.
- Changing the grading and drainage to redirect some runoff toward other LID facilities which may have more capacity.
- Making tributary landscaped DMAs self-treating or self-retaining.
- Expanding the LID facility footprint/infiltration area.
- Using a flow-control orifice on the underdrain
- Using large-diameter pipes, arches, vaults, or other structures to more efficiently create subsurface storage and thereby reduce the facility depth and volume of gravel required.

Tier 4 Requirements

For Tier 4 projects, the PCRs require that post-development peak flows do not exceed pre-development peak flows for the 2-year through 10-year storms. The LID facilities designed for Tiers 2 and 3 may provide adequate reduction in post-development peak flows to satisfy this requirement, or additional facilities may be required to provide onsite detention. In either case, calculations are required to document the existing and proposed peak flows from your project site.

In addition, calculations may be required for flood control in accordance with the permitting municipality or local flood control agency requirements.

A hydrograph based procedure is required by the PCRs for Tier 4 calculations. Acceptable methods for hydrograph analysis include the NRCS Method and SBUH Method. The parameters included in the PCRs attachment D should be used for basin routing calculations. The NRCS Method is discussed in the NRCS Technical Release 55 (TR-55), "Urban Hydrology for Small Watersheds." The SBUH Method is discussed in the City of Portland Stormwater Management Manual.

Bioretention facility design criteria

Layout. Bioretention facilities may be of any shape. However, the following layers must be designed and built flat and level throughout the facility:

- bottom of the excavation
- top of gravel storage layer
- top of soil layer
- rim of facility reservoir

See Figure 4-4. The facility must be designed to "fill up like a bathtub." This rule ensures all the storage is used during intense rainfall, prevents short-circuiting, and avoids erosion of the soil mix.

The surface reservoir should be level. To address concerns about a trip hazard, or to achieve a softer visual effect, soil mix and/or mulch may be gently mounded against the rigid edge. Plantings can be selected and arranged to discourage entry.

Gravel layer. Caltrans "Class 2 Permeable Material," , is recommended. ¾" drain rock, or other locally available drain rock may be used; however, a 4"-thick layer of pea gravel is recommended to cover the top of the drain rock to reduce movement of fines from the BSM layer into the interstices of the drain rock. Do not use filter fabric for this purpose.

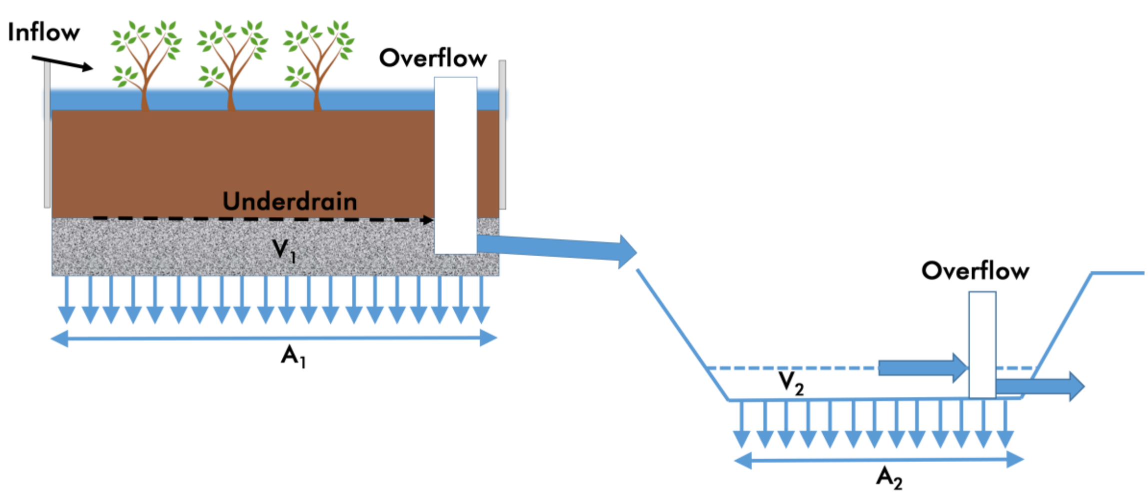
Bioretention Soil Mix (BSM). A mixture of 60%-70% washed sand (ASTM C33) and 30%-40% compost should be used. The specification developed by the Bay Area Stormwater Management Agencies Association (available on the MRSWMP website) is recommended.

Overflow Structure. Overflows from bioretention facilities must be routed safely, used (see below), it needs to be accessible for maintenance, and the catch basin should be sized accordingly. (Typically a 24"x24" catch basin is needed for access to an orifice located inside the catch basin if it is more than 18" below the catch basin grate.)

Underdrain. Use minimum 4" dia. PVC SDR 35 or equivalent, perforated pipe, installed with the holes facing down. The underdrain can be placed in a groove dug into the top of the gravel layer; the discharge elevation (typically, where the underdrain is connected to the overflow structure) is critical and determines the retention volume. Connect to the overflow structure and at the other end, provide a threaded, capped cleanout connected by a sweep bend.

Figure 4-3. Schematic of Bioretention Facility Combined with a Downstream Basin

The surface areas A_1 and A_2 may be added and entered into the calculator. The required retention storage volume may be met by combining the subsurface storage in the bioretention facility (V_1) with "dead storage" (V_2, storage below the lowest discharge elevation) in the basin or vault.



typically via an overflow structure and connection to a storm drain. The best option is to use a catch basin with grate set to the desired overflow elevation, which should be specified in the plans. Note that if an orifice is

Flow-restricting orifice. An orifice can be constructed by several methods. One is extending the underdrain pipe into the overflow structure and capping it with a standard threaded cleanout, then drilling a hole of the required diameter in the cap.

Landscape Design. Many bioretention facilities incorporate native plants in an attractive garden setting, achieving low maintenance costs, low water demand, and maximum habitat value. However, combined uses, including active uses on turf or mulch, may be appropriate for part or all of a bioretention facility.

Select a plant palette to tolerate fast-draining soils and the microclimate specific to the facility location. The soil surface will be inundated briefly and rarely (for a few hours on 3 to 5 occasions per year, typically) but otherwise dry unless irrigated. Consider the facility's relationship to existing and proposed buildings and the resulting exposure to sun, heat, shade, and wind.

Here are some problem conditions that should be avoided when developing a planting plan:

- Overly dense plantings that, after growing in, prevent flow into and through the surface reservoir
- Aggressive roots that block inflow or percolation
- Invasive weeds
- Plants that need irrigation or fertilization
- Too much mulch; floating mulch

Trees and large shrubs installed in bioretention facilities are susceptible to blowing over before roots are established. They should be staked securely. Three stakes per tree are recommended at windy sites.

Aged mulch, also called compost mulch, reduces the ability of weeds to establish, keeps the soil mix moist, and replenishes soil nutrients. Compared to bark mulch, aged mulch has somewhat less tendency to float into overflow inlets during intense storms.

Irrigation. Irrigation controls should allow separate control of times and durations of irrigation for bioretention facilities vs. other landscape areas. Smart irrigation controllers are strongly encouraged. Available controllers can access weather stations, use sensors to measure soil temperature and moisture, and allow input of soil types, plant types, root depth, light conditions, slope, and usable rainfall. Bioretention facilities may need to be irrigated more than once a day, depending on the plants selected.

Drip emitters are strongly recommended over spray irrigation. Use multiple, lower-flow (0.5 to 2 gallons per hour) emitters—two to four emitters for perennials, ground covers, and bunchgrasses; four to six emitters for larger shrubs and trees. If spray heads are used, they must be positioned to avoid direct spray into outlet structures.

Signage. Signs are recommended at each bioretention facility. Signs and sign templates may be available from MRSWMP; check for availability. Signs help educate the public on topics of stormwater awareness, and also, importantly, they advise landscapers and other maintenance personnel of the fact that the facility is a stormwater facility, and must be treated differently from typical landscaping and pavements.

Compatibility with Larger Storms. Bioretention facilities must be designed considering flows from larger storms (flood flows). Overflow structures and/or high flow bypass structures may be required to safely convey runoff around or out of the bioretention facility. Consideration should be made for the type of landscape surface amendment proposed, to avoid material that would float and/or flow downstream during a larger storm. Refer to the permitting municipality's or local flood control district requirements for design storm criteria.

Tips for avoiding design conflicts

Review your SCM design for the following:

- Elevations all around each facility are consistent with grading, drainage, and paving plans, and with architectural plans.
- Facilities do not interfere with circulation or with pedestrian access between parking areas and building entrances.
- Facilities are represented in architectural and landscape renderings.
- Bioretention facilities are shown in landscape plans, and a suitable plant palette has been chosen.
- Cable vaults, phone vaults, electrical boxes, and other utility boxes are accommodated in designated locations outside the bioretention facilities.
- Foundations and pavement subgrades adjacent to the facilities are shored and protected against moisture intrusion, as needed.

Designing SCMs Other than Bioretention

For dry wells, infiltration trenches, infiltration basins, and other retention facilities, demonstrate that your preliminary design meets the proposed infiltration area and Minimum Required Storage Volume (as shown in the calculator file submitted with your Stormwater Control Plan). Standard designs for these facilities may be used. Links to some design guidance manuals are on the MRSWMP website. SCMs that rely on underground storage, such as dry wells and underground chambers, require a pre-treatment system. Refer to Appendix C for further information.

Ten Percent Adjustment

As noted in Chapter 3, following determination that it is infeasible to incorporate facilities that will retain the specified amount of runoff on-site, compliance may be achieved by dedicating a minimum 10% of the site's New and Replaced "Equivalent Impervious Surface Area" (EISA) to Stormwater Control Measures (SCMs). The following SCMs may be used for the Ten Percent Adjustment: Bioretention, Biofiltration, or pervious pavements.

Calculation of EISA. Divide the project area into DMAs. Delineate separate DMAs for each surface type.

Tabulate and total the square footage of DMAs with concrete or asphalt paving, conventional or metal roofs, or other wholly impervious surfaces.

Then tabulate the square footage of DMAs with the surfaces shown in Table 4-6. Multiply the square footage of each DMA by the "correction factor" shown and total the products.

Total the contributions of the pervious and partially pervious DMAs. This is the EISA for the site.

Calculation of SCM Area. Total the square footage of bioretention facilities and other facilities designed using the simple method or the calculator.

Ratio. Divide the SCM Area by the EISA to determine if the 10% criterion is met. Use of the 10% adjustment requires that the applicant first demonstrate the infeasibility of implementing bioretention facilities sized using the calculator to manage runoff from all impervious DMAs. The project must retain on-site the amount of runoff feasible.

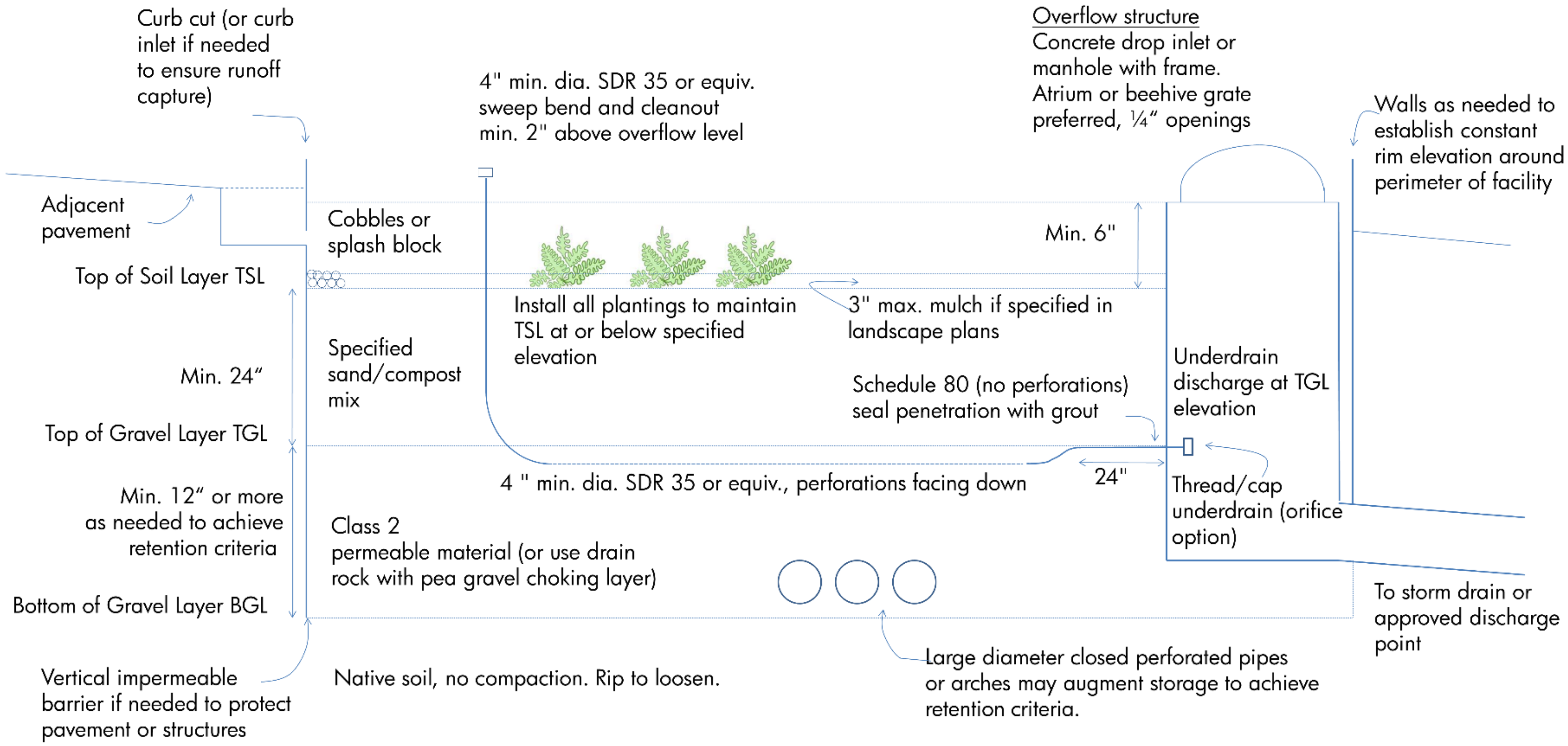
Refer to the PCRs Attachment E for additional information regarding the Ten Percent Adjustment.

Table 4-2. Correction Factors for Use in Calculating Equivalent Impervious Surface Area (EISA) (from the PCRs)

Pervious Surface	Correction Factor
Pervious concrete	0.60
Cobbles	0.60
Pervious Asphalt	0.55
Natural Stone (without grout)	0.25
Turf Block	0.15
Brick (without grout)	0.13
Unit Pavers on Sand	0.10
Crushed Aggregate	0.10
Grass	0.10

Figure 4-4. Bioretention Facility Cross-Section

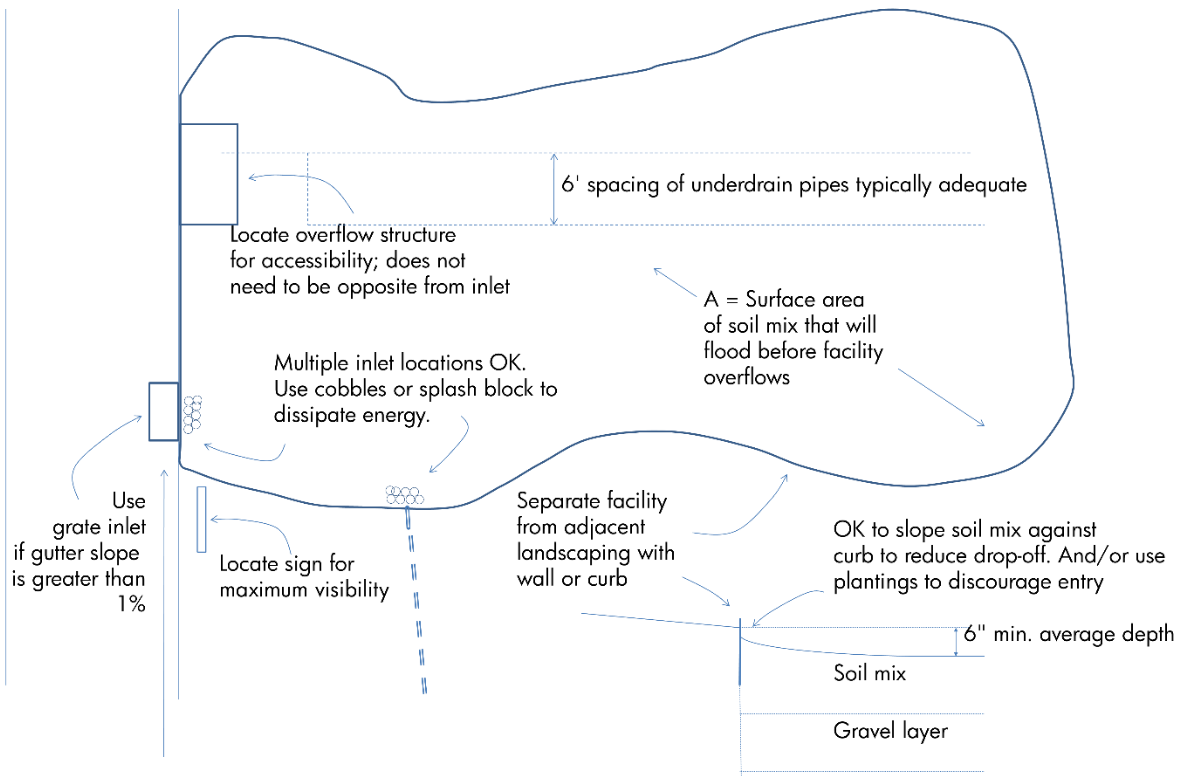
Not to Scale



Notes:

- No liner, no filter fabric, no landscape cloth.
- Maintain BGL. TGL, TSL throughout facility area at elevations to be specified in plan.
- Class 2 permeable material layer may extend below and underneath drop inlet.
- Elevation of underdrain discharge is at top of gravel layer.
- See Chapter 4 for instructions on facility sizing and additional specifications.
- Drawings available at www.centralcoastlidi.org can be adapted and customized to meet project requirements and these minimum specifications.

Figure 4-5. Bioretention Facility Plan
Not to Scale

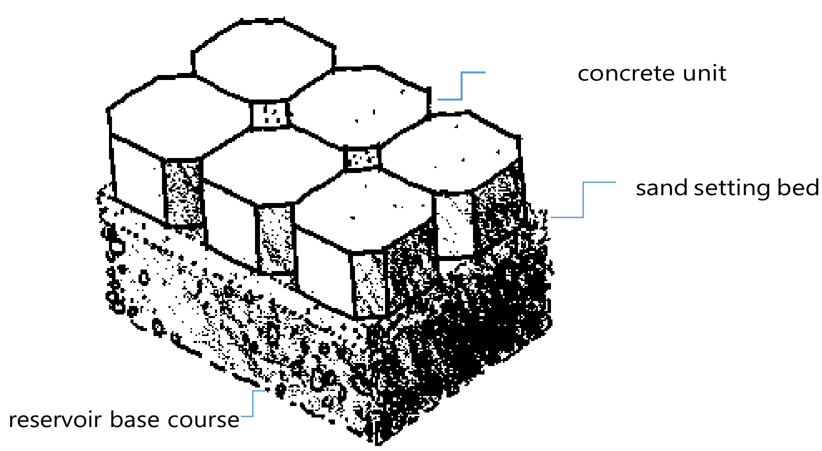


Note: Call out elevations of curb, pavement, inlet, top of soil layer (TSL), bottom of soil layer (BSL), and bottom of gravel layer (BGL) at all inlets and outlets and at key points along edge of facility.

Figure 4-6: Design Criteria for porous pavements to achieve runoff reduction

The following minimum design criteria must be followed where porous pavements are used as a site design measure for Tier 1 projects, or a self-retaining area for Tier 2,, 3, and 4 projects. As with other areas draining to self-retaining areas (p. 4-3), porous pavements built to these criteria may receive runoff from impervious areas up to a ratio of 2:1 impervious-to-pervious, if the soils underlying the porous pavement drain well enough to handle the additional run-on. Porous pavements may receive runoff from additional impervious areas so long as appropriate calculations are provided to justify the design.

- ❑ No erodible areas drain on to permeable pavement.
- ❑ Subgrade is level; or subgrade is benched if surface grade slopes.
- ❑ Subgrade compaction is minimal.
- ❑ Reservoir base course is of open-graded crushed stone. Stone reservoir depth is adequate to retain rainfall from the pervious pavement and any tributary areas. More depth may be required to support design loads.
- ❑ No subdrain is included or, if a subdrain is included, outlet elevation is above the top of the stone reservoir bottom of base course/top of subgrade.
- ❑ Concrete curbing or other rigid edge is provided to retain granular pavements and unit pavers.
- ❑ Permeable concrete or porous asphalt, if used, are installed by industry-certified professionals according to the vendor's recommendations.
- ❑ Selection and location of pavements incorporates Americans with Disabilities Act requirements (if applicable), site aesthetics, and uses.



Typical configuration for a pervious pavement.

CHAPTER 5

PREPARING YOUR OPERATION & MAINTENANCE PLAN

Introduction

LID facilities—in particular, bioretention facilities and pervious pavements—require little care beyond normal maintenance and periodic rejuvenation of the landscaping. Other types of structural SCMs may require more frequent and/or more labor-intensive maintenance.

Applicants must verify provisions have been made for maintenance of the LID facilities in perpetuity, including annual certifications that maintenance has been performed.

This verification is accomplished by executing and recording an agreement that "runs with the land." The agreement provides the municipality a right of access for inspections and requires the owner to certify annually that facilities have been recently inspected and are functioning as intended. If maintenance is not adequate, the municipality may conduct any maintenance or repairs needed and bill the owner to recover costs. The agreement is binding on future owners of the entire property or any subdivided portion of the property. A model agreement is available at the MRSWMP website.

When facilities are located in a privately owned common area, such as private street or landscaped area within a residential subdivision, the joint responsibilities of the property owners must be spelled out in Covenants, Conditions, and Restrictions (CC&Rs).

Your Operation and Maintenance Plan (O&M Plan) will address the specific drainage patterns and treatment facilities on the development site and is typically referenced in the agreement or attached as an exhibit. The O&M Plan is used to plan, direct, and record maintenance of the SCMs. The O&M Plan is kept on-site, and a copy maintained at municipal offices.

Updated information, including contact information, must be provided to the municipality whenever a property is sold and whenever responsibility for maintenance is changed.

Step by Step

Follow these five steps to prepare your O&M Plan.

Step 1: Designate Responsible Individuals

Step 2: Describe the Facilities

Step 3: Document the Facilities "As Built"

Step 4: Schedule Maintenance Activities

Step 5: Compile the Plan

BEST PRACTICES

1. Designate Responsible Individuals.

Identify the following individuals:

- Person who will have direct responsibility for the maintenance of stormwater controls, maintain self-inspection records, and sign any correspondence with the municipality regarding the inspections.
- Employees or contractors who will report to the designated contact and are responsible for carrying out maintenance.
- Contact for response to problems, such as clogged drains or broken irrigation mains, that would require immediate response should they occur during off-hours.

Describe the methods and schedule of initial training for staff or contractors regarding the purpose, mode of operation, and maintenance requirements for the facilities on the site.

"Municipalities will typically require a draft Operations and Maintenance Plan be submitted when building permits are applied for — or even before."

2. Describe the Facilities to be Maintained

Incorporate the following into the O&M Plan:

- Exhibits from your Final Stormwater Control Plan delineating the Drainage Management Areas on the site and showing the locations of the SCMs.

3. Document Facilities "As Built"

Include the final construction drawings as an attachment. The construction drawings should reflect As-Built conditions and show:

- Plans, elevations, and details of all the SCMs on the project site. If necessary, annotate the drawings with the SCM designations used in the Stormwater Control Plan so it is clear which drawing refers to which facility.
- Construction details and specifications, including depths of sand or soil, compaction, pipe materials, and bedding.
- Location and layouts of inflow piping and piping to off-site discharge.
- Native soils encountered (e.g., sand or clay lenses beneath or near facilities).

Municipalities may require a *draft* Operations and Maintenance Plan be submitted when building permits are applied for — or even before.

Changes made in the field during construction should be noted on As-Built Plans, and attached to the *final* O&M Plan following construction.

4. Schedule Maintenance Activities

Identify required maintenance activities for each SCM, along with recommended frequency. Reference and include the manufacturer's recommendations for any proprietary stormwater facilities.

The following activities should be scheduled at least annually for bioretention and other landscaped based LID facilities. The frequency should be adjusted in response to the needs of each particular facility.

Clean up. Remove any soil or debris blocking planter inlets or overflows. Remove trash that typically collects near inlets or gets caught in vegetation.

Prune or cut back plants for health and to ensure flow into inlets and across the surface of the facility. Remove and replant as necessary. When replanting, maintain the design surface elevation and minimize the introduction of soil.

Control weeds by manual methods and soil amendment. In response to problem areas or threatening invasions, corn gluten, white vinegar, vinegar-based products such as Burnout, or non-selective natural herbicides such as Safer's Sharpshooter may be used.

Add mulch. Aged mulch, also called compost mulch, reduces the ability of weeds to establish, keeps soil moist, and replenishes soil nutrients. Mulch may be added from time to time to maintain a mulch layer thickness of 1" to 2", but only if the underlying soil surface beneath the mulch layer is a minimum 6" below the overflow elevation, consistently throughout the surface area of the facility.

Check signage. Remove graffiti and replace if necessary.

Check irrigation, if any, to confirm it is adequate but not excessive.

Landscape maintenance personnel should be aware of the following:

Do not add fertilizer to bioretention facilities. Compost tea, available from various nurseries and garden supply retailers, may be applied at a recommended rate of 5 gallons mixed with 15 gallons of water per acre, up to two weeks prior to planting and once per year between March and June. Do not apply when temperatures are below 50°F or above 90°F or when rain is forecast in the next 48 hours.

Do not use synthetic pesticides on bioretention facilities. Beneficial nematodes and non-toxic controls may be used. Acceptable natural pesticides include Safer® products and Neem oil.

5. Compiling the Plan

Format plans to 8½" x 11" where possible to facilitate duplication, filing, and handling. If the O&M Plan will be an attachment to the Maintenance Agreement, it should be formatted in black-and-white, because the County Assessor's office will not record color documents.

Include the revision date in the footer of each page.

Consider scanning the graphics and incorporating with the text in electronic files that can be backed up.

The following resources at the MRSWMP website may help you when preparing your plan:

- Sample outline and format for an O&M Plan.
- Form for designating individuals responsible for operation and maintenance.
- Sample facility inspection and maintenance log.
- Example of an inspector's report.

Updates to the O&M Plan

Updates can be made, and a copy transmitted to the municipality, at any time. In particular, contact information should be updated regularly.

The O&M Plan should be reviewed annually and updated as needed.