

PRELIMINARY DRAFT

County of San Luis Obispo Low Impact Development Handbook

*Strategies for Post-Construction Stormwater Management in
New Development and Redevelopment*

December 21, 2009

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Strategies for Post-Construction Stormwater Management in New Development and Redevelopment

This handbook is intended to provide guidance in using Low Impact Development tools and techniques. It should be viewed as a companion to San Luis Obispo County's Land Use Ordinances, which contain the detailed requirements for applying Low Impact Development to projects. Users of this Handbook should be aware that it has been developed using an iterative process that results from the cumulative effect of implementing, continuously evaluating, and making corresponding changes to a variety of technically and economically feasible tools. Therefore, it should be expected that this Handbook will be updated on a regular basis, and subsequently adopted by resolution of the Board of Supervisors. Users should consult the County's website or contact the appropriate County staff to ensure access to the latest information.

December 21, 2009

Funding for this project has been provided in part through an agreement with the State Water Resources Control Board. The contents of this document do not necessarily reflect the views and policies of the State Water Resources Control Board, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

(Gov. Code 7550. 40 CFR 31.20)

**County of San Luis Obispo
Low Impact Development Handbook**

***Strategies for Post-Construction Stormwater Management in New Development
and Redevelopment***

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Ch 1: Introduction

1.1 Purpose of this Handbook

The purpose of this handbook is to provide guidance and direction on how to comply with Low Impact Development (LID) techniques. This handbook is intended for the use by developers, contractors, builders, designers, engineers, architects, planners, homeowners, and all others interested in learning how to address stormwater quality during the planning, design, and maintenance phases of a project. Project applicants should use this handbook to determine LID design features and post-construction stormwater management application and maintenance requirements for their new development and redevelopment projects. Please refer to Chapter 3 for the procedures and requirements on how to comply with Low Impact Development (LID) requirements.

1.2 How to Use this Handbook

This handbook is a supplement to current County land use and development permit policies. It is meant to be used as a design aid for both the onsite and public improvement portions of projects; however, all improvements within the public right-of-way must be consistent with County Public Improvement Standards. Requests for adjustments to Design Standards, Standard Specifications or Standard Drawings for public improvements must follow the process identified in Section 1.2 “Design Adjustments” of the Public Improvement Standards. This process is also referenced in Land Use Ordinance Section 22.52.150B.1 and Coastal Zone Land Use Ordinance Section 23.05.048.b(1).

Overview

- Chapter 2 gives the background and regulatory requirements for stormwater quality and Low Impact Development (LID).
- Chapter 3 gives the steps for how to complete a successful project permit application.
- Chapter 4 provides guidance for planning and designing LID integrated management practices (IMPs).
- Chapter 5 provides instructions for stormwater pollution prevention Source Control Measures.
- Chapter 6 provides Hydromodification Planning Measures. This chapter is to be completed as part of the Central Coast Region’s Joint Effort for hydromodification control. Following completion of the Joint Effort, this chapter will be adopted by the Board of Supervisors after a duly noticed public hearing.
- Chapter 7 provides instructions for Treatment Control Measures.
- Chapter 8 outlines requirements for long-term maintenance.

The appendices provide permit application forms, checklists, point scoring criteria, and plant selection guidelines to assist project applicants.

Since LID designs are highly site-specific, only broad considerations can be provided in this handbook. References are provided to assist designers find detailed information for LID designs.

Ch 2: Background & Regulatory Requirements

2.1 The Impact of Development on Water Quality

Undeveloped natural landscape areas such as forests and grasslands act like sponges for rainfall. When natural landscape areas are covered with impervious (nonporous) surfaces like roads, parking lots, and roofs, this “sponge-like” function is lost and the amount of rainfall that can be absorbed is dramatically reduced. As shown in Figure 2-1, the percentage of impervious surface area of a site influences how much of a rain storm is infiltrated into the ground, evapotranspirated back into the atmosphere, or leaves the site as stormwater runoff.

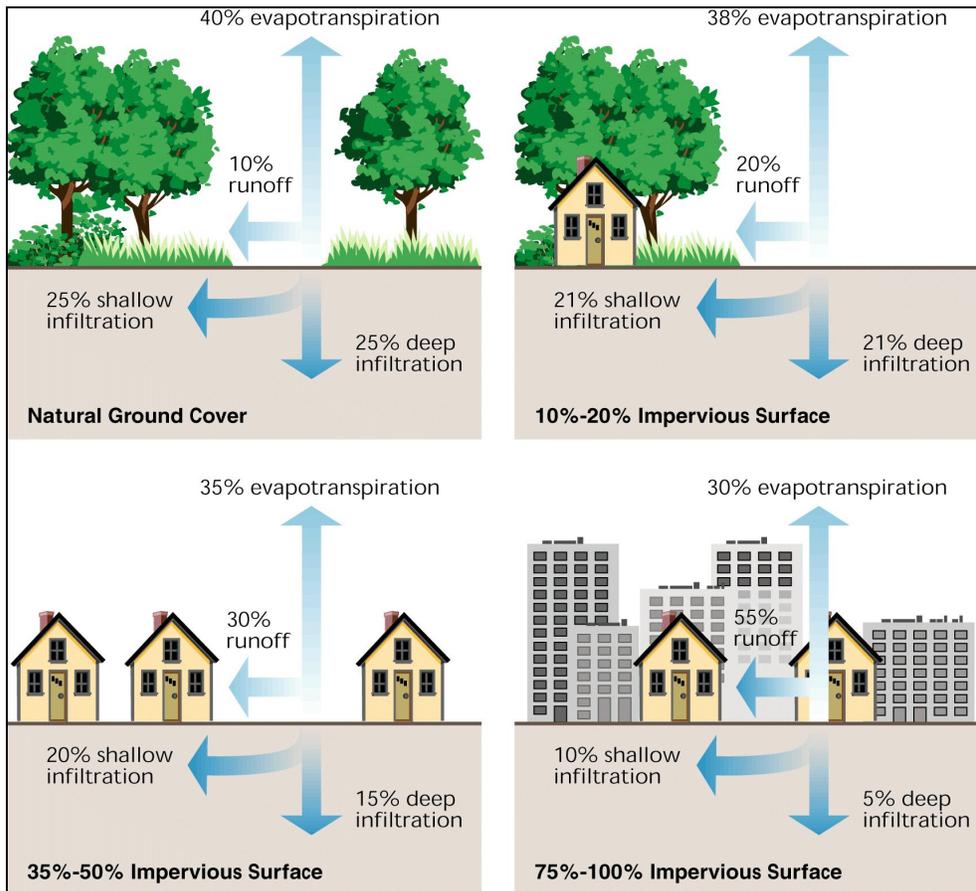


Figure 2-1 Relationship between impervious surface area, surface runoff, infiltration and evapotranspiration (Source: Stream Corridor Restoration: Principles, Processes, and Practices, FISWG 1998)

Increasing the amount of impervious surface area of a site can lead to a host of problems, including:

- Increased flooding frequencies and magnitudes;
- Increased erosion of streams and hillsides;
- Increased pollutant concentration levels in stormwater runoff; and
- Reduced groundwater recharge rates.

Development projects can also impact neighboring properties. Traditional stormwater management practices emphasize conveyance; that is, using street gutters, curbs, pipes and canals to remove water from the developed areas as quickly as possible and engineered flood control measures such as dams, dikes, levees, and detention facilities to offset the impact of development. This transfers the immediate problems downstream by increasing the amount of runoff leaving sites. The compound effect of increased impervious surface area with more efficient collection and conveyance systems is downstream flooding and erosion.

When runoff leaves a storm drain network and empties into a creek, the excessive volume and energy can scour creek banks, damaging streamside vegetation and harming aquatic habitat. Runoff that travels over impervious surfaces often picks up pollutants that accumulated on that surface as a result of everyday activities such as driving, maintaining vehicles and lawns, disposing of waste, washing cars and even walking pets. Polluted runoff may contain



Figure 2-2 Bank scour along San Luis Obispo Creek (Source: USFWS)

nutrients, pathogens, hydrocarbons, toxic organics, sediments, metals, trash, and debris. Increased creek and lake temperatures may result as the runoff picks up heat from paved surfaces. Pollutants and warmer water are carried to the storm drain system and are discharged directly to lakes, streams, and the ocean where pollutants can accumulate and degrade water quality and aquatic habitat for fish and wildlife.

The loss of infiltration from urbanization has also resulted in profound groundwater changes. As more surface area becomes covered with impervious surfaces, less water is able to seep back into the ground. Reduced groundwater recharge rates may result in lower base flows during dry weather as less groundwater available to move through the soil and into stream channels and aquifers.

To protect surface water quality and groundwater resources, new development and significant redevelopment projects should be designed, constructed, and maintained to minimize increases in runoff using Low Impact Development post-construction stormwater management strategies as the first choice alternative whenever possible.

2.2 Local Environmental and Economic Impacts

Polluted stormwater has measurable environmental and economic impacts, including increased flooding, public health, harm to aquatic life, (including coastal shellfisheries), aesthetic impacts, impacts to tourism and recreation, and harm to community water supplies.

Flooding

According to the County Local Hazard Mitigation Plan¹ San Luis Obispo County has experienced severe flooding events that have resulted in loss of life and extensive property damage. Flooding can also inundate sewage treatment plants, prevent the safe passage of people and commodities, contaminate water supplies, damage agricultural resources, and result in accelerated rates of erosion.

Public Health

Stormwater can transport disease-causing bacteria, viruses, and protozoa. The County of San Luis Obispo Environmental Health Division consistently monitored 20 beach locations in 2007. Twenty percent of the samples taken during wet weather years received a grade of 'C' or 'D' according to Heal the Bay Foundation. The grade indicates the presence of total coliforms, fecal coliforms, enterococcus and fecal ratios observed in the overall number of samples taken. A complete listing of San Luis Obispo County health advisories is available on Heal the Bay's website².

Harm to Aquatic Life

Urban runoff can harm aquatic life in many ways due to changes in water chemistry and habitat loss. This includes:

Nitrogen and Phosphorous promote toxic and non-toxic alga blooms that harm aquatic life by depleting the amount of oxygen in the water and by decreasing light penetration for photosynthetic organisms. These pollutants also promote unwanted weeds.

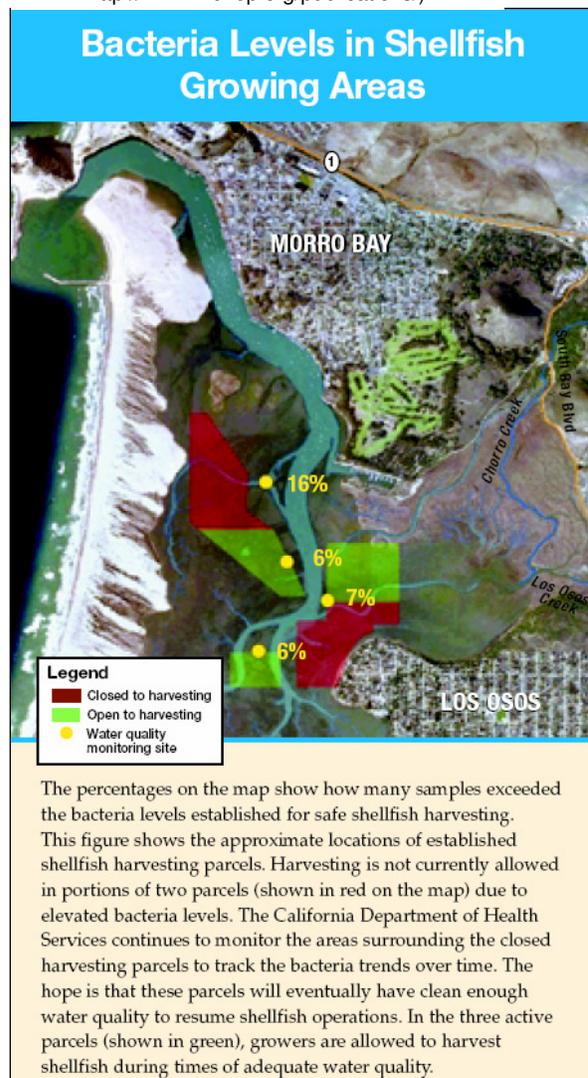
Parking lots and roads can have an accumulation of **oil and grease**. The oil and grease forms a film over water which spreads and makes oxygen transfer difficult and is toxic to aquatic animals and plants.

Metals such as lead, copper, cadmium, zinc, mercury, chromium, selenium and nickel are toxic to fish and other forms of aquatic life and can cause genetic defects.

Organics may lead to human and animal reproductive abnormalities.

Sediment can reduce the suitability of creeks for spawning beds, decrease the light available for photosynthetic organisms and increase the transport of heavy metals and nutrients that adhere to the sediment particles.

Figure 2-3 Excerpts from MBEP (Source: <http://www.mbnep.org/publications/>)



¹ www.slocountyoes.com/lhmp_bos.pdf

² <http://www.healthebay.org/brc/annual/2007/counties/slo/analysis.asp>

Trash in stormwater harms wildlife. The plastic loops that hold six-packs of beer or soda together can strangle gulls and plastic bags cause the death of marine animals through ingestion or entanglement.

Pathogens in stormwater also contaminate shellfish beds. Contaminated stormwater, along with pollution from other sources, have causes the closure of shellfish beds. According to the Morro Bay Estuary Program publication, "Estuary Tidings: A Report on the Health of the Morro Bay Estuary," two of the three harvesting parcels in Morro Bay have been partially closed to shellfish harvesting by the California Department of Health Services (DHS). DHS is responsible for ensuring that harvested shellfish are safe. DHS has concluded that bay waters are clean enough to support commercial shellfish operations in portions of the three parcels but require mandatory closures immediately following rainfall events due to high bacteria levels.

A key contributing factor is that levels of bacteria and viruses are usually 100 to 1,000 times greater in the bottom sediment, where shellfish live, than in the water above.

Aesthetic Impacts

The beauty of San Luis Obispo County's coastlines is world renown. The presence of cigarette butts, polystyrene cups, and other trash that storm sewers dump into the streams, lakes and the ocean creates an unwelcome eyesore. Sediment loads in these waters reduce water clarity.

Impacts to Tourism and Recreation

Potential human illness and aesthetic losses result in more than unpleasantness. Coastal and recreational tourism are major components of the local economy. On a typical weekend, many visitors look to the Central Coast as a getaway destination. If the degradation of the water bodies that accept contaminated stormwater is allowed to continue, these locations will be less attractive for visitors and may deter people from making San Luis Obispo County a vacation or travel destination.

Harm to Community Water Supplies

Many groundwater basins within San Luis Obispo County are at or near overdraft. Excessive water withdrawals from our inland and coastal streams and basins will have potentially significant environmental impacts, including impacts to riparian habitats and altering of stream flows potentially affecting anadromous fish.

2.3 Stormwater NPDES Regulatory Requirements

To address the impacts of development on water quality, the National Pollutant Discharge Elimination System (NPDES) Small Municipal Separate Storm Sewer System (MS4) General Permit requires the County to develop and implement a Stormwater Management Program (SWMP) that describes Best Management Practices (BMPs), measurable goals, and timetables for implementation in the following six program areas:

1. Public Education and Outreach

The County must educate the public about the importance of the stormwater pollution and the public's role in stormwater pollution prevention.

2. Public Participation and Involvement

The County must comply with all State and local notice requirements when implementing a public participation and involvement program.

3. Illicit Discharge Detection and Elimination

The County must adopt and enforce ordinances or take equivalent measures that prohibit illicit discharges. The Permittee must also implement a program to detect and eliminate illicit discharges.

4. Construction Site Stormwater Runoff Control

The County must develop a program to control the discharge of pollutants from construction sites greater than or equal to one acre in size within its permitted jurisdiction. The program must include inspections of construction sites and enforcement actions against violators.

5. Post-Construction Stormwater Management for New Development and Redevelopment

The County must require long-term post-construction BMPs that protect water quality and control runoff flow, to be incorporated into development and significant redevelopment projects. Post-construction programs are most efficient when they stress (i) low impact design; (ii) source control measures; and (iii) treatment control measures.

6. Pollution Prevention/Good Housekeeping for Municipal Operations

The County must examine its own activities and develop a program to prevent the discharge of pollutants from these activities. At a minimum, the program must educate staff on pollution prevention and minimize pollutant sources.

This handbook addresses the Post-Construction Stormwater Management aspect of the Stormwater Management Program. For this program area, the County is required to:

- Develop, implement, and enforce a program to address stormwater runoff from new development and redevelopment projects that disturb greater than or equal to one acre including projects less than one acre that are part of a larger common plan of development that discharge into the municipal separate storm sewer system by ensuring that controls are in place that would prevent or minimize water quality impacts;
- Develop and implement strategies that include a combination of structural and/or non-structural BMPs;
- Use an ordinance or other regulatory mechanism to address post-construction runoff from new development and redevelopment to the extent allowable under local law;
- Ensure adequate long-term operation and maintenance of BMPs; and
- Comply with Attachment 4 of the General Permit. The complete text of Attachment 4 of the General Permit Attachment 4.³

The County must implement a post-construction program with design standards for the following types of discretionary development and redevelopment projects:

- Single-Family Hillside Residences;
- 100,000 Square Foot Commercial Developments;
- Automotive Repair Shops;

³ Available at: http://www.swrcb.ca.gov/stormwtr/phase_ii_municipal.html

- Retail Gasoline Outlets;
- Restaurants;
- Subdivisions with 10 or more housing units; and
- Parking lots 5,000 square feet or more or with 25 or more parking spaces and potentially exposed to stormwater runoff.

2.4 Low Impact Development (LID)

In contrast to traditional stormwater management approaches, the guiding principle of Low Impact Development is not conveyance. Low Impact Development (LID) uses a basic principle modeled after nature: Manage rainfall at the source using uniformly distributed, decentralized micro-scale controls. LID designs can reduce stormwater volumes, rates, pollutant loading, and downstream erosion associated with development while recharging the groundwater table.

The ability of LID to successfully mimic the site's predevelopment hydrology is a function of the region's climate regimes, the soil's ability to infiltrate runoff, the site's topography, the depth of the groundwater table, and the proportion of pervious area maintained on the site. While LID has the potential to reduce the impacts of development, it also can decrease the project's direct life-cycle costs by reducing the amount of infrastructure needed to convey stormwater and by decreasing the cost of maintaining stormwater infrastructure.

Ideally, upon development, an LID site would discharge and infiltrate the same volume of stormwater, at the same peak rate, duration and frequency, and maintain the same water quality that had been historically discharged from the site prior to development. In new developments and where possible in re-developments, LID focuses on site design. The project should:

- Minimize the impacts of increased stormwater runoff from impervious surfaces and land conversions by maintaining peak flow frequencies and durations of the site's predevelopment hydrologic condition;
- Retain and incorporate natural site features that promote infiltration of stormwater;
- Design the project to fit the terrain instead of grading the topography to fit the project's structures;
- Preserve existing drainage patterns, pervious areas, and sensitive habitat areas within the project limits;
- Minimize the extent of proposed impervious surfaces (roofing, parking lots, streets, etc.);
- Minimize the use of structural stormwater controls (pipes, inlets, etc.);
- Use multifunctional landscapes to infiltrate, store, and intercept as much runoff as possible and as close to the origin as possible; and
- Limit the connectivity of impervious areas.

Although all projects will be required to integrate LID concepts into project designs, it is recognized that not all sites will be able to effectively incorporate all LID practices. For instance, soil permeability, soil contamination, slope, and water table characteristics may limit the potential for local infiltration. Large urban projects with significant lot coverage may lack the area to offset their increased volume of runoff. The criteria for obtaining a LID waiver are provided in Chapter 3.

LID designs must be carefully integrated into projects with a thorough consideration of engineering and geotechnical limitations. LID is particularly well suited for the following project sites:

- Project sites situated in closed depressions;
- Project sites with permeable soil types;
- Project sites containing, situated adjacent to, or draining to wetlands, riparian areas, fish or wildlife areas and/or estuaries;
- Projects resulting in negative impacts caused by the increase in volume or rate of surface water leaving or arriving at the site;
- Project sites located in an area underlain by a critical aquifer recharge area; and
- Project sites with designated open space area requirements.

To adhere to the MS4 General Permit requirements and the County's sustainability goal of "*Meeting the needs of the present without compromising the ability of future generations to meet their own needs,*" LID strategies have been incorporated into County policies and this handbook. Provisions have been included to waive the requirement where infeasible or impractical.

LID has been successfully applied to government, residential, commercial, and industrial development and redevelopment projects. In areas with low impervious values and high porosity soils, LID can be a cost-efficient and effective method for managing runoff and protecting the environment. In areas with significant amounts of impervious surfaces and low porosity clay soils, incorporating LID may increase project costs and may not be feasible or appropriate.

2.5 Numeric Sizing Requirements

The Central Coast Regional Water Quality Control Board recognizes that:

- It is cost prohibitive to maintain the pre-development hydrologic regime everywhere at all times and still meet current development demands; and
- Impacts to receiving waters are real and measurable.

To maximize the return on stormwater investment, numeric sizing requirements were strategically selected to minimize cost while achieving key watershed health criteria including all of the following:

- Establishing groundwater recharge volume goals;
- Maintaining peak runoff rates consistent with pre-development rates;
- Establishing treatment control standards (volume and rate); and
- Minimizing directly connected impervious areas.

Land Use Ordinance Section 22.52.110 and Coastal Zone Land Use Ordinance Section 23.05.040 et seq. require that the control of drainage and drainage facilities minimize harmful effects of stormwater runoff and resulting inundation and erosion on proposed projects, and protect neighboring and downstream properties from drainage problems resulting from new development. Where conflicts exist between the ordinances and the thresholds provided herein, the ordinances shall control.

Groundwater Recharge Volume

Ideally, projects would be designed to recharge groundwater supplies at the historical rate. Sections 22.52.140 (LUO) and 23.05.046 (CZLUO) require projects to mitigate the impacts on recharge caused by the reduction in the permeability of soil areas on the site with logical exceptions. While on many sites it is currently impractical to construct retention facilities of the size necessary to replace the storage lost to development; it is often possible to retain the majority of the smaller, more frequent storm events using LID designs. Therefore, projects should infiltrate the initial runoff of each storm event. *Note:* Additional points can be obtained by using multiple basins throughout the project site (see Appendix D).

Projects shall infiltrate the initial runoff of each storm based upon the annual average rainfall as follows:

Table 2-1. Depth of Storm to Be Retained Onsite Per Acre of Impervious Surface Area

AVERAGE ANNUAL RAINFALL FOR SITE LOCATION BASED ON COUNTY HISTORICAL RAINFALL DATA	24 HOUR RAINFALL DEPTH TO BE TREATED ONSITE PER ACRE IMPERVIOUS SURFACE AREA
Less than or equal to 15 inches per year	0.50 inches
>15 and less than or equal to 18 inches per year	0.75 inches
>18 and less than or equal to 25 inches per year	1.00 inches
Greater than or equal to 25 inches per year	1.32 inches

*Based on 85th percentile storm depth calculated using available rain gage data

This goal is not additive (i.e. the retention basin volume requirements specified in Public Improvement Standards Section 5.2.2A. "Retention Basins" can be used to meet groundwater recharge volume goals), although distributed, small-scale retention systems are preferred over a single retention basin.

Peak Runoff Rate

To reduce channel and slope erosion, runoff from a site should be discharged at a rate and volume compatible with the capacity of the natural streams it discharges to.

Runoff rates from the site for storms up to the 50 year, 10-hour intensity and duration storm shall not exceed the pre-developed 2 year discharge rate at each of the historic discharge locations.

This goal is consistent with Land Use Ordinance Sections 22.52.110 through 22.52.150 and Coastal Zone Land Use Ordinance Sections 23.05.040 through 23.05.048. These sections require that proposed projects include design provisions to retain off-site natural drainage patterns and, when required, limit peak runoff to predevelopment levels. Additionally, this threshold is consistent with the detention basin volume requirements specified in Section 5.2.2B "Detention Basins" of the Public Improvement Standards. Specific projects may have unique attributes that necessitate no detention (such as projects where detention would exacerbate flooding) or that could require detention volumes greater than the amount

specified here (such as projects where discharge is limited based on downstream infrastructure that is unable to convey projected rates of runoff).

Channel Protection

Many channels receiving stormwater runoff are susceptible to degradation as a result of changes in the runoff and sediment regime due to the development tributary to the receiving channel.

The County of San Luis Obispo has several provisions to protect the downstream channel resources, including energy dissipation at discharge locations, detention and retention policies, peak runoff rate controls and creek setback criteria. However, the extended duration of discharge from detention basins has been attributed to adversely affect the shear stress of receiving channels. To compensate for this, detention facilities and receiving waters should be evaluated to determine if a multi-stage discharge outlet that would allow low flow discharges (i.e. 2 year peak runoff rate), intermittent flow discharges (5 or 10 year peak runoff rate) and high flow discharges (50 or 100 year peak runoff rate) would be appropriate.

The benefits associated with selecting a lower intermittent flow discharge design storm can decrease detention basin sizes, but also increase the risk of downstream flooding and therefore should be selected carefully.

It is recommended that project proponents discuss the appropriateness of multi-stage discharge outlets with the County Public Works and Planning and Building Departments early in the design process or at the pre-application meeting.

Treatment Control Standards

The need for treatment control is dependent on the designation of the project (See Chapter 3). If required, treatment control standards are either based on volume-based or flow-based treatment control Best Management Practices (BMPs).

The CCRWQCB requires Permittees to use Low Impact Development Integrated Management Practices (IMPs) to treat stormwater runoff where possible. Rainfall infiltrated into the soil (with proper pre-treatment), may be excluded from the volume and rate of runoff to be treated per this requirement.

The CCRWQCB will only allow conventional treatment control BMPs if the Permittee can demonstrate that the cost of incorporating LID is prohibitive because the “cost would exceed any benefit to be derived.” (State Water Resources Control Board Order No. WQ 2000-11.)

The purpose of establishing a **volumetric** treatment control BMP is to provide confidence that volume-based treatment control BMPs are capable of capturing and treating a specified percentage of the annual runoff. This involves detaining the runoff for a duration long enough to address the pollutants of concern. The BMP detention time is either associated with the inherent infiltration rate of the soils on the site or a restriction applied to the BMP means of discharge (typically a pipe, plate or weir). Treatment control BMPs that use volumetric-based design requirements are listed in Table 2-2.

Table 2-2. Treatment Control BMP Minimum Detention Rates

VOLUMETRIC BMP (CALIFORNIA STORMWATER QUALITY ASSOCIATION BMP NUMBER)	TIME TO EMPTY (HOURS)
Constructed Wetlands (TC-21)	24
Infiltration Basins (Retention Basins) (TC-11) Wet ponds (Retention Basins with permanent Ponds) (TC-20) Extended Detention Basin (TC-22) Media Filters (2 chambered: settling basin & sand / absorptive filtering media) (TC-40)	48
Bioretention (TC-32)	72

For projects proposing volumetric treatment control, a hydrograph analysis is required to demonstrate adequate detention times. Information on computing composite curve numbers to account for disconnected impervious areas and Low Impact Development design components will be provided in Chapter 6 of this handbook, upon completion of the *Joint Effort* led by the Central Coast Regional Water Quality Control Board (CCWRQB). Projects required to treat stormwater shall use the volumes generated using the stormwater depths provided in Table 2-1.

The purpose of establishing a *flow-based* Treatment Control BMP rate is to provide confidence that the flow-based treatment control BMP is able to provide sufficient treatment to the runoff prior to it leaving the site. This generally involves a minimum contact time and maximum velocity and depth. See individual BMP design guidance for specifics.

The peak flow rate shall be determined using the Rational Method: $Q = C * I * A$ where:

- Q = Peak flow rate, cfs
- C = Runoff coefficient per Chapter 6
- I = 0.36 in/hr (based on Caltrans District 5 treatment intensity number for SLO County)
- A = Drainage area (in acres)

Additional information on treatment control measures is provided in Chapter 7.

Directly Connected Impervious Areas

To reduce adverse impacts to biological resources associated with surface water, directly connected impervious area should be minimized to the greatest extent possible.

Chapters 4, 5, and 6 provide techniques to disconnect directly connected impervious areas.

Ch 3: Preparing Permit Applications

3.1 The Development Review Process

To comply with Federal and State NPDES stormwater regulatory requirements, the County has integrated post-construction stormwater management into the development review process. This chapter outlines the County’s development review process and gives step-by-step instructions for how to prepare permit applications for new development and redevelopment projects.

Figure 3-1 illustrates the process for addressing stormwater quality requirements in permit applications.

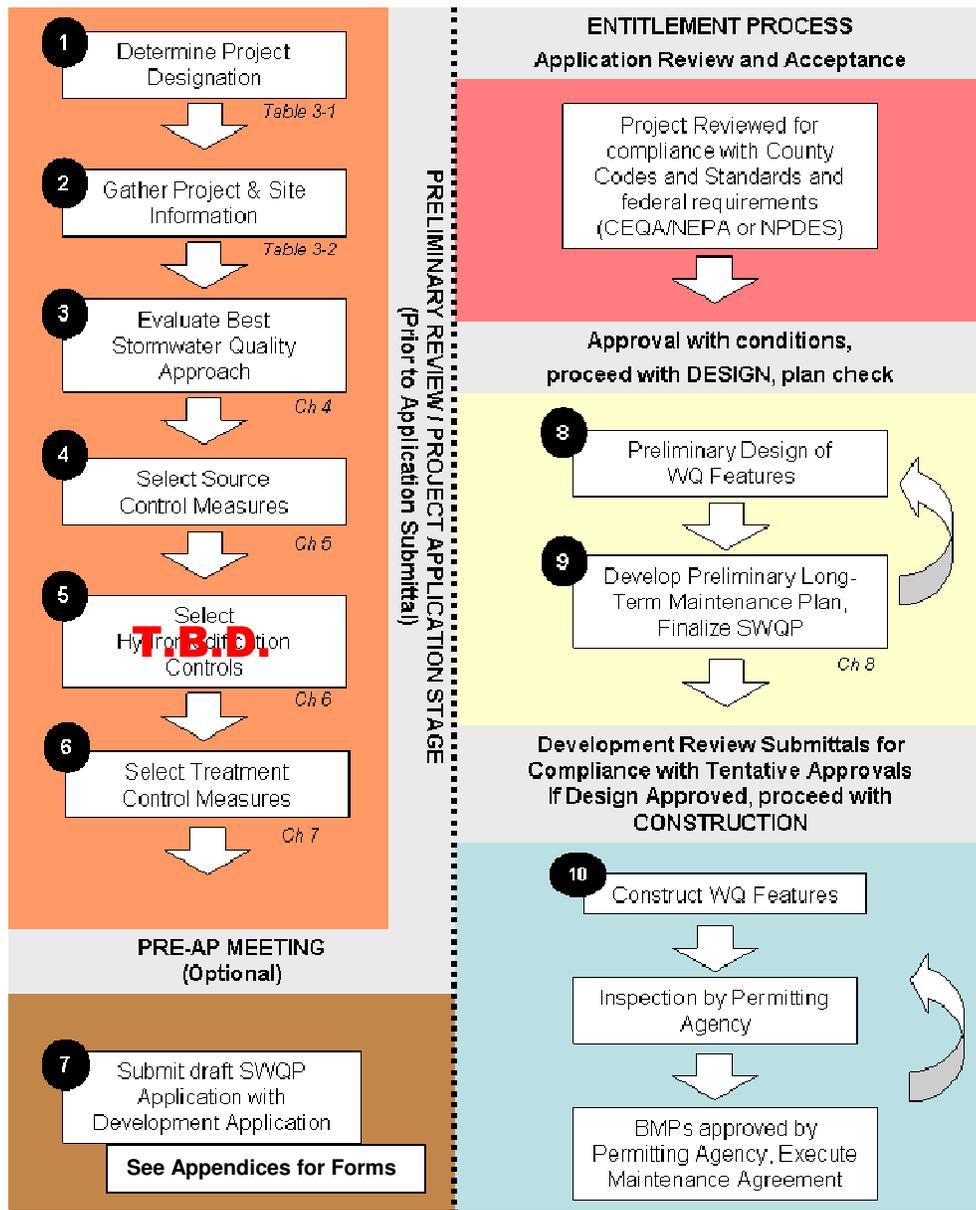


Figure 3-1: Process for Addressing Stormwater Quality Requirements during the Development Review Process

Stormwater management strategies should be considered early in site planning. Including stormwater management in the preliminary site plan can reduce overall project costs by minimizing rework and reducing infrastructure costs. Early planning enables more stormwater management flexibility.

The County’s application process is designed to assure that post-construction stormwater controls are in place throughout the life of the project. The County requires additional documentation for erosion and sediment controls during construction.

3.2 Ten Steps in the Project Application Process

The ten steps outlined below must be followed to complete a successful project application. Subsequent chapters in this handbook provide more detailed instructions on how to accomplish each step.

Step 1: Determine Project Designation

To determine if your project is a Priority Project, check the appropriate boxes from the table below:

Table 3-1. Project Permit Designation Checklist (also available in Appendix A)

ITEM	DEVELOPMENT AND REDEVELOPMENT CATEGORY	YES	NO
1.	Single-family hillside residences on slopes greater than or equal to 10 percent		
2.	Commercial development where the land area for development is \geq 100,000 square feet		
3.	Automotive repair shop		
4.	Retail Gasoline Outlet		
5.	Restaurant where the land area for development or redevelopment \geq or 5,000 square feet		
6.	Detached residential development of 10 or more units		
7.	Attached residential development of 10 or more units		
8.	Parking lots \geq 5,000 square feet or with at least 25 parking spaces AND potentially exposed to stormwater runoff		
9.	Discharging to Clean Water Act 303(d) receiving waters, Sensitive Riparian Vegetation (SRV) or Wetlands (WET) Overlays		

If you answered **YES** to any of the above questions, your project is considered a **PRIORITY PROJECT** and will be required to submit a Stormwater Quality Plan (SWQP) and a Priority Project Stormwater Quality Application.

If you answered **NO** to all of the above questions and your project does not meet one of the established exceptions or exclusions **AND** your project disturbs greater than or equal to one acre, including projects less than one acre that are part of a larger common plan of

development or sale, your project is considered a **STANDARD PROJECT**. Standard projects must submit a completed Stormwater Quality Standard Project Application.

Projects that disturb less than one acre and are not part of the larger common plan of development or sale, and do not meet any of the Table 3-1 descriptions, may be considered **EXEMPT** from meeting the stormwater quality requirements specified in this handbook. Exempt projects are not required to follow the process outlined in Steps 2 through 10, however following these steps is recommended.

Post-construction stormwater controls are required for all projects. The required documentation and level of processing may vary based on the project designation: **“Priority”**, **“Standard”** or **“Exempt”**. Exempt projects are not required to follow this handbook. Please check with the Planning and Building Department to verify that a project meets the criteria to be considered “Exempt.”

Consult with the Planning and Building Department staff to verify that your project meets the criteria to be considered “Exempt.” Exempt project applicants are encouraged to implement practices that will reduce stormwater impacts associated with development. A list of suggested practices appropriate for homeowners is included on the “Measures Homeowners Can Take to Reduce Stormwater Impacts Form” found in Appendix A.

Maintenance and utility projects are also typically considered “exempt” from meeting the post-construction requirements specified in this handbook. Examples of exempt maintenance projects include routine overlays and slurry seals. Examples of exempt utility projects include the installation or repair of subsurface utilities or aerial utilities. Other types of exempt projects include installation of ADA ramps, small retaining walls, interior improvements and projects on private property that do not require a grading permit.

Industrial activities may be required to obtain an individual General NPDES Permit for Stormwater Discharges Associated with Industrial Activities¹.

Appendix B includes the forms needed for Priority Project stormwater quality applications and Appendix C includes the forms needed for Standard Project stormwater quality applications.

Step 2: Gather Project and Site Information

Gather and evaluate the project and site information listed in Table 3-2. Table 3-2 provides a list of the most commonly needed information, its purpose, and its source. This list is preliminary and more specific information may be required prior to final design.

¹ See State Water Resource Control Board web site at http://www.swrcb.ca.gov/water_issues/programs/stormwater/industrial.shtml for more information on obtaining individual General NPDES Permit for industrial activities.

Table 3-2: Commonly Needed Site Information

CATEGORY	DESCRIPTION	PURPOSE	SOURCE
Hydrologic	Creeks, wetlands, watercourses, seeps, springs, ponds, lakes, areas of 100-year floodplain, any contiguous natural areas, include locations of run-on.	Development location should balance site constraints and opportunities (on the least sensitive portion of a site and conserving the naturally vegetated areas to minimize environmental impacts in general and stormwater runoff impacts in particular).	Site inspections, topographic survey and existing maps such as US Geologic Survey (USGS) quadrangle maps, Federal Emergency Management Agency (FEMA) floodplain maps, and US Fish and Wildlife Service (USFWS) wetland inventory maps.
Receiving Water Limitations	Discharge locations, including existing drainage, developed drainage and storm drain connections, where applicable.	The stormwater plan should be designed considering the receiving water limitations based on the Clean Water Act 303 (d) list of impaired water bodies.	Receiving water quality Clean Water Act 303(d) list for the Central Coast Region http://www.waterboards.ca.gov/water_issue_s/programs/tmdl/docs/303dlists2006/epa/r3_06_303d_reqtmcls.pdf US Geologic Survey (USGS) quadrangle maps
Topographic	Steep slopes, outcrops, or other significant geologic features	The project needs to comply with any local restrictions on development of steep slopes and soils that are susceptible to erosion. Avoidance of such areas is advisable in order to reduce stormwater impacts.	Site inspections, a topographic survey of the site, geotechnical report.
Soil Types	Hydrologic soil groups and depth to groundwater	Determining the feasibility of onsite infiltration of stormwater.	Natural Resources Conservation Service (NRCS) Soils Survey maps http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx
Effective Impervious Area (EIA)	Existing and proposed impervious surfaces, e.g., roof, sidewalk, street, parking lots	To measure the relationship that exists between watershed health and the percentage of impervious surface area within a watershed.	Site inspections, a topographic survey of the site.
Setbacks	Building, septic, open space, riparian, setbacks etc.	Development should be set back from creeks and riparian habitat as required by the local jurisdiction and the Central Coast Regional Water Quality Control Board.	County Dept. of Planning and Building County Code and Environmental requirements. www.sloplanning.org Water Quality Control Plan, Central Coast Region (Basin Plan) http://www.waterboards.ca.gov/centralcoast/BasinPlan/Index.htm

CATEGORY	DESCRIPTION	PURPOSE	SOURCE
Known or suspected Environment ally Sensitive Areas	Biological and culturally sensitive areas	Mature trees and native vegetation offer stormwater control benefits. Their preservation, along with other sensitive areas, is recommended.	County Dept. of Planning and Building County Code and Environmental requirements. www.sloplanning.org
Hazardous areas	Hot spots	Determine suitable BMPs.	Current SLO Co Hazardous Waste Site List, Special Studies, See Appendix H.
Pollutants of Concern (POCs) in Site Runoff	Existing POCs at site and possible POCs after project completion.	Knowing the target POCs at a site is necessary to designs appropriate post-construction BMPs.	Project Site History (see above) Project Pollutant Generating Activities

Review the project and site information listed above to identify site constraints, the most appropriate stormwater treatment control measures, and opportunities to incorporate LID design features into the site and landscape design. Constraints might include impermeable soils, high groundwater, steep slopes, and geotechnical instability. Opportunities might include existing natural areas, localized depressions, and unbuildable portions of irregularly shaped parcels.

Step 3: Evaluate Best Stormwater Quality Approach

The project must demonstrate that it has included measures to reduce stormwater quality impacts. The best way to reduce stormwater quality issues over the life of a project is to employ good site planning techniques that:

- Minimize disturbance of natural drainage features and vegetation;
- Avoid sensitive areas and significant site features;
- Minimize the amount of directly connected and overall impervious surface area;
- Manage stormwater (quality and quantity) as close to the point of origin as possible; and
- Discharge site runoff at a rate and volume that maintains downstream receiving channel stability.

These strategies may decrease the project’s retention or detention requirements as well as the need to incorporate costly mechanical, underground and/or “end-of-pipe” treatment systems into the project.

Table 3-3 is a checklist taken from the Project Stormwater Quality Application. The checklist can be used to determine if the project design reduces or eliminates stormwater quality issues. A **YES** response means that the item is addressed in the project. A narrative should be provided as part of the Stormwater Quality Application to discuss how, and when appropriate, where, the item is addressed in the plans. A **NO** response means the item is not addressed. A **NO** response will require a brief explanation for why the option was not selected. A **N/A** response means that the item does not pertain to the project.

Table 3-3A: Stormwater Approach Considerations

A. Minimize Direct Stormwater Impacts – Refer to Section 4 and Section 6 of this Handbook for more information on how to do this		Yes	No	N/A
1.	Has the project been designed to avoid or reduce impacts to receiving waters and historic flow paths, to increase the preservation of critical areas such as floodplains, wetlands, and areas with erosive or unstable soil conditions?			
2.	For roadway projects, have structures and bridges been designed or located to reduce work in live streams and minimize construction impacts?			
3.	Is flow into natural open spaces conveyed in a non-concentrated manner?			
4.	Are disturbed slopes protected from erosion?			
5.	Have slope lengths or steepness been minimized by utilizing retaining walls, benches or terraces to shorten slope length?			
6.	Has top soil been preserved for re-distribution on disturbed slopes?			
7.	Have areas subject to compaction been minimized (i.e. minimize site disturbance, deep till areas compacted during construction or will soil amending be required)?			
8.	Have landscaped areas been used to minimize the amount of runoff?			

Table 3-3B: Stormwater Approach Considerations

B. Minimize Directly Connected and Overall Impervious Surfaces - Refer to Section 4 and Section 6 of this Handbook for more information on how to do this		Yes	No	N/A
1.	Has the project been designed to minimize its impervious footprint (i.e. reduce street widths, street layouts, cul-de-sac design, parking, reduced setbacks and frontages)?			
2.	Can surfaces with greater porosity be substituted for impervious surfaces (i.e. replace traditional concrete and asphalt with permeable pavers or porous concrete)?			
3.	Where landscape is proposed, do rooftops, impervious sidewalks, walkways, trails and patios drain into adjacent landscape?			

Table 3-3C: Stormwater Approach Considerations

C. Increase the Travel Time of Water off the Site (Time of Concentration) - Refer to Section 4 and Section 6 of this Handbook for more information on how to do this		Yes	No	N/A
1.	Have grades been flattened for stormwater conveyance to the minimum sufficient to allow positive drainage?			
2.	Are swales utilized in lieu of pipe or hardened channels (i.e., shallow grade swales with sand or gravel substrate below the vegetation to promote infiltration and storage)?			
3.	Is the post-development Time of Concentration (Tc) greater than the Tc for the pre-development condition?			

Table 3-3D: Stormwater Approach Considerations

D. Reduce Risk of Channel Erosion - Refer to Section 4 and Section 6 of this Handbook for more information on how to do this		Yes	No	N/A
1.	Has the project mitigated project-related increases in downstream velocity, volume and/or sediment loading?			
2.	Has the project addressed all project-related stream encroachments, crossings, realignments, or other hydraulic changes upstream and downstream of the project?			
3.	Have energy dissipation devices been included at outlets?			
4.	Are all transitions between culvert outlets/headwalls/wing walls and channel areas smooth to reduce turbulence and scour?			
5.	Are detention facilities included to reduce peak discharges?			

See Chapters 4 and 5 for a detailed description of potentially suitable site design and source control measures. LID criteria pertaining to hydromodification control will be developed through the Joint Effort amongst jurisdictions in the Central Coast Region. Once these criteria have been determined, they will be incorporated into Chapter 6 of this document by resolution of the Board of Supervisors after a duly noticed public hearing.

A pre-application meeting at this step is beneficial and is recommended.

Step 4: Select Source Control Measures

Source control measures include activities, prohibition of practices, maintenance procedures, managerial practices, or operational practices that aim to prevent stormwater pollution by reducing the potential for contamination at the source of pollution. The goal of implementing source control measures is to:

- Prevent stormwater from contacting work and storage areas so it doesn't pick up pollutants; and
- Prevent pollutants from contacting surfaces that come into contact with stormwater runoff.

All sources of potentially significant post-construction pollutant loading shall be identified. The introduction of pollutants from these sources into stormwater and non-stormwater discharges shall be prevented or reduced to the maximum extent practicable.

Table 3-4 identifies the source control measures and when they are required.

Table 3-4: Source Control Measures

Source Control Measure (Section Reference)	Requirements
Water Quality Markers (5.2.1)	Mandatory on all projects with inlets connected to storm drain system.
Alternative Building Materials (5.2.2)	Voluntary on all projects.
Clean Water Segregation (5.2.3)	Voluntary on all projects, but doing so will reduce water quality treatment requirements associated with priority projects.
Efficient Irrigation (5.2.4)	Voluntary on all projects.
Fueling Areas (5.3.1)	Mandatory on all projects with fueling areas.
Maintenance Bays and Docks (5.3.2)	Mandatory for 100,000 sf commercial developments with loading docks and retail gasoline outlets, automotive repair shops.
Trash Storage Areas (5.3.3)	Mandatory for all Priority Projects except single family residences.
Vehicle Washing Areas (5.3.4)	Mandatory for all Priority Projects except single family residences.
Material Storage Areas (5.3.5)	Mandatory for all Priority Projects except single family residences.
Pool/Spa/Fountain Discharge (5.3.6)	Clean out or designated land disposal area mandatory for projects with pools, spas or fountain discharges.
Outdoor Work and Processing Areas (5.3.7)	Mandatory for all Priority Projects except single family residences with outdoor work or processing area.
Pet Waste Management (5.3.8)	Voluntary on all projects.

Chapter 5 provides instructions and acceptable design criteria for various site-specific source control measures.

The use of **runoff reduction measures** can reduce the amount of treatment control measures required for a site.

Step 5: Implement Hydromodification Measures

Step 5 is not a requirement at this time. Selection of appropriate LID Measures identified in Step 4 and Step 6 will satisfy the requirements until such a time as hydromodification control measures are adopted into Chapter 6 of this handbook by the Board of Supervisors after a duly noticed public hearing.

The goal of implementing hydromodification measures is to mimic a site's predevelopment balance of runoff and infiltration. Two components satisfy hydromodification requirements: volume control and peak flow rate control.

Volume control requires that the post-developed project infiltrates the same volume of water as the pre-development condition for the design storm. Once adopted, Chapter 6 will provide additional details on volume control BMPs.

Peak flow rate control requires that the post-developed project retains the pre-development peak discharge rate for the design storm. Once adopted, Chapter 6 will provide guidance on determining a site's pre-development condition and provide techniques that can be used to infiltrate, filter, store, evaporate, or detain runoff close to its source.

Step 6: Select Treatment Control Measures

Stormwater treatment control measures are required for all Priority Projects. Treatment control measures are designed to reduce the concentration of pollutants in site runoff. The selection of a specific treatment control measure is based on a number of considerations, including:

- Type of pollutant targeted for removal;
- Receiving water limitations;
- Volume or flow rate of runoff to be treated;
- Amount of space available within the project;
- Site-specific conditions and associated limitations;
 - Slopes;
 - Depth to water table;
 - Depth to bedrock/hardpan;
 - Proximity to foundations/wells/septic systems; and
- Costs to construct and maintain.

Chapter 7 provides several tools to aid in selecting an appropriate treatment control measure based on the type of pollutants expected. In general, "end of pipe" treatment approaches are costly and maintenance intensive and are the least favorable option.

Applicants may request a waiver from the requirement to install Treatment Control Measures if they can provide an alternative compliance measure approved by the Director of Planning and Building and Director of Public Works, and also demonstrate that:

- The installation of stormwater treatment devices or flow control devices are impracticable for their particular site, or

- The applicant will financially support an alternative project that will provide other equivalent water quality benefits.

The CCRWQCB prefers natural/passive water quality control BMPs over mechanical and underground options, but will allow for mechanical and/or underground options when passive water quality control BMPs have been found to be infeasible. Applicants must incorporate LID methodology into new and redevelopment projects unless they can demonstrate that conventional BMPs are equally effective, or that conventional BMPs would result in a substantial cost savings while still adequately protecting water quality and reducing discharge volume. In order to justify using conventional BMPs based on cost, the applicant must show that the cost of LID would be prohibitive because the “cost would exceed any benefit to be derived.” (State Water Resources Control Board Order No. WQ 2000-11.)

Conventional site layouts, construction methods, and stormwater conveyance systems with “end of pipe” basins and treatment systems that do not address the changes in volume and rates of stormwater runoff and urban pollutants (including thermal pollution) do not meet MEP standards.

Step 7: Prepare Application Submittals

All applicants are required to describe how existing runoff characteristics will be affected by the development project. The application shall contain measures for mitigating any adverse impacts to water quality. The submittal requirements vary based on the project designation.

Project Designation	Submittal Requirements
<u>Standard</u>	<ul style="list-style-type: none"> √ Standard Project Stormwater Quality Application (Appendix C) √ LID Project Checklist (Appendix D)
<u>Priority</u>	<ul style="list-style-type: none"> √ Stormwater Quality Plan (Appendix B) √ Priority Project Stormwater Quality Application (Appendix B) √ LID Project Checklist (Appendix D)

All Standard and Priority Projects must complete the LID Checklist, attached in Appendix D. This checklist is intended to allow the applicant to demonstrate how their project will meet the minimum requirements for LID design on their site. A project will be considered consistent with the LID Handbook if the project can achieve 14 credits (18 credits for rural development). Conditions of project approval will reflect the applicant’s selected LID techniques.

Step 7a: Priority Projects Submittals

The Stormwater Quality Plan (SWQP) is a document that describes how existing runoff characteristics will be affected by development and contains measures for mitigating any adverse impacts to water quality. The SWQP shall identify constraints, expected pollutants of concern, and site design measures that minimize impervious surfaces and redirect runoff

from impervious surfaces to pervious surfaces, as well as source and treatment control BMP locations. In addition, the SWQP must be consistent with other application material (plans and reports). Things to consider when coordinating stormwater controls with other site construction plans include:

- **Excess fill.** Excavation for landscape detention areas, swales and other BMPs, as well as over-excavation/replacement of clay soils with more permeable soils, can alter the cut-and-fill balance for site grading. By considering this issue early in the site design, it may be possible to avoid excessive export of soil from the site.
- **Soil Compaction during construction.** Compaction from construction traffic can radically reduce the infiltration capacity of site soils. Construction staging plans should set aside and protect areas that will be used for infiltration BMPs.
- **Building Drainage.** Building codes require that drainage from roofs and impervious areas be drained away from buildings. The UBC also specifies minimum size and slopes for runoff leaders and drain piping. Detailed designs for BMPs locating in or on the building, or that may affect the building foundations, must accommodate these codes while also meeting the minimum requirements for detention or flow stated in this handbook.
- **Control of Elevations.** Distribution of overland flow to landscaped areas will require that grading and landscape plans be coordinated to provide adequate reveal (a drop required between pavement and vegetated areas to avoid ponding at edge of the paved surface) and prevent differential settling.
- **Drainage Plans.** Water quality measures are typically sized for low flow conditions. They must be able to incorporate or bypass flood flows. Drainage basin release rates must consider detention times and water quality sizing discharge criteria which are likely to be different from flood control sizing criteria.
- **Landscape Plans.** Bioretention areas, vegetated swales, wetlands, etc., require appropriate plant selection to function properly. Additionally, several of the source control BMPs require specific plant and irrigation selection.
- **Organizing Traffic and Parking.** Your stormwater plan may call for depressing landscape areas below paved areas rather than setting them above paved areas and surrounding them with curbs. Striping or bollards may be needed to guide traffic.
- **Maintenance Procedures.** Preservation of grades, drainage structures and landscaping, etc.

Stormwater Quality Plans (SWQPs) are required for all Priority Projects and shall accompany the Priority Project stormwater quality application. The SWQP must meet the design requirements of the County and include sufficient information to evaluate the environmental characteristics of affected areas, the potential impacts of the proposed development on water resources, and the effectiveness and acceptability of measures proposed for managing stormwater runoff. The information to be provided in the SWQP is provided in Appendix B.

The SWQP shall be prepared under the direction of a professional civil engineer registered in the State of California. The plan shall be stamped, signed and include a certifying statement indicating that all stormwater BMPs have been designed to meet the County's stormwater quality requirements.

A professional civil engineer must certify that the improvements conform to the approved plans before final inspection or sign off. The certifying engineer shall provide proof that they have been trained on BMP design for water quality not more than two years prior to the signature date. Training conducted by an organization with stormwater BMP design expertise may be considered qualifying. Examples of organizations deemed qualified to provide stormwater BMP design training include:

- California Stormwater Quality Association;
- American Society of Civil Engineers;
- American Society of Landscape Architects;
- American Public Works Association; and
- California Water Environment Association.

If the plans include additional plants not listed in the County's approved plant list, landscape plans shall be prepared under the direction of a professional landscape architect registered in the State of California.

Step 7b: Standard Project "Application" Submittals

In lieu of providing a Stormwater Quality Plan, Standard Projects may address post-construction stormwater management as part of the preliminary drainage report. Applications must also include the Standard Project Stormwater Quality Application in order for the report to be deemed complete.

Stormwater Quality Applications shall be submitted with the permit applications (e.g. land use permit, subdivision, grading permit, etc.) for the proposed project. Within 30 days of receipt of project applicant and Stormwater Quality Application (for both Priority and Standard projects), the application will be evaluated for completeness and, if necessary, additional information will be requested.

Once found to be complete, an environmental determination will be made on the application to determine if significant environmental impacts could potentially result from the proposed project. Mitigation measures may be required to reduce impacts to a level of insignificance, or an Environmental Impact Report may be required.

For discretionary projects, the Department will prepare a staff report to the Review Authority (e.g., the County Planning Commission, Subdivision Review Board) for the project's consideration. The Review Authority, based on County ordinances and policies, project facts, the environmental determination, and recommendations from other agencies, may approve, conditionally approve or deny the application. Pursuant to Sections 22.10.155.J (Land Use Ordinance) and 23.04.450.j (Coastal Zone Land Use Ordinance), the Review Authority may consider waiver or modifications of requirements under this Handbook. If the project is approved, proceed to Step 8.

Step 8: Submit Final Stormwater Quality Plan

Standard design guidelines (Chapters 4, 5, 6 and 7) are provided in this handbook. Alternative designs will be considered if documentation is provided that includes supporting calculations and testing results that demonstrate equal water quality protection.

Priority projects will be required to implement all stormwater-related conditions of approval and mitigation measures associated with the approved project in a Final Stormwater Quality Plan.

Standard projects will document final stormwater related features in a water quality section in their final drainage report.

Step 9: Establish Long-Term Maintenance

The long-term performance of BMPs depends on proper maintenance.

Prior to the issuance of building or grading permits (or prior to establishing a use) requiring stormwater management BMPs, the property owner(s) shall enter into a formal written stormwater BMP operation and maintenance agreement with the County². The plan shall describe who is financially responsible for long-term maintenance. The required content of the Long-Term Maintenance Agreement is provided in Chapter 8.

Step 10: Construct Water Quality Features

While the owner is responsible for self-certification and inspection, the County will review water quality BMPs throughout construction. BMPs must be constructed according to the approved plans. BMPs relying on infiltration must be protected from contamination from construction site runoff.

² Reference LUO Section 22.10.155G.7 and CZLUO Section 23.04.450.g(7)

Ch 4: Good Site Planning & Design Using LID Integrated Management Practices

This chapter provides a guidance primer to assist applicants in integrating stormwater management and hydrologic goals and objectives into good site planning and design.

4.1 Introduction to Good Site Planning & Design

New development and redevelopment projects¹ that consider stormwater management early in the design process are much more successful in reducing the need for expensive stormwater treatment controls later. It is more efficient and cost-effective to prevent stormwater problems early rather than fixing them later.

Consider these fundamental Low Impact Design principles first to reduce project water quality impacts:

- Stormwater is rain, an important natural resource that is critically important for replenishing our streams, reservoirs, and groundwater supplies.
- LID post-development stormwater management systems use the natural features of the project site to mimic pre-development runoff characteristics (volume, rate, timing and pollutant loading).
- Using onsite storage, infiltration, transpiration and evaporation of stormwater reduces water quality impacts in contrast to discharging stormwater directly to water bodies.
- Non-LID structural or maintenance-heavy practices (such as detention basins, hydrodynamic structures, water quality filters, etc) should be used after all LID (non-structural) integrated management practices have been fully explored and deemed technically infeasible, environmentally unsound, or too costly.

4.2 Planning Level Considerations

This section provides design guidelines to minimize stormwater impacts at the planning level.

Guiding Principles

When weighing potential development locations within a site, consider the constraints and opportunities for the site and adjacent properties. Ideally, the following considerations should be addressed:

- Follow the topographic contours to minimize soil and vegetation disturbance and the loss of topsoil and organic duff layer when laying out roads and lots.
- Avoid excessive grading, that is, grading beyond that which is necessary to construct the project.

¹ “Redevelopment projects” are as defined in the Land Use Ordinance and Coastal Zone Land Use Ordinance. An example of a redevelopment project would be the creation or addition of at least 5,000 square feet of impervious area on a previously developed site.

- Limit removal of rock outcroppings, natural drainage courses, wildlife corridors, and mature native vegetation to the greatest extent possible.
- To reduce the extent of grading required and vegetation impacted, pads should not be built on compacted soil that is significantly raised above existing topography, unless no feasible alternatives exist given engineering constraints.
- Maintain buffers between developed areas and riparian corridors and shorelines.
- Cluster development areas to maximize the area available for stormwater infiltration and to reduce the effective impervious area of a project.
- Discharge impervious areas to vegetated areas.
- Surface infiltration systems are preferred over subsurface systems.
- Bioretention areas or vegetated channels designed with detention are preferred only where full infiltration is not feasible.

4.2.1 Development Constraints and Opportunities

Description

Carefully consider the optimal location for the building site within the project area. The building site location can influence the site's overall potential for erosion, habitat disruption, and ability to infiltrate water. Integrate the development project into the site rather than modifying the site to fit the proposed development project. Inventory the environmental features of the site and adjacent properties to assess how the project will impact or be influenced by the surrounding areas. To determine the project's constraints and opportunities, the analysis should consider both site and watershed-wide features.

Applicability

These procedures are most suitable for new development projects or projects seeking to expand.

Limitations

Redevelopment and in-fill projects may have limited opportunity to incorporate these recommendations.

Design Criteria

To the extent possible, development should be located outside natural protection areas (as identified in the preliminary site assessment) and within designated buildable areas to minimize soil and vegetation disturbance and to take advantage of the site's natural ability to store and infiltrate stormwater. The following design criteria are intended to help foster a development plan that is compatible with the site:

- Conserve natural areas, soils and vegetation, preferably in contiguous blocks or linear corridors.
- Drain runoff from impervious areas through vegetated areas before leaving the site.
- Avoid stream crossings for roads and conveyance systems whenever possible.

- Integrate small, dispersed bioretention areas to capture, store, and infiltrate stormwater on-site.
- Maintain pre-development flow path lengths, groundwater recharge rates and natural drainage patterns, whenever possible.
- Minimize soil compaction, where feasible.
- Minimize site disruption, where feasible.

Site Analysis Process

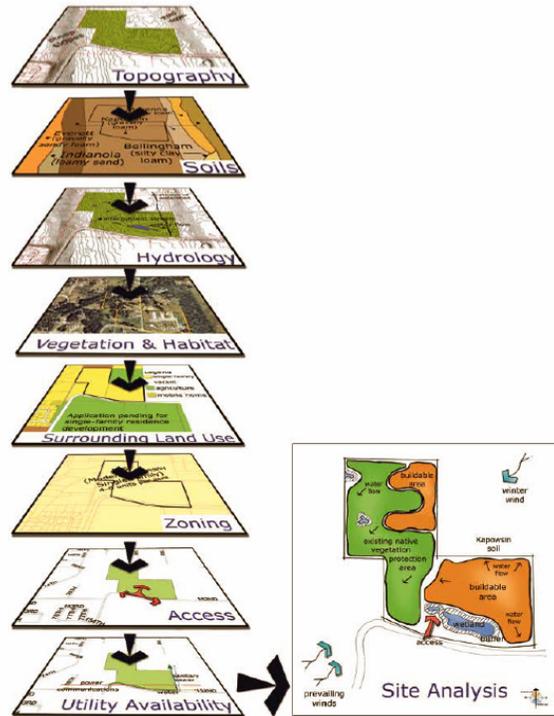


Figure 4.2.1-1 – Site Analysis Process (excerpted from Puget Sound LID Manual, graphic by AHBL Engineering)

Process

Develop a site constraints map that shows:

- Creeks, wetlands, watercourses, seeps, springs, ponds, lakes and areas within the 100-year floodplain, including existing drainage patterns including locations of concentrated run-on and runoff.
- Natural steep slopes, cliffs, outcrops, or other significant geologic features, as well as geotechnical hazard areas.
- Tree conservation areas (include tree species, diameter at breast height, canopy cover and condition of ground cover and shrub layer).
- Hydrologic soil groups and areas with high groundwater. Highlight the soils that provide the greatest opportunity for storage and partial infiltration.

To determine the most suitable areas for development, you will also need to consider other constraints, such as visual, traffic, septic systems, easements, etc.

To receive an overview of the process and a checklist of information and materials you will need to provide, schedule a pre-application meeting with County planning staff.

- ___ Existing impervious surfaces, e.g., roofs, sidewalks, streets, and parking lots. Differentiate between streets with rates of 15,000 average daily travel (ADT) and streets with 25,000 ADT.
- ___ Archeological (use terminology such as “Environmentally Sensitive Area”) and biological sensitive areas, including potential wildlife movement corridors.
- ___ Existing fuel tanks (both on-site and within 500 feet of site).
- ___ Public and private wells and septic systems including leach lines (within 250 feet of the site).

Use the site information collected and design criteria to locate the most suitable areas for development on the site constraints map.

4.2.2 Landform Grading

Prerequisite A.2
PRIORITY: Required
STANDARD: Required

Description

Landform grading is a technique that converts “engineered” slopes to stable, naturally functioning slopes that mimic nature. Concave slopes allow water and vegetation to concentrate at flow lines. Grasses and groundcovers are planted on the convex portions of the slopes. Landform grading is intended to reduce erosion potential, runoff, and water quality degradation associated with land form alteration (grading).

Applicability

Landform grading is suitable on all development projects that require significant cut and fill and where the average natural slope is ten percent or greater.

Limitations

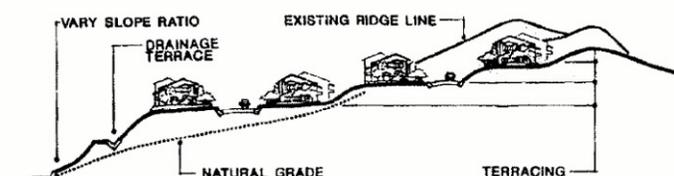
Grading must be consistent with geotechnical engineering recommendations.

Design Criteria

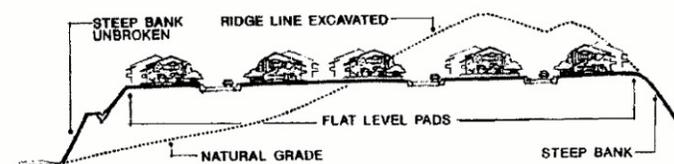
The overall grading of the project should work together with the surrounding topography, existing vegetation, circulation, and land features as well as other elements of the total project site to minimize the erosion potential, runoff and water quality degradation associated with land form alteration (grading). Grading proposals should conform to the following standards:

- In lieu of one large pad, development proposed for hillsides should use smaller pads gradually terracing up hillsides, where feasible.
- The use of long, continuous slopes with sharp, angular forms should be avoided. Slopes should retain a natural appearance.

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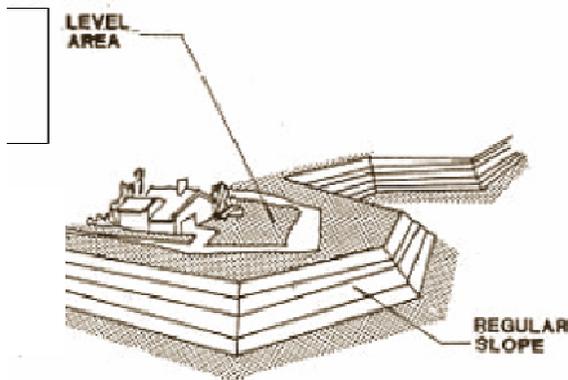


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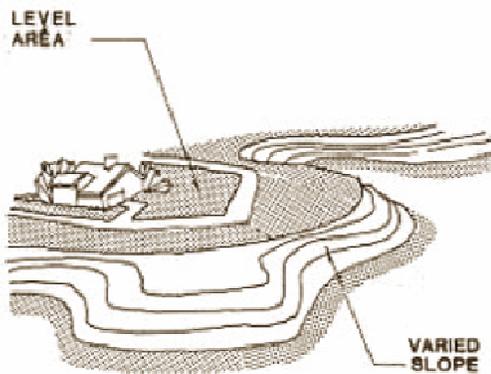


Source: White County Sample Mountain and Hillside protection ordinance

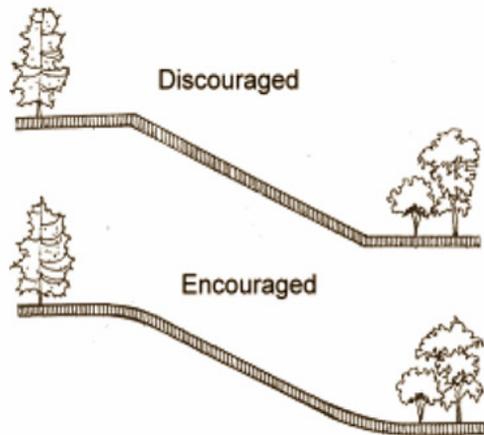
- Hillside development should conceal graded slopes and retaining walls, where possible. Retaining walls and all significantly graded slopes should be planted.
- Pads should not be built on compacted soil that is significantly raised above existing topography, unless no feasible alternatives exist given engineering constraints.
- Avoid creating directly connected impervious areas, where possible.
- Require compacted soils in areas receiving sheet flow runoff (such as yards, down slope of downspouts) be disked and amended with loam prior to planting.
- Ensure that concentrated flow paths have stable outlets able to handle the water expected to be received.



UNDESIRABLE TYPICAL SLOPE GRADING



DESIRABLE CONTOUR SLOPE GRADING



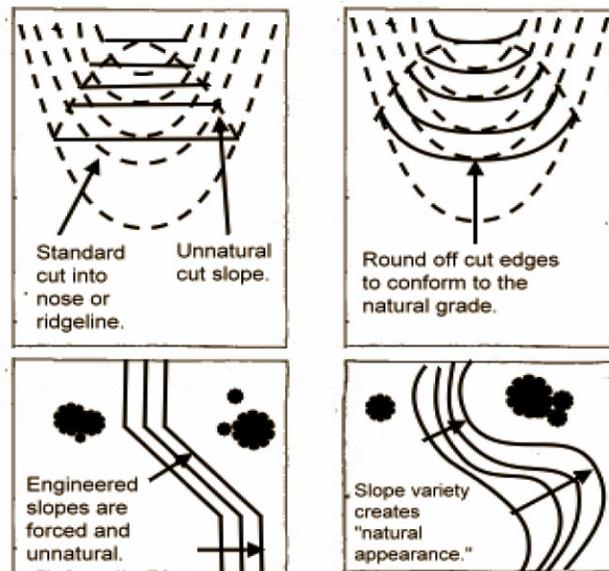


Figure 4.2.2-2
(Excerpted from City of Encinitas Grading Ordinance)

Credit B.4.1 / B.4.2 / B.4.3
1-3 Credits

4.2.3 Clustered Development

Description

Clustered development maximizes open space and encourages site planning sensitive to the natural characteristics of the land. It also helps reduce the effective impervious area associated with development.

Applicability

Clustering may be used with nearly all development projects, but is most effectively used in the development of subdivision of larger parcels, where concentrating the allowable development on only a portion of the site allows preservation of sensitive resources. Incentives such as smaller lot size or bonus density increases over that permitted in the zone are often components of cluster development.

Limitations

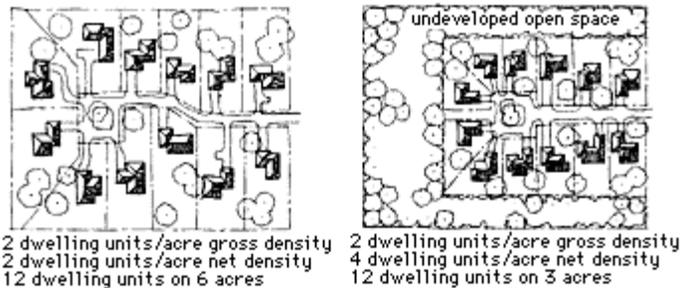
Grading plans must comply with geotechnical engineering recommendations.

Design Criteria

To the extent possible:

- Preserve areas within or adjacent to identified sensitive areas (steep slopes, wetlands, riparian corridors, etc) or with high infiltration capacity.
- Run-on to preserved areas should mimic existing natural drainage patterns (i.e. if run-on formerly was conveyed to an area under sheet flow conditions, sheet flow conditions shall be maintained to the preserved area even after development of the surrounding area).
- Bioretention and open swale systems are integrated into landscaping.

- Road and driveway stormwater are dispersed to adjacent open space and landscaped areas.
- Pre-development flow path lengths in natural drainage patterns are maintained, or lengthened as necessary to prevent an increase in runoff rates.
- Native vegetation and soils are preserved or enhanced to disperse, store and infiltrate stormwater.



Sources for Figures 2, 3, 4, and 5: Protecting Water Quality in Urban Areas: Best Management Practices for Minnesota, Ch. 3, Minnesota Pollution Control Agency, Division of Water Quality, St. Paul, MN, Oct. 1989.
Excerpted from City of Chesapeake, VA –Design Guidelines Handbook

4.2.4 Parking Alternatives

Credit B.2.1
1-2 Credits

Description

Nearly all rainfall falling onto parking areas constructed of impervious surfaces (asphalt and concrete) will runoff the site. As runoff travels over the parking surface, it picks up sediment, dust, oils and greases. The smooth surface of the pavement increases the rate and volume of runoff.

Reducing parking standards not only reduces impervious surface area, but also reduces parking related development cost and is intended to assure that the number and type of parking spaces specified does not exceed the number of parking spaces needed for the project.

Applicability

Parking alternatives are appropriate for adjacent developments with different peak demand periods and can be effective in compact and/or high density communities where dwelling units are within walking distance to transit stops and services.

Limitations

Reduction or elimination of off-street parking requirements for one neighborhood or commercial center may increase the parking density of adjacent neighborhoods or commercial centers. Shared parking agreements must include a contingency plan to accommodate changes in ownership, operations or other uses that might increase the parking demand in the future.

Design Criteria

- Parking requirements should reflect projected demand for parking and include an analysis of the potential impact of spillover parking on adjacent areas.
- Minimize off-street parking to meet or decrease Title 22 and 23 parking ratios. If additional parking beyond the parking ratios is permitted, consider using pervious materials or storied parking garages.
- Maximize the use of compact car spaces.
- Use parking garages where feasible.
- Use pervious parking surfaces.
- Use legally binding shared parking agreements when adjacent proposed land uses have peak parking demands at different times of the day or week.
- Incorporate bioretention areas into parking lots.



http://www.slocountyhomes.com/uploaded_images/100_0210-726655.JPG

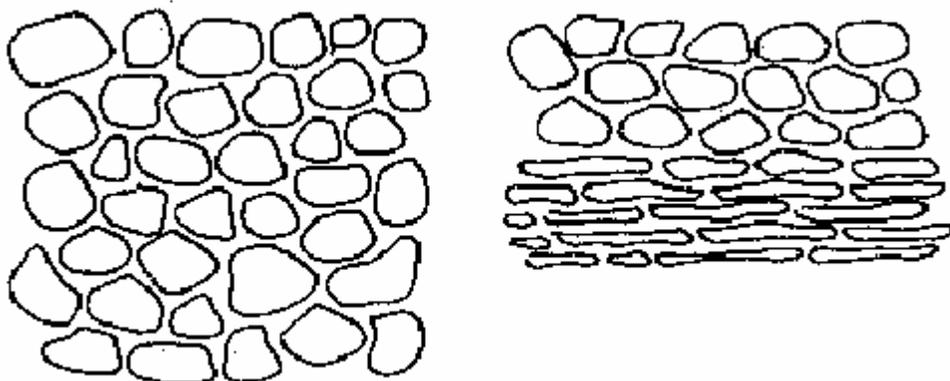
4.2.5 Conserve Top Soil

Credit A.1.1 (1-2 Credits)
Credit A.1.2 (1-2 Credits)

Description

Undisturbed top soil has characteristics (texture, structure and biology) well suited for infiltration and water treatment. When soil is compacted or otherwise disturbed, it can lose its texture, structure and biology.

The soil on the left has pore spaces indicative of healthy soil that allows the efficient exchange of air and water. The soil on the right is compacted and will restrict root growth, limit infiltration and air circulation in the soil.



Source: <http://www.dpi.nsw.gov.au/agriculture/resources/soils/structure/compaction>

Applicability

These procedures are suited for most sites.

Limitations

None

Design Criteria

To the extent possible,

- Top soil to be conserved in place shall be identified and delineated on the plans and in the field using orange construction fence around areas to be protected from heavy equipment.
- Areas requiring cuts shall have the native topsoil removed (to the depth of the top soil) and stockpiled for replacement to the surface of the area cut or used elsewhere on the site to amend areas with deficient topsoil. Stockpile depths shall not exceed 3 feet if left in staging area for more than 6 months. Stockpiled top soil shall be spread onto cut slopes that have been tilled to a depth of 6 inches. The top soil shall be placed in lifts not exceeding 1 foot. Compaction should be limited to the density of existing, undisturbed areas.
- Natural resource areas that have been disturbed may need to be replanted with native trees and vegetation.

References:

<http://www.cabmphandbooks.com/Documents/Construction/EC-2.pdf>

4.3 Common Area Design Considerations

The purpose of this section is to provide design guidelines for common areas. Common areas are usually maintained by a public agency, assessment district, or Home Owners Association. The following guidelines are intended to minimize stormwater impacts by incorporating stormwater friendly design principles into project plans.

Guiding Principles

- Reduce overall street lengths and widths in street and sidewalk layouts.
- Convey drainage in open swales rather than in closed conduits.
- Use medians, bulb-outs, cul-de-sacs and roadside swales to limit continuous flow paths over impervious surfaces.
- Use alternative pervious surfaces for driveways, alleys, low volume residential roads and parking lots rather than traditional impervious surface materials.
- Minimize hardscaping by including sidewalks on one side of the street only and/or constructing sidewalks using pervious materials.
- Design stormwater outlets properly to prevent erosion.
- Cluster residential parking areas to maximize area available for non-structural stormwater conveyance (roadside swales).
- Plant trees throughout commercial parking lots, along street frontages, and on residential lots.

4.3.1 Street and Sidewalk Layout

Credit B.4.3
1 Credits

Description

Streets and roads are among the largest contributors to polluted stormwater runoff. LID practices reduce impervious area, maximize stormwater infiltration, and reduce pollutant loads.

Subdivision street and sidewalk layout influences the amount of impervious area significantly. As shown below, the overall impervious area associated with streets is significant. Various street configurations can also influence the connectivity of a neighborhood and the land available for open space.

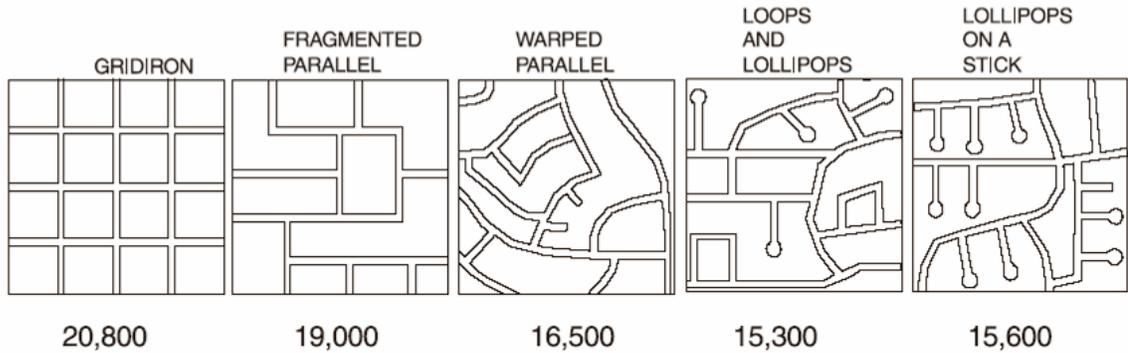
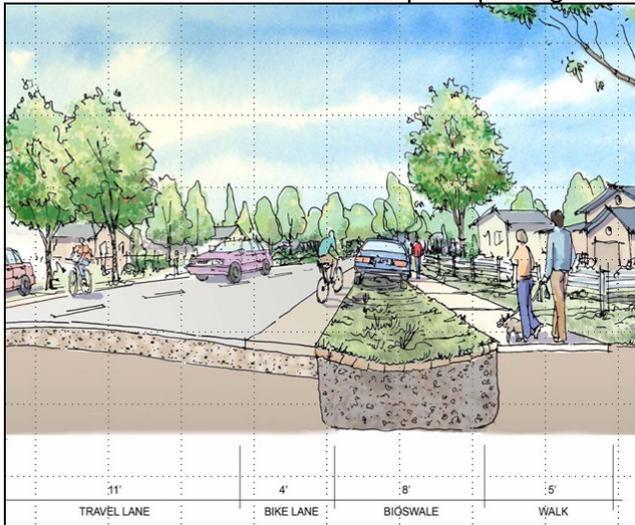
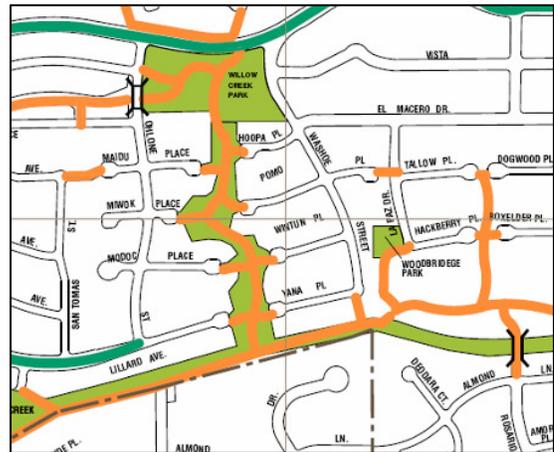


Figure 4.3.1-1 Comparison of linear feet of pavement associated with various street layout alternatives. Excerpted from NEMO LID Handbook, originally adapted from ULI 1980

As shown in the City of Davis Bike Map, pedestrian and recreational facilities can also be used to meet stormwater and open space goals.



Source: RRM Design Group



Source: City of Davis Bike Map

Applicability

These procedures are suitable for all development projects, but must be weighed against other considerations, such as the amount of earthwork required or specific traffic patterns to the site and surrounding areas.

Limitations

The roadway system must follow County Improvement Standards and safely accommodate all users of the road including pedestrians, people requiring mobility aids, bicyclists, drivers and passengers of transit vehicles, trucks, automobiles and motorcycles. Requests to incorporate LID will require an exception in accordance with Section 1.2 “Design Adjustments” of the Public Improvement Standards. The minimum street widths for a particular project may be limited based on average traffic daily counts and/or terrain and size of vehicles requiring regular access to the site.

Design Criteria

To the extent possible,

- Provide pedestrian and bicycle path connections to encourage walking and cycling and increase access without adding significant impervious areas. Plot a likely “paths” exhibit using the lot layout to map pedestrian routes to schools, bus stop and neighborhood services.
- Reduce the length and width of residential streets by reviewing minimum lot widths and exploring alternative street layouts.
- Street location considerations should include natural drainage patterns and soil permeability and must provide for large vehicles, equipment, and emergency vehicles access where applicable.

See the Public Improvement Standard Plans for minimum street widths for public roads and adjustment procedures. Discuss options for reduced street widths with the applicable fire agency.

References:

<http://www.completestreets.org/resources.html>

<http://www.walkinginfo.org/index.cfm>

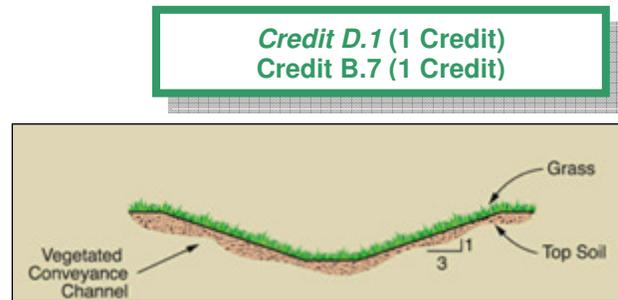
4.3.2 Vegetated Open Channels

Description

Vegetated open channels are shallow channels meant to blend into surrounding landscape while conveying stormwater runoff short distances, typically ending at a bioretention facility, detention or retention basin or to a level spreader. This design technique should be considered instead of storm drain pipes at locations where storm drain pipes are proposed.

Applicability

This practice should be considered on all projects with ground slopes less than 4 percent. Tributary areas to open channels may be limited to allow runoff to be conveyed in a non-erosive manner.



Credit D.1 (1 Credit)
Credit B.7 (1 Credit)

www.omafr.gov.on.ca

Limitations

Structures and pavements adjacent to vegetated open channels may require a moisture barrier to preserve their integrity. Pipe systems may be more appropriate on sites with steep slopes or highly erodible soils. Depending on the tributary area, a high-flow drainage system may be necessary. Vegetated open channels are not appropriate at locations with high ground water table elevations. Grassed swales without underdrains may result in soggy, wet areas conducive to mosquito breeding.

Design Criteria

To the extent possible,

- Channels should be sized to maintain a low velocity during small storms and to accommodate secondary design storms (see Public Improvement Standard 5-1) without significant erosion or re-suspension of accumulated sediment.
- Channels should have shallow depths and gentle side slopes.
- Swales should be planted with native vegetation. The vegetation of channels located along a roadway and at driveways must conform to County Standard Plan A-5a and A-5b (no greater than 30 inches).
- Check dams may be used to increase detention time, slow the velocity of runoff, and allow sediment to settle out.
- Use pipe or subsurface stone recharge bed to accommodate driveways and intersecting roads. Infiltration is promoted by elevating the outlet of the channel above the flow line of the pipe or subsurface stone recharge bed.
- To obtain water quality treatment control benefit, the water surface elevation associated with water quality storms must not exceed the vegetation height AND the runoff should remain in the channel for a minimum of 10 minutes.

Channels adjacent to roads may require pavement edge stability measures (such as a flush curb), to keep the pavement edge from spalling.

References:

http://www.stormwatercenter.net/Handbook_Builder/Performance%20Criteria/Open%20Channels.htm
www.cabmphandbooks.com/Documents/Development/TC-30.pdf
<http://www.epa.gov/owm/mtb/vegswale.pdf>

4.3.3 Multi-Functional Landscapes

Areas proposed for landscaping can also be used to filter, treat and infiltrate stormwater runoff. Often this requires an interdisciplinary team to ensure the functionality of the landscaped areas. This team should be assembled early in the design process and consist of geotechnical engineers, landscape architects, architects and civil engineers.

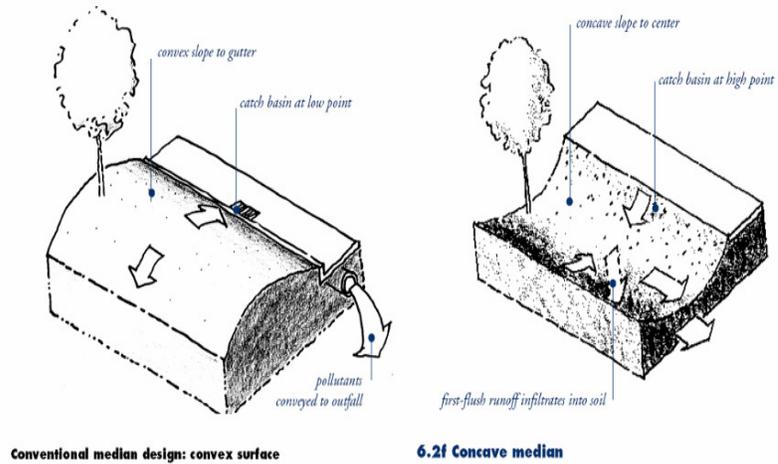
Credit B.3
1-3 Credits

This section includes LID practices that can be implemented in common areas or private yard areas to meet diverse functional needs.

4.3.3a Concave planted areas

Description

Most vegetated areas in parking lots, along roads or in landscaped medians can be designed to reduce the overall amount of runoff (and treatment required for that runoff) that leaves a site simply by using concave rather than raised landscaped areas. Concave landscape areas reduce overall effective impervious area, treat first flush runoff, and recharge groundwater supplies at locations where site engineering or subsurface soil conditions allow infiltration.



Start at the source.

Applicability

This practice is suitable for all planted areas within roadway medians, parking lots islands and at the center of cul-de-sacs, with planting widths greater than 2 feet. It also applies to locations where retention/detention basins are necessary.

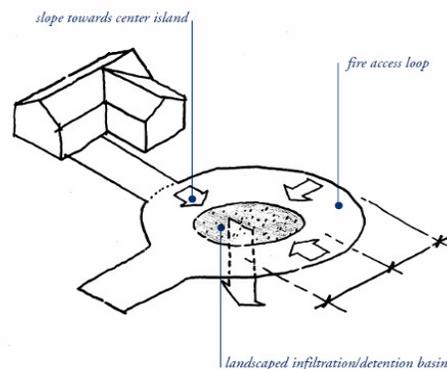
Limitations

Structures and pavements adjacent to concave medians may require a moisture barrier to preserve their integrity. Depending on the tributary area, a high-flow drainage system may be necessary.

Design Criteria

To the extent possible,

- Concave, planted areas are favored over impervious or convex planted areas.
- Overflow drains or paths are placed strategically to allow some of the stormwater to percolate into the soil.



If necessary, replace existing soil with engineered soil mixtures designed to enhance retention and pollutant breakdown.

References:

[http://scvurppp-](http://scvurppp-w2k.com/pdfs/0203/c3_related_info/startatthesource/Start_At_The_Source_Full.pdf)

[w2k.com/pdfs/0203/c3_related_info/startatthesource/Start_At_The_Source_Full.pdf](http://scvurppp-w2k.com/pdfs/0203/c3_related_info/startatthesource/Start_At_The_Source_Full.pdf)

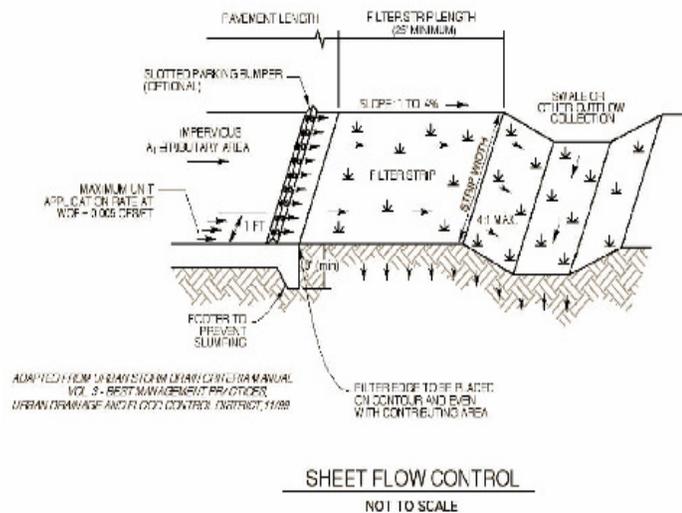
4.3.3b Vegetated Filter Strips

Description

Filter strips are vegetated areas that are situated between an impervious area and a location where runoff will leave the site. The vegetation (typically grass) serves to slow runoff velocities and filter out pollutants.

Applicability

This practice should be considered on projects that receive sheet flow runoff and room available to provide at least 25 feet of filter strip slope length. The width of the filter strip should extend the length of the pervious area or level spreader tributary to it. Tributary areas should be less than 5 acres.



Limitations

Filter strips are not appropriate for use on unstable or steep slopes. Runoff with high contaminate levels should be treated prior to discharge over a filter strip.

Design Criteria

- Filter strip slope should not exceed 6%. Slopes between 2 and 4% are more ideal. Slopes less than 2% may create mosquito habitat.
- Slope should be disked to a depth of 6 inches to incorporate topsoil for plant growth.
- Strips should not be overly long (which tends to concentrate runoff).
- The top and toe of a filter strip should be level to prevent erosion and encourage sheet flow.
- Benching can be used in conjunction with level spreaders to restore sheet flow when greater filter strip lengths are required.

References:

See California Stormwater BMP Handbook Vegetated Buffer Strip Treatment Control Fact Sheet at <http://www.cabmphandbooks.com/Documents/Development/TC-31.pdf>

4.3.3c Detention and Retention Basins

Shallow retention and detention basins may be suitable as playgrounds or picnic areas.

Description

Detention basins temporarily store stormwater runoff and slowly release it through an outlet (control structure).

Retention basins temporarily store stormwater runoff until it can be infiltrated into the ground.

Applicability

This practice should be considered on all projects with the need to maintain pre-existing peak flows (detention) or pre-existing volumes (retention). Shallow, multi-functional basins are most appropriate for small tributary areas.



Small multi-functional detention area at Dove Creek (Atascadero, CA).
Source Wallace Group.

Limitations

Retention basins must adhere to County Public Works requirements.

Neither type of basin is appropriate for locations with steep terrain. High ground water elevations reduce the effectiveness of retention basins.

Design Criteria

- Distributed small basins are preferred over a single, large deep basin.
- Pre-treatment is required to prevent significant sediment loads from entering basins.
- Basins should completely drain within 72 hours (but no longer than 7 days) after the completion of a storm event to minimize the risk of mosquitoes. Under drains may be used in areas with inadequate infiltration rates.
- Basins not fenced and with public access must have 5:1 or flatter side slopes and ponding depths not greater than 2 feet.
- Forebays and microbasins may improve the water quality treatment capacity of the basin.
- Basins should be sized to store accumulated sediment.
- Measures to address overflows are required.
- Detention basin outlet should be designed to meter out post-development low flow discharge at a rate similar to pre-development conditions.
- Pilot channel may be of turf (for low velocity flows) or permanent turf mat (for higher velocity flows).

References:

Public Improvement Standard Section 5.2.2 "Basins"

See California Stormwater BMP Handbook Infiltration Basin and Extended Detention Basin Treatment Control Fact Sheets at Detention basins:

<http://www.cabmphandbooks.com/Documents/Municipal/TC-22.pdf>

<http://www.cabmphandbooks.com/Documents/Development/TC-11.pdf>

4.3.4 Curb and Gutter Alternatives

Credit B.3
1-3 Credits

Description

Curb, gutters and catch basin inlet systems are highly discouraged for use as stormwater collection systems because they concentrate flows and pollutants, increase velocities and discourage groundwater recharge.



Applicability

Alternatives to curb and gutter are encouraged in parking lots and in low- and medium-density residential zones where soils and slopes permit.

Limitations

Drainage inlets may be more appropriate in localized areas subject to frequent flooding during minor rain events. Curb and gutter systems may be required in urban settings, or where a new road must tie into an existing collector road. Additionally, where high-speed traffic and pedestrian use occur in the same vicinity, a curbs and gutter system may be necessary to provide distinct area for each use.

Design Criteria

- Where curb and gutters have been designated as a means of separation between pedestrians and motorized traffic, consider the following hybrid LID/conventional stormwater management approaches:
 - The ability to place a vegetated channel between the sidewalk and the roadway.
 - The potential to incorporate a two-foot side concrete strip constructed along the edge of the pavement at the same surface elevation of the pavement. This concrete strip gives drivers a visual cue of the edge of the driving surface and helps protect the vegetated channel from tire ruts.
 - Implementing a curb and gutter system on one side of the road and allowing the road to drain to the other side of the road (road will have super-elevation instead of crowned section).
- Where curb and gutter systems are required for drainage purposes, curb cuts can be spaced strategically to allow runoff to enter adjacent channels. Curb cuts initially discharge into a surface feature (such as a planter or sand filter) where there is an opportunity to infiltrate runoff instead of conveying it directly to a subsurface drainage network. The frequency of curb cut openings is determined to minimize the spread width of stormwater on the road during primary storm events or to keep the volume and velocity of discharge passing through the curb cut from being erosive in the vegetated swale.
- Parking lots that incorporate sumped vegetation areas can use wheel stops in lieu of curb systems to protect the vegetated area from traffic intrusion while allowing parking lot runoff to be drained into the vegetation.
- The design shall provide an emergency overflow path.

References:

For more information on Curb-cuts, see San Diego Co. LID Handbook Fact Sheet 17:
<http://www.co.san-diego.ca.us/dplu/docs/LID-Handbook.pdf>

Lower Columbia River Field Guide to Water Quality Friendly Development:

<http://www.lcrep.org/fieldguide/examples/curbalalternatives.htm>

Idaho Department of Environmental Quality Best Management Practices Catalog:

http://www.deq.state.id.us/water/data_reports/storm_water/catalog/sec_3/bmps/34.pdf

4.3.5 Alternative Parking Surfaces

Credit B.2.2
1 Credit

Description

Impervious surfaces increase the amount of surface runoff and contribute to heat island effects and pollutant loading as stormwater runs over the impervious surface.

Permeable pavement surfaces may be used to replace traditionally impervious surfaces. Examples of materials that have increased permeability include:

- Unit pavers
- Granular materials
- Poured-in-place materials
- Porous concrete or asphalt



Porous concrete and asphalt are similar to traditional concrete and asphalt except that these products are made without the fines.

Applicability

These procedures are suitable for parking lots and driveways with generally flat surfaces. Alternative parking surfaces are most effective in areas with native sandy soils.

Limitations

The designer must certify that any porous surface proposed for use is able to provide adequate structural integrity for the intended purpose. These materials are not suitable for areas with a hard pan soils, high water table or in commercial/industrial areas of any soil type that have the potential for hazardous spills to occur on the parking surface. Development projects in areas with native clay soils require a subsurface drainage system.



Source Wallace Group. Porous concrete was used in lieu of traditional asphalt to protect the oak tree adjacent to the parking lot.

Paving surfaces must accommodate pedestrian (including ADA requirements), bicycle and auto traffic while allowing infiltration and storage of stormwater.

Design Criteria

- Replace traditional impervious parking surfaces with an alternative pervious surface such as porous concrete, porous asphalt, permeable pavers, turf pave, etc. Pavers should have rigid edge systems to prevent movement of paving stones.
- Vegetate parking overhang areas or the area between the tire paths.
- Surface and stone recharge bed must be suitable for design traffic load.
- An underdrain is required for soils with limited infiltration rates.
- Terraced infiltration beds are required if porous concrete and asphalt are used on steep hills.
- Pre-treatment is advised in areas with high sediment loads.

The ability of porous concrete and asphalt to exchange air and water makes it especially suitable for use around trees.

References:

For more information on porous concrete, porous asphalt, permeable pavers, turf pave, please see: <http://www.cabmphandbooks.com/Documents/Development/SD-20.pdf>
http://icpi.org/design/permeable_pavers.cfm
<http://www.redwoodcity.org/cds/engineering/pdf/DesignGuidelinesforPermeablePavements.pdf>

National Ready Mixed Concrete Association:
<http://www.perviouspavement.org/>

Georgia Stormwater Management Handbook:
<http://www.georgiastormwater.com/vol2/3-3-7.pdf>

4.3.6 Interceptor Trees

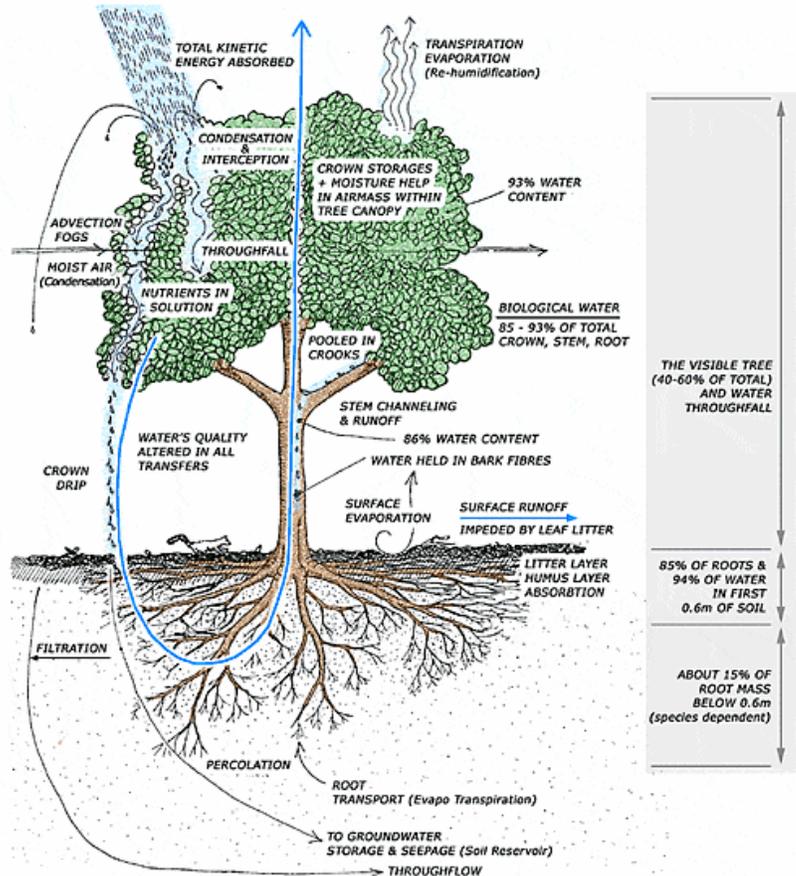
**Credit D.4.1 / D.4.2
 1-2 Credits**

Description

Trees are effective in intercepting light storm events by temporarily capturing, storing and evaporating rain water from their leaves, branches and trunk bark.

Applicability

Interceptor trees are well suited for parking lots but can be



<http://www.water-sos.org/sketches/trees-500pix.gif>

incorporated into much of a project's landscaped areas.

Limitations

Trees should not be planted where they will interfere with utility lines (both surface and subsurface facilities) or create a fire hazard. Certain trees should not be used as their roots are known to damage adjacent impervious hardscapes. Consider the potential impacts of tree shade on adjacent structures and landscaping.

Design Criteria

Broadleaf evergreens and conifers intercept more rainfall than deciduous species. Trees that grow well in winter in San Luis Obispo County include:

- *Cedrus deodara* / Deodar Cedar
- *Cupaniopsis anacardioides* / Carrot Wood
- *Ilex altaclarensis* 'Wilsonii' / Wilson Holly
- *Laurus nobilis* 'Saratoga' / Sweet Bay
- *Olea europaea* / Olive (male specimens only)
- *Pittosporum undulatum* / Victorian Box
- *Quercus ilex* / Holly Oak
- *Quercus suber* / Cork Oak
- *Quercus virginiana* / Southern Live Oak
- *Rhus lancea* / African Sumac
- *Tristania conferta* / Brisbane Box
- *Umbellularia californica* / California Bay

Use native or drought tolerant plants to decrease the need for supplemental irrigation. Root barriers are suggested if trees will not be irrigated once established.

Resources:

US Forest Service Center for Urban Forest Research:

<http://www.fs.fed.us/psw/programs/cufr/research/studies.php?TopicID=4>

Trans-Agency Resources for Environmental and Economic Sustainability:

<http://www.treepeople.org/>

Rainfall interception and water loss from semiarid tree canopies:

<http://rangeland.tamu.edu/people/wilcox/RLEM%20689/7-transpiration%20interception/Owens%20et%20al.2006.pdf>

Urban Forest Ecosystem Institute (tree information):

http://selectree.calpoly.edu/name_search.lasso

4.4 Building/Lot Level Design Considerations

The purpose of this section is to provide design guidelines appropriate for building or lot level considerations. Lot-level considerations are key to reducing the impacts associated with the "first flush." First flush describes the initial high pollutant load that occurs during the first (few) rainstorms of the season. The increased pollutant loading is a result of the rainfall-runoff process that mobilizes pollutants deposited on exposed areas that are dislodged and entrained in the initial runoff. First flush is most easily controlled at the individual lot level.

The following guidelines are intended to minimize stormwater impacts by incorporating stormwater friendly design principles into lot level or site specific project plans.

Guiding Principles

- Reduce building footprint.
- Disconnect impervious surfaces.
- Amend soils.
- Use rainwater harvesting practices:
 - Disperse rooftops, impervious sidewalks, walkways, trails and patios into adjacent landscaping.
 - Incorporate bioretention facilities.
 - Incorporate rainfall reuse systems (i.e. rain barrels) at locations with unavoidable large contiguous impervious areas.
- Use level spreading of flow (sheet flow) into natural open space areas.
- Incorporate vegetated roofs.

4.4.1 Reduce Building Footprint/Foundation Excavation

*Credit B.5
1 Credit*

Description

By minimizing the footprint and excavation associated with constructing a building, a greater area can be used to preserve some of the hydrologic functions for a site. Building footprints can be minimized by using pillars, pin foundations, multiple stories, and stepped foundations.

Applicability

These procedures are suitable on all development projects but are most easily applied on large lots in rural areas.

Limitations

In areas with heavy clay soils, there is significant runoff from undeveloped areas and the addition of impervious areas may not significantly increase the amount of runoff. Building height restrictions may limit allowable structure heights which lead to increased structural footprints.

Design Criteria

To the extent possible, go up and not out and minimize construction area.

References

Diamond Pier Pin Foundations

<http://www.pinfoundations.com/green.htm>

4.4.2 Disconnect Impervious Surfaces

*Credit B.3.1 – B.3.3
1-3 Credits*

Description

Impervious areas that drain into the stormwater system are considered “connected impervious areas.” These areas can be “disconnected” by directing the runoff to a

landscaped area instead. Traditionally “connected” impervious areas well suited for “disconnection” include roof tops, parking lots and driveways.

Applicability

These procedures are suitable on all development projects including redevelopment.

Limitations

Runoff must be discharged at locations that will flow away from structures, have adequate area available to receive the runoff, and are sloped to avoid erosion.

Design Criteria

To the extent possible,

- Roofing downspouts should be redirected to a yard, garden or swale or replaced with drip chains or scuppers.
- Runoff from driveways should not drain directly to a road; instead driveways should:
 - Be constructed from pervious materials, or
 - Be sloped to drain onto stabilized groundcover area, or
 - Be designed to intercept and drain runoff in dispersion trench to adjacent vegetated area.
- Sidewalks and street runoff should drain to stabilized groundcover areas.



Directing driveway runoff into a vegetated area by intercepting it with a trench drain is one way to reduce the volume of runoff leaving the site during small storms.



Above, NE Siskiyou green Street stormwater curb extension: Environmental services, City of Portland NEMO Nevada



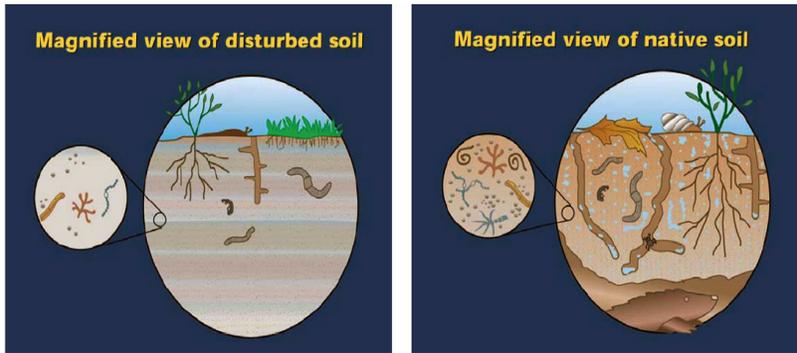
Above, roof scuppers are used to direct runoff through planters. This practice reduces the overall volume of runoff leaving the site during small storms. Source: www.tualatinriverkeepers.org

4.4.3 Amend Soils

Credit A.2.1 / A.2.2
1-2 Credits

Description

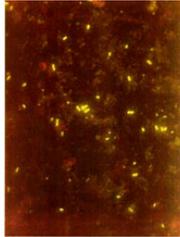
Physical, chemical and/or biological properties of soils can be improved through the addition of soil amendments. The potential hydrologic benefits of compost amended soils include increasing the soil's permeability and water holding capacity, thereby delaying and often reducing the peak stormwater runoff flow rate, and decreasing irrigation water, fertilizer and pesticide requirements.



Disruption of soil can kill most of the beneficial biota and remove the air spaces in the soil that the aerobic biota need to thrive. Surface plantings, fertilizer and other nutrient supplements typically only help the first few inches of soil to develop new biota. Chemical fertilizer addition can actually kill or restrict the development of this biota. The biota is necessary for healthy vegetation.

A cup of undisturbed native topsoil can contain numerous bacteria, fungi, protozoa, nematodes, earthworms and arthropods. These living organisms are essential for maintaining healthy soil.

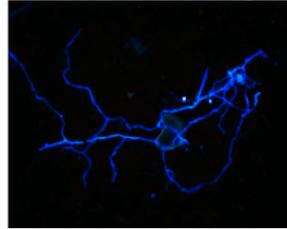
200 billion Bacteria



100,000 Nematodes



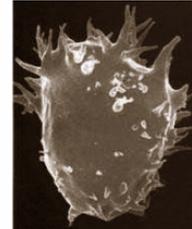
100,000 meters of Fungi



Earthworms <1



20 million Protozoa



50,000 Arthropods



www.deq.state.or.us/lq/pubs/docs/sw/compost/RestoringSoilHealth.pdf

Where soil impacts cannot be avoided or sterile fill is brought in, the soil organic matter can be restored through numerous materials such as compost, composted yard waste, industrial by-products and wood residuals. It is important that the materials used to improve post-construction soil quality be appropriate and beneficial to the plant cover to be established.

Applicability

These procedures are suitable for soils that have been compacted as a result of construction or previous land use and for soils where the organic quality has been compromised due to overuse of pesticides and fertilizers or an exposure to household/industrial chemicals, concentration of pet waste or extreme and unnatural temperatures.

Limitations

Soil testing should be done to verify that soil amendments will produce a soil with similar chemistry, fertility and biology found in healthy regional soils.

Design Criteria

To the extent possible,

- Ripping, spading or tilling of the soil is recommended to alleviate soil compaction, wherever the subsoil has been compacted by equipment operation. Amending existing soil mitigates sub-soil compaction when compost is incorporated to a 12 inch depth.
- The upper eight inches of existing soils should be amended to restore the soil organic matter to pre-disturbed levels.

References:

Idaho Department of Environmental Quality Catalog of Stormwater BMPs:

http://www.deq.state.id.us/water/data_reports/storm_water/catalog/sec_3/bmps/25.pdf

http://www.deq.state.id.us/water/data_reports/storm_water/catalog/sec_3/bmps/26.pdf

City of Seattle Natural Yard Care public handout:

[http://www.seattle.gov/util/Services/Yard/Natural Lawn & Garden Care/Natural Yard Care/index.asp](http://www.seattle.gov/util/Services/Yard/Natural_Lawn_&_Garden_Care/Natural_Yard_Care/index.asp)

4.4.4 Harvest Rainwater

**Credit B.6.1 – B.6.3
1-3 Credits**

Description

Rainwater harvesting is the process of intercepting stormwater runoff from a surface and either letting it soak into the ground or storing it for reuse.

There are many types of rainwater harvesting practices including retention grading, rain gardens/bioretention cells, bioswales, pervious pavements, rain cisterns, rain barrels, and infiltration trenches.

Applicability

Rainwater harvesting may be used as on-lot retention facilities in all types of planted soil. Rainwater harvesting is also appropriate in common areas.

Limitations

Infiltration practices must be situated away from structure foundations unless a barrier or waterproofing is incorporated into the building or pavement design. The bottom of the subgrade shall be at least 3 feet above the seasonal high groundwater level.

Design Criteria

While each type of rainwater harvesting practice has its unique design criteria, there are several design criteria that are common to all.

- Managing small volumes of water throughout the watershed is preferred over managing large volumes of stormwater at the bottom of the watershed. Begin at highest elevation of the site and continue to the lowest point of the site, dividing the site into small catchment areas. Flood control detention basin volume credit is

allowed if the volume of runoff retained in smaller catchment areas can be quantified using a hydrograph analysis.

- Overland escape capable of handling large rainfall events up to the 100-year storm event is necessary.
- In facilities where standing water cannot be tolerated, an underdrain should be installed beneath the soil amendment layer.

Resources:

Brad Lancaster “Rainwater Harvesting for Drylands and Beyond”:

<http://www.harvestingrainwater.com/>

4.4.4a Retention Grading

**Credit A.5.1 – A.5.3
1-3 Credits**

Description

This practice involves the creation of shallow depressions on gently sloped or nearly flat landscapes. The shallow depressions intercept and infiltrate small volumes of surface water tributary to the depressed area.

Applicability

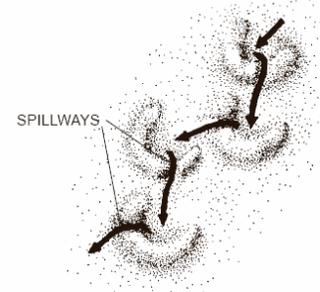
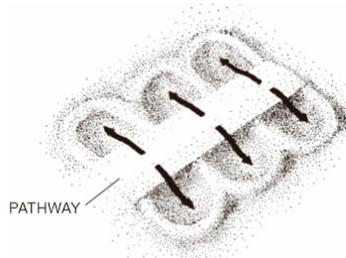
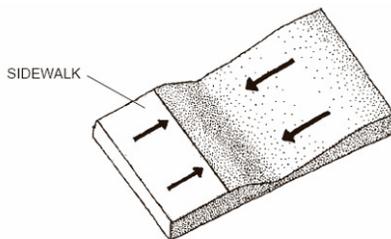
Retention grading works best in highly permeable soils.

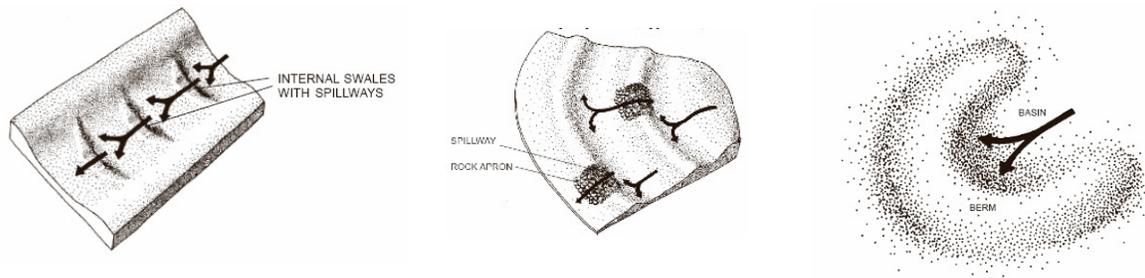
Limitations

Retention grading is not applicable for use on steep banks or in highly erodible soils. Poned areas should be located 10 ft away from the structure foundation.

Design Criteria

1. Vegetation is needed to stabilize soil and assist with infiltration and transpiration of runoff. Shrubs and trees should be planted slightly above the ponded water elevation. Grasses are generally used in the ponding area.
2. Catchment areas in new developments should be located and existing low points. In existing developments, grading may be necessary to create a low point.
3. Spillways or channels can be used to link and distribute water throughout the site.
4. Soils in catchment ponding areas should not be compacted.
5. For detailed design criteria associated with retention grading, go to Appendix F – Part 1.





<http://dot.tucsonaz.gov/stormwater/downloads/2006WaterHarvesting.pdf>

4.4.4b Rain Gardens and Bioretention Cells

*Credit B.6.1 – B.6.3 (1-3 Credits)
Credit C.13 (1 Credit)*

Description

Rain gardens (also known as bioretention cells) are made from shallow depressions similar to retention grading. Native soil beneath the sump area is excavated out and backfilled with soil that serves to enhance retention and degradation of contaminants in stormwater runoff. The sump area is heavily planted and mulched. These low spots collect rain water during wet periods. Rain gardens reduce the volume of stormwater runoff delivered to surface water during the more frequent, low runoff events through plant interception and transpiration and by infiltration into the soil. The soil and root system also improves water quality.



<http://ricecreek.org/bmp/rg>

Rain gardens are differentiated from detention and retention basins based on their size.

Applicability

Rain gardens can be installed and are effective in most residential, commercial and industrial areas with NRCS type A and B hydrologic group soils. Projects located in NRCS type C and D hydrologic group soils require an underdrain. The NRCS soil web survey is available on-line².

Limitations

Rain gardens are limited to a 5 acre or less tributary area and are not recommended on sites with steep slopes or with high ground water or bedrock elevations. Rain gardens should not be located over septic fields or leach lines, shallow utilities, or within 10 feet of a building foundation.

Design Criteria

- Rain gardens should be located downstream of impervious surfaces and a minimum of 10 feet from structure foundation
- Grass filter strips are excellent at pre-treating sediment laden runoff.

² <http://websoilsurvey.nrcs.usda.gov/>

- Ponding depth is dependent on the underlying soils. The rain garden must drain within 72 hours. See Chapter 6 for information on determining infiltration rates.
- Rain garden must be equipped with an overland escape or overflow outlet.
- Rain garden vegetation should consist of diverse, native or drought tolerant species. Species at the bottom of the rain garden must be able to withstand wet conditions. Species planted on the side slopes must be able to withstand occasional inundation.
- Locations of rain gardens should be protected from construction site run-on and compaction.
- Backfill should be rich in aged organic matter with appropriate percolation rates.

Resources:

“Rain garden, Handbook for Western Washington Homeowners”:

http://www.pierce.wsu.edu/Water_Quality/LID/Raingarden_handbook.pdf

“Rain gardens, A How-to Handbook for Homeowners”:

<http://clean-water.uwex.edu/pubs/pdf/home.rghandbook.pdf>

4.4.4c Bioswales

Credit B.3.1 – B.3.3 (1-3 Credits)
Credit D.1 (1 Credit)

Description

Bioswales function similarly to rain gardens except that they are sloped to a destination. They differ from vegetated swales, because in most instances, the bottom of the swale is replaced with soil that is more conducive to infiltration than existing site soils.

A subsurface stone recharge bed can be used to provide stormwater storage.



Costco Bioswale. Source Wallace Group.

Applicability

Bioswales can be installed and are effective in all residential and most commercial and industrial in all types of soil conditions.

Limitations

Limited to a 5 acre or less tributary area. Bioswales are not recommended on sites with steep slopes or with high ground water or bedrock elevations. Bioswales should not be located over septic fields or leach lines, shallow utilities or within 10 feet of a building foundation. Bioswales should not be used in locations where there is a high sediment load or soils that are not stabilized.

Design Criteria

- Bioswales are most effective when used in conjunction with a filter strip or forebay.

- Bioswales should be located downstream of impervious surfaces and a minimum of 10 feet from structure foundation (unless structure foundation is protected by waterproof barrier).
- Swale bottom shall be sloped steep enough to drain but not so steep as to cause erosion. Bottom width should be a minimum of 2 feet wide (to uniformly spread stormwater at a slower velocity than a v-ditch would offer) and a maximum of 10 feet wide (to keep runoff from channelizing).
- Swale must be able to handle the storm events delivered to it without re-suspending sediments or scouring slopes.
- Locations of swales should be protected from polluted construction site run-on and compaction.
- Backfill should be rich in aged organic matter with infiltration rates that will allow the swale to drain within 72 hours.
- Swales should not convey stormwater at depths greater than 2 ft and should have gentle side slopes (5H:1V or flatter)
- When bioswales cross driveways (and intersecting roads and alleys), conveyance under the driveway can be provided by culverts or open graded rock veins wrapped in a getoextile.
- When bioswales are specified as a treatment control BMP, stormwater runoff should have a minimum 10 minute hydraulic residence time with a velocity less than 1 feet per second and the water surface elevation at the same height (or less) as the bioswale vegetation is required.

4.4.4d Rain Cisterns and Rain Barrels

Credit B.6.1 – B6.3 (1-3 Credits)
Credit C.13 (1 Credit)

Description

Approximately 40 percent of all urban water use is for irrigation. Capturing and later reusing rainwater in water barrels or cisterns reduces the volume of runoff during rain events and conserves potable water supplies. Roof runoff contains no chlorine or hard minerals. It can easily be used later for landscape irrigation purposes or as collected water conveyed to typical grey water usages (flushing toilets).

In arid areas with heavy rainfall events, large cisterns are necessary if the goal is to capture entire rain events. For instance, a house in the City of San Luis Obispo subject to a 1 inch storm (0.083 ft), with a total roof area of 1000 square feet could yield 620.8 gallons of water for that storm event alone.



<http://www.lid-stormwater.net/images/cistern4.jpg>

*Supply in Gallons = Roof Area directed
to rain barrel x rain event, depth (ft) x 7.48 gallons/cf*

$$= 1000 \text{ sf} \times 0.083 \text{ ft} \times 7.48 \text{ gallons/cf}$$

$$= 620.8 \text{ gallons produced}$$

That's enough water to meet the daily domestic needs of more than seven average Americans. Capturing the average annual runoff could yield over 12,000 gallons of water.

However to completely capture an entire 1 inch rain event, a total of twelve 55 gallon barrels would be needed (assuming that no draw was being taken from the barrel during the rain event and roof rain was lost to evaporation).

$$\begin{aligned} \text{Number of 55 gallon barrels needed} &= 620.8 \text{ gallons} / 55 \text{ gallons per barrel} \\ &= 11.3 \text{ barrels} \\ &= 12 \text{ barrels} \end{aligned}$$

The equation below can be used to calculate the storm that would fill up a single 55 gallon barrel:

$$\begin{aligned} \text{The depth of rain that will fill a barrel} &= \frac{\text{Capacity of rain barrel (gallons)}}{\text{Contributing roof area (sf)} \times 7.48 \text{ gallons/sf (conversion factor)}} \\ &= \frac{55 \text{ gallons}}{1000 \text{ sf} / 4 \times 7.48 \text{ gallons/sf}} \\ &= 0.03 \text{ inches of rain} \end{aligned}$$

Rain barrels can come in all shapes and sizes. For the committed rainwater harvester, a large underground tank (equipped with pumps) may be more suitable (but more costly) than an above ground tank.

Applicability

The volume of roof runoff to be intercepted is directly proportional to the area of the roof. A larger roof yields more runoff.

Limitations

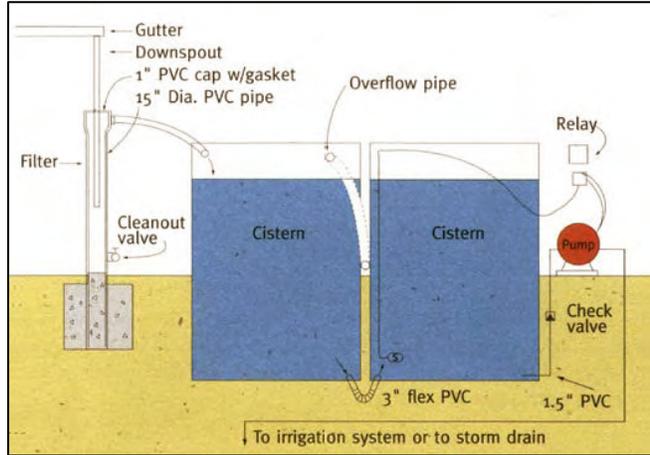
Roofs constructed with tar, gravel, treated cedar shakes or old asbestos shingle roofs may create too much contamination for rainwater harvesting. Similarly, rainwater should not be harvested if it is conveyed via gutters with lead soldering or lead-based paints. Runoff from roofs exposed to air borne particles originating from cement kilns, gravel quarries, crop dusting, or concentrated automobile emissions could adversely affect the rainwater quality.

Low storage capacities will limit rainwater harvesting so that the system may not be able to provide water in a low rainfall period. Increased storage capacities add to construction and operating costs.

Design Criteria

- Sizing of cisterns and rain barrels should be based on roof area, rainfall patterns, anticipated water usage of connected plumbing facilities or landscape water needs.
- Rainwater collected and intended for flushing toilets will require a parallel plumbing system.

- Rainwater collected and intended for potable uses should include filtration and disinfection to eliminate potential contamination originating from leaves, bird droppings, dust, and other natural causes.
- Tanks should be securely covered with fine-mesh screens on all inlet and outlet pipes to keep mosquitoes from entering tanks. This also protects the tanks from inadvertently trapping and drowning children and wild or domestic animals.
- Rain cisterns and rain barrels should be equipped with overflow devices able to convey spills away from any adjacent structures. Verify that the overflow device is adequately sized to convey the anticipated rain events it will be subject to.
- Consider installing a “first flush” diverter to increase stored water quality and reduce tank maintenance needs. The first flush diverter should allow the first 10 minutes of a storm event after a long dry period to bypass the system.



TreePeople, *Rainwater as a Resource: A Report on Three Sites Demonstrating Sustainable Stormwater Management*. 2007.

References:

Rain Barrel Guide:

<http://www.rainbarrelguide.com/>

Aquabarrel Rain Barrel:

<http://www.aquabarrel.com/>

How to construct a Rain Barrel:

<http://home.comcast.net/~leavesdance/rainbarrels/construction.html>

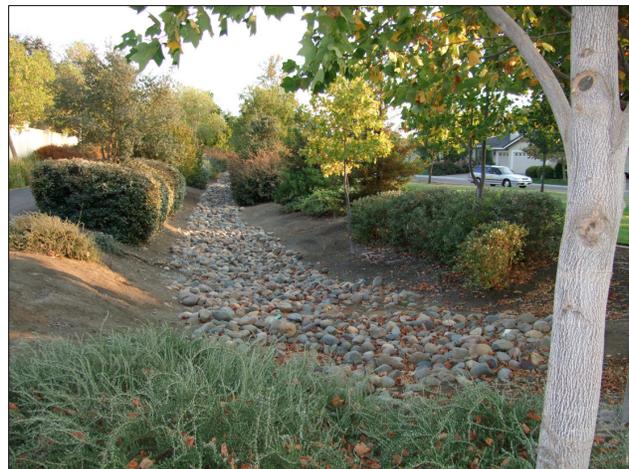
Credit B.3.1 – B.3.3
1-3 Credits

4.4.4e Infiltration Trenches

Description

Infiltration trenches are shallow excavations that are lined with stone to create underground reservoirs. These trenches intercept runoff and store it until it can percolate into the soil through the bottoms and sides of the trench.

Infiltration trenches receiving polluted stormwater may introduce those contaminants into ground water supplies since they do not have the benefit of soil and roots to filter pollutants out.



Infiltration trench in Davis, CA

Applicability

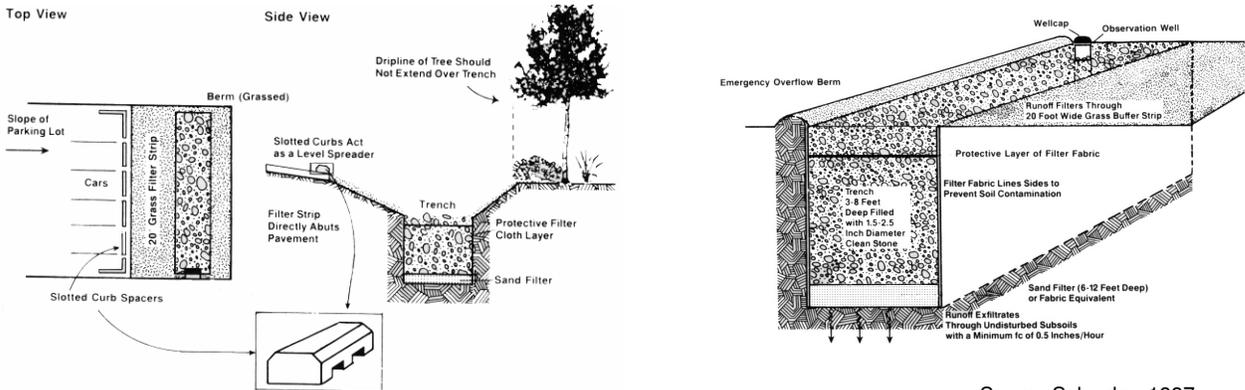
Infiltration trenches are recommended in areas with tributary areas less than 2 acres AND where pollutant loads are low and space is not available for bioretention BMPs.

Limitations

Not appropriate for soils without good drainage.

Design Criteria

- Soils percolation rate must allow the structure to drain within 72 hours.
- Stormwater directed towards infiltration trenches must be pretreated to remove suspended solids, nitrates and dissolved metals. Solids can clog the trenches. Nitrates and dissolved metals can be introduced into ground water supply.
- Equip with observation well.
- Infiltration trenches should be located to collect sheet flow from impervious surfaces.
- Infiltration trenches should have a flat bottom slope (or subsurface check dams if use in conjunction with sloped bioswale) and a narrow width to reduce mounding risks.



Source: Schueler, 1987.

References:

<http://www.epa.gov/owmitnet/mtb/infiltrenc.pdf>

<http://www.cabmphandbooks.com/Documents/Development/TC-10.pdf>

4.4.5 Level Spreaders

Description

Level spreaders

disperse concentrated water over a wide enough area so that erosion of the receiving area does not result. It can reduce erosion and the movement of sediment. An additional benefit of a level spreader is to remove other pollutants from runoff by filtration, infiltration, absorption, decomposition and volatilization.

Credit B.3.1 – B.3.3
1-3 Credits



Level spreaders are constructed at zero grade across a slope and used to disperse or "spread" concentrated flow thinly over a receiving area.

Source: NCSU-BAE

Applicability

- Where runoff from an impervious surface is uneven and/or runoff is released as concentrated flow, such as through curb cuts or roof downspouts.
- At the ends of diversions.
- Where the lip of the level spreader can be constructed in undisturbed soil.
- Where there will be no traffic over the spreader.

Limitations

Level spreaders address concentrated flows in small tributary areas (less than 2 acres) and should not be used on steep slopes or highly erodible gentle slopes.

Design Criteria

The spreader lip shall be constructed to a uniform height and zero grade over the length of the spreader. The length of the level spreader lip is based on the volume of water that must be discharged. In general,

- The weir can be constructed of gravel, timber, asphalt, or concrete or of vegetation. Vegetated weirs work best in areas with low flows. However if vegetation is used, it must be inspected frequently to ensure that the vegetated weir will function properly over the range of flows it is subject to.
- Flow volumes and velocities should be verified to ensure that they do not cause channelized flow and erosion in receiving areas.

References:

<http://www.lrc.usace.army.mil/co-r/level%20spreader.pdf>

<http://h2o.enr.state.nc.us/nwetlands/documents/LevelSpreaderGuidancefinal.pdf>

4.4.6 Vegetated "Green" Roofs

Description

Standard roof tops accelerate and increase stormwater runoff. Replacing the traditional impervious roof with a vegetated roof can make substantial improvements in stormwater runoff quality and quantity.

Credit C.10
1 Credit

There are two types of vegetated roofs: eco-roofs and roof gardens. Eco-roofs are lightweight roof systems supporting a few



Vegetated Rooftop over car wash facility in San Luis Obispo

inches of soil and small plants while roof gardens are heavy roofs, usually with a foot or more of soil supporting large plants, shrubs, or trees, either directly on the roof or in planters.

Both types of vegetated roofs slow runoff and increase interception, evaporation, and transpiration of stormwater, in addition to reducing heat island effects associated with roofs. Vegetated roof systems can extend the life of the roof by 2-3 times over conventional roofing systems while reducing the energy required for heating and cooling of the structure.

Applicability

Vegetated roofs are best suited on new construction projects with flat roofs (pitches less than 1.5 percent) and no opportunities to infiltrate or store roof water in other locations on the site.

Limitations

In retrofit applications, load restrictions are usually the main limitation. Follow state and/or local standards with respect to wind and fire resistance of rooftop elements. Extreme sun or wind conditions present a challenge for plant survival. Vegetated roofs may not be appropriate for areas with snow or rooftops with slopes greater than 15 percent and may require irrigation.

Design Criteria

To the extent possible, impervious surface should be replaced with more pervious surfaces. Vegetated roofs are one way to reduce the impact of the project's overall impervious area; however, infiltration techniques are favored over green roofs in areas with groundwater recharge priorities.

Vegetated roofs should be planted with drought tolerant species, but may require supplemental water.

References:

Green Roofs for Healthy Cities: <http://www.greenroofs.org>



*Photo, exterior overview of roofs and distant context · Gap Offices in San Bruno, CA
http://www.greatbuildings.com/buildings/Gap_Offices_in_San_Bruno.html*

Ch 5: Preventing Stormwater Pollution at the Source – Source Control Measures

5.1 Introduction to Source Control

Source control refers to any schedules of activities, prohibitions of practices, maintenance procedures, managerial practices or operational practices that prevent stormwater pollution by reducing the potential for contamination at the source of pollution.

Source control measures are required for all projects. Source control measures can be categorized as Structural, Procedural or Operational.

Structural source control measures are physical measures employed to prevent stormwater from contacting work and storage areas to prevent stormwater from picking up pollutants.

Operational source control BMPs are non-structural practices such as employee training, record keeping, good housekeeping, preventative maintenance, spill prevention and cleanup.

Procedural source controls BMPs include implementing process changes such as substituting a less hazardous material for a highly hazardous material in an industrial process.

Implementing operational and procedural source control BMPs are generally considered more cost-effective in minimizing pollution than structural source control measures. Operational and procedural source controls are addressed in Chapter 8 “Operation and Maintenance” of this handbook.

While some source control measures can be broadly applied to development, others are site and pollutant specific. This chapter describes the purpose, design criteria, maintenance requirements and appropriate use of structural source control measures approved for use in the unincorporated areas of San Luis Obispo County.

5.2 General Structural Source Control Measures

The source control measures included in this section generally apply to all development.

5.2.1 Storm Drain Markers

Description

Storm drain markers are highly visible source controls that are placed adjacent to storm drain inlets. This measure informs the public that runoff drains

Prerequisite C.1
PRIORITY: Required
STANDARD: Required



directly to water bodies. Storm drain markers raise awareness to help deter littering and illegal dumping.

Applicability

Storm drain marking procedures are suitable for storm drain inlets with concrete curb and gutters.

Design Criteria

- All new storm drain inlets shall be provided with a marker as specified by the County Public Improvement Standards.

References:

See CASQA SD-13 for additional design, installation and maintenance considerations:
<http://www.cabmphandbooks.com/Documents/Development/SD-13.pdf>

5.2.2 Alternative Building Materials

Credit C.10
1 Credit

Description

Some building materials, such as copper, are prone to leach toxic compounds into stormwater runoff. Some building materials require the routine use of pollutants (i.e. toxic paints and finishes) to maintain their integrity. This BMP employs alternative materials that are not prone to leach toxic compounds or require toxic compounds to maintain their integrity.

Applicability

Alternative building materials are suitable for all developments.

Design Criteria

- Consider using building materials that incorporate green technology, use less toxic materials in their manufacturer, or require minimum maintenance.
- Avoid roofing, gutters, and trim made of copper or other unprotected metals that could leach into runoff.

References:

See CASQA SD-21 for additional design, installation and maintenance considerations:
<http://www.cabmphandbooks.com/Documents/Development/SD-21.pdf>

5.2.3 Clean Water Segregation

Credit C.13
1 Credit

Description

Runoff originating from roof and landscaped areas is considered relatively clean. Runoff increases its risk of picking up contaminants if it is allowed to flow over parking lot areas.



Roof top runoff inappropriately discharged onto pavement (left) will pick up parking lot pollutants. Roof top runoff discharged into stabilized landscaped areas or rain water cisterns is available for infiltration or onsite reuse.

Adding relatively clean runoff into the treatment train or stormwater treatment process can reduce the overall effectiveness of the treatment train in removing contaminants.

Applicability

Clean water segregation is suitable for all properties with roof drains and/or vegetated areas that produce runoff.

Limitations

Clean water segregation is not appropriate for roof runoff from industrial areas or from runoff traveling over galvanized metal roofs, roofs fabricated with electroplating and metal finishes, including the use of copper chloride etchers, ammonia etchers or that have acid plant bath exhaust vents. Runoff from galvanized roofs should be treated prior to discharge from the site.

Design Criteria

- Relatively clean runoff should be kept isolated from runoff requiring treatment. This can be achieved by:
 - Retaining runoff on site.
 - Directing roof runoff into vegetated areas.
 - Connecting roof and landscape area runoff into a separate storm drain system.
 - Connecting roof and landscape runoff into the site's storm drain system after treatment BMPs to ensure parking lot pollutants have been addressed.
 - Detaining roof and landscape runoff onsite long enough for first flush parking lot runoff to be treated and then sending it from the site in a common storm drain system.
- Consider reuse of roof rain water.

References:

See Fact Sheet SD-11, "Roof Runoff Controls," in the CASQA Stormwater Quality Handbooks at: <http://www.cabmphandbooks.com/Documents/Development/SD-11.pdf>

Credit C.11
1 Credit

5.2.4 Efficient Irrigation

Description

Efficient irrigation techniques minimize waste and reduce the amount of dry weather runoff discharged to the storm drain system. Efficient irrigation techniques include rain and wind-triggered shutoff devices, automatic line break detection shutoff valves and soil moisture sensors.

Applicability

Efficient irrigation is suitable for all development with irrigated areas.

Limitations

None

Design Criteria

To the extent possible, install

- Native plants that require minimum irrigation.
- Irrigation controllers with evapotranspiration, high wind, and rainfall sensors to prevent over- and under-watering and watering during rainfall events and/or with programmable schedules to set watering time and duration according to plant and seasonal needs.
- “Smart” irrigation controller with master valve connected to flow sensor to detect and shut off water when the sensor indicates an out of expectation flow rate.

References:

A list of “smart” controllers is available at:

<http://www.irrigation.org/SWAT/Industry/ia-tested.asp>.

See CASQA SD-12 for additional design, installation and maintenance considerations:

<http://www.cabmphandbooks.com/Documents/Development/SD-12.pdf>

5.3 Site and Pollutant-Specific Structural Source Control Measures

The source control measures included in this section apply to specific types of development or are specified to control specific types of pollutants.

5.3.1 Fueling Areas

Required – Priority
Credit C.3
1 Credit (Standard)

Description

Fueling areas have the potential to contribute oils, grease, solvents, car battery acids, coolants and fuels to stormwater conveyance systems. Spills at vehicle and equipment fueling areas can have a significant impact on the quality of stormwater runoff because fuels contain heavy metals and toxic substances that are not easily removed by stormwater treatment devices. Spill prevention is paramount.

Applicability

The design criteria below (items 1-4) are mandatory for projects with

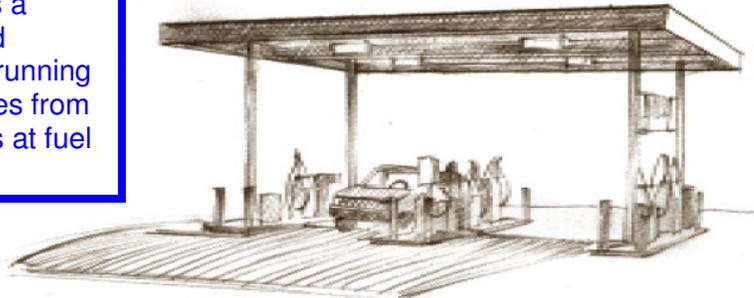


fueling dispensing equipment.

Design Criteria

- The fuel dispensing area must be covered with an overhanging roof structure or canopy. The canopy's minimum dimensions must be equal to or greater than the area within the grade break. The canopy must not drain onto the fuel dispensing area, and the canopy downspouts must be routed to prevent drainage across the fueling area.
- The fuel dispensing area must be paved with Portland Cement Concrete (or equivalent smooth impervious surface). The use of asphalt concrete is prohibited.
- The fuel dispensing area must have a 2% to 4% slope to prevent ponding, and must be separated from the rest of the site by a grade break that prevents run-on of stormwater to the extent practicable.
- At a minimum, the concrete fuel dispensing area must extend 6.5 feet from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 foot whichever is less.
- Signs discouraging the topping-off of fuel tanks should be posted.
- Spill response kits, including absorbent materials and disposal containers for accidental spills should be clearly located within the fueling area.

The best fuel island design has a cover for all the dispensers and prevents any stormwater from running over and removing contaminants from the fueling area. Keep spill kits at fuel islands, if possible.



References:

See CASQA SD-30 for additional fueling area design, installation and maintenance considerations: <http://www.cabmphandbooks.com/Documents/Development/SD-30.pdf>

5.3.2 Maintenance Bays and Loading Docks

**Required – Priority
Credit C.4 / C.5
1-2 Credits (Standard)**

Description

Oil and grease, solvents, car battery acid, coolant and gasoline from repair/maintenance bays can negatively impact water quality if allowed to come in contact with stormwater runoff.

Applicability

These procedures are suitable for all commercial and industrial applicable locations.

Design Criteria

- Repair/maintenance bays must be indoors or designed in such a way that does not allow contact with stormwater run-on or runoff.

- Design a repair/maintenance bay drainage system to capture all wash water, leaks and spills. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required, obtain an Industrial Waste Discharge Permit and ensure that drains are equipped with a fail-safe valve that remains closed except during rainfall.
- Cover loading dock areas or design drainage to minimize run-on and runoff of stormwater. If roof is used to shelter loading maintenance bay and loading docks from stormwater, the roof should be surfaced with a non-metallic material to decrease the likelihood of introducing heavy metals into the stormwater system.
- Loading dock area drains connected to the storm drain system must be equipped with a valve or equivalent device that remains closed except during rainfall.
- Loading docks for loading and unloading liquids in containers shall be provided with an inlet with a shutoff valve and have the capacity to hold a spill while the valve is closed.
- Door skirts between the trailers and the building should be installed to prevent exposure of loading activities to rain.

References:

See CASQA SD-31 for maintenance bay and loading dock design, installation and maintenance considerations:

<http://www.cabmphandbooks.com/Documents/Development/SD-31.pdf>

5.3.3 Trash/Recycling Storage Areas

*Required – Priority
Credit C.6
1 Credit (Standard)*

Description

The trash and recycling storage area refers to an area where a trash receptacle or recycling receptacles (dumpsters) are located for use as a repository for solid wastes. Loose trash and debris can easily be transported by the forces of water or wind into nearby storm drain inlets, channel, and/or creeks.

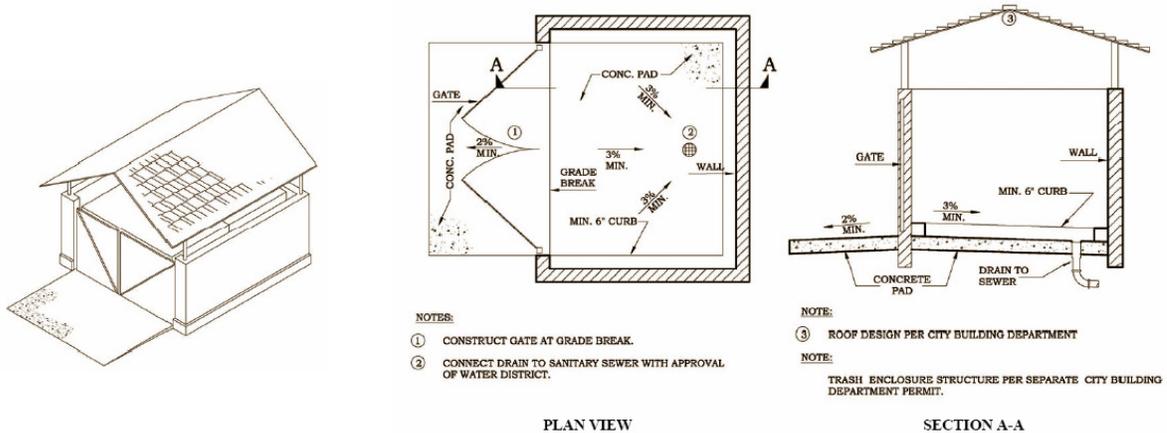
Applicability

These procedures are suitable for all multi-family residential units with four or more units, commercial projects, and industrial trash areas. Single family residences are exempt from these requirements.

Design Criteria

- Project design should provide an appropriate number of adequately sized receptacles.
- Trash and recycling storage areas must divert drainage from adjoining roofs and pavements around the area(s). Project plans should show how the container area will be graded and paved to prevent run-on to the area and to prevent runoff from leaving the area.
- Trash and recycling storage container areas must be screened or walled to prevent offsite transport of trash.
- Trash and recycling storage within containers should be secured to prevent loose trash and debris from being dispersed by the wind.
- Uncovered bins should be roofed to prevent rainwater from co-mingling with bin contents.

- Trash and recycling storage enclosure pads should be designed to drain to a pervious surface through indirect soil infiltration or to an appropriate treatment control BMP prior to connection to a sanitary sewer.
- The proposed enclosure detail shall be submitted to the County and contracted recycling and garbage hauler for review and approval. Before a building permit can be issued, a form from each hauler accepting the relevant container location and enclosure detail must be submitted.
- No connection to the storm drain system is allowed for new facilities.



References:

See CASQA SD-32 for additional trash storage area design, installation and maintenance considerations:

<http://www.cabmphandbooks.com/Documents/Development/SD-32.pdf>

5.3.4 Vehicle and Equipment Wash Areas

Description

Vehicle and equipment wash waters commonly contain high concentrations of sediments, oils and grease, cleaning chemicals, phosphates, antifreeze and heavy metals. These materials are prohibited from entering the storm drain system through the illicit discharge detection elimination ordinance.

**Required – Priority
Credit C.7
1 Credit (Standard)**

Applicability

These procedures are suitable for all multi-family residential, commercial and industrial areas.

Design Criteria

Describe measures taken to discourage onsite vehicle and equipment washing and explain how these will comply with the appropriate design criteria provided below for commercial/industrial, restaurant, and residential applications.

Commercial/industrial applications:

- 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.

- Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system.
- Wastewater from the commercial vehicle and equipment wash areas shall be equipped with a clarifier, or other pretreatment facility, and properly connected to the sanitary sewer, or other appropriately permitted disposal facility.
- Secondary containment shall be provided 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 area.
- Vehicle wash water should only be discharged to the sanitary sewer and only after obtaining permission from the local wastewater treatment authority. Fueling and maintenance activities shall be isolated from vehicle and equipment wash areas.
- Tanks, containers or sinks used for parts cleaning or rinsing shall not be connected to the storm drain system and may only be connected to the sanitary sewer system. These connections may require additional approvals and permits.

Residential application:

- Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited onsite and hoses are provided with an automatic shutoff to discourage such use).
- Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area and in large common areas plumbed to drain to the sanitary sewer.

Restaurant application:

- Restaurant wash areas must be self-contained and equipped with a grease trap and properly connected to a sanitary sewer.
- Food service facilities, including restaurants and grocery stores shall have a sink or other area for cleaning floor mats, containers and equipment. The cleaning area must be located over a paved area and have secondary containment. It must be large enough to clean the largest mat or piece of equipment that needs cleaning. The sink or cleaning area shall be connected to a grease interceptor prior to discharge to the sanitary sewer system.

References:

See CASQA SC-21 for additional vehicle washing area design, installation and maintenance considerations:

<http://www.cabmphandbooks.com/Documents/Industrial/SC-21.pdf>

5.3.5 Material Storage Areas

Description

Outdoor material storage areas include areas or facilities designated solely for storage of materials. Improper storage of materials outdoors may provide an opportunity for toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to enter the storm drain system.

*Required – Priority
Credit C.8
1 Credit (Standard)*

Proper storage is necessary to prevent materials being stored outside from being washed away in stormwater runoff, spilled, or inadvertently discharged to the storm drain system.

Applicability

These procedures are suitable for all projects that include outdoor storage areas for materials. Sites with large quantities or liquids or bulk materials at sites that are connected to the storm drain system are at greatest risk, including:

- Nurseries and garden centers
- Auto recyclers/body shops
- Building supply outlets
- Landfills and recycling centers
- Solid waste and composting facilities
- Maintenance depots
- Power plants



Design Criteria

- Store materials indoors, if feasible.
- Infiltration is discouraged in outdoor material storage areas.
- Protect materials stored outside from rainfall and wind dispersal by keeping them in an enclosure such as a cabinet or shed.
- Protect materials stored outside from run-on by constructing a secondary containment structures (such as berms, dikes or curbs) around the perimeter of the storage area.
- Provide an area to pool spills for collection and disposal or, if allowed, pre-treat and drain the area to the sanitary sewer system. If required, obtain an Industrial Waste Discharge Permit. Secondary containment areas should be sized to hold 110% of the volume of the storage tank or container unless other containment sizing regulations apply (e.g. fire codes).
- Store materials on paved or impervious surfaces.
- Exterior storage areas shall be covered with a roof or awning to minimize collection of stormwater within the secondary containment area.

References:

See CASQA SC-33 for additional outdoor material storage area design, installation and maintenance considerations:

<http://www.cabmphandbooks.com/Documents/Industrial/SC-33.pdf>

5.3.6 Pools, Spas and Fountains

Credit C.9
1 Credit

Description

Draining pools, spas and fountains to the street, gutter or storm drain system can pollute water bodies with copper, chlorine, sediments and other contaminants.

Applicability

These procedures are suitable for all properties with a pool, spa and/or fountain.

Design Criteria

- The preferred method to discharge dechlorinated/debrominated pool, spa and/or foundation algae-free water with pH levels between 6.5 and 8.5 is onto adjacent land surfaces.
- Pool, spa and/or fountain discharges not able to be drained onto adjacent land surfaces should be drained to a sanitary sewer cleanout—never to a street, gutter, or storm drain system.

Water from pools, spas and fountains should only be discharged to the sanitary sewer only after obtaining permission from the local wastewater treatment authority. See CASQA SC-72 or other the other link for “Fountain and Pool Maintenance” considerations:

<http://phoenix.gov/WATER/pooldrn.html>

<http://www.cabmphandbooks.com/Documents/Municipal/SC-72.pdf>

5.3.7 Outdoor Work and Processing Areas

Description

Outdoor work areas, such as material collection or cleaning points, and outdoor processing areas, such as painting, grinding degreasing areas, have the potential to contribute metals, oil and grease, solvents, phosphates, and suspended solids to the storm drain system.

Applicability

These procedures are suitable for all properties with outdoor work and/or processing area.

Design Criteria

- Infiltration is discouraged.
- Keep runoff from relatively clean areas separate from relatively dirty areas by installing diversion drains or berms.
- When practical, provide a roof over the work area.
- Equipment and accessory washing/steam cleaning facilities should be self-contained and equipped with a grease trap that discharges to the sanitary sewer system.

References:

See CASQA SD-35 and SD-36 for additional Outdoor Work Area and Outdoor Processing Area considerations:

<http://www.cabmphandbooks.com/Documents/Development/SD-35.pdf>

<http://www.cabmphandbooks.com/Documents/Development/SD-36.pdf>

5.3.8 Pet Mitt Stations

Credit C.14
1 Credit

Description

Pet waste is a known contributor to stormwater pollution. Providing pet mitt stations at locations that are attractive to dog owners can encourage owners to pick up pet waste.

Applicability

These procedures are suitable for all properties with large, accessible open areas.

Design Criteria

Pet mitt stations should consist of a dispenser with biodegradable bags for scooping the poop, informational signage and a trash cans should be provided for convenient disposal.

References

County Parks Mutt Mitt Program

Ch 6: Hydromodification Control Measures

Hydromodification control BMPs are not currently required. Hydromodification control requirements are in the process of being developed as part of the Joint Effort, which is a collaborative process being undertaken by several municipalities throughout the Central Coast Region. This is a two-year process which was initiated in October 2009.

Upon completion of the Joint Effort, hydromodification control requirements developed through that process will be adopted into Chapter 6 of this document. Adoption will occur by resolution of the Board of Supervisors after a duly noticed public hearing. Once adopted, projects will need to comply with the hydromodification control requirements.

More information on the Joint Effort can be obtained from the Regional Water Quality Control Board's website¹.

1

http://www.swrcb.ca.gov/rwqcb3/water_issues/programs/stormwater/docs/lid/lid_hydromod_charette_index.shtml

Ch 7: Treatment Control Measures

7.1 Introduction to Treatment Control

Stormwater leaving a site must meet the treatment goals established in Chapter 2.

The following outlines the preference for treatment control implementation:

- Prevent and eliminate the need for treatment control.
 - See source controls.
 - Increase public awareness and employee training.
- Use LID practices to eliminate runoff from storms.
- Use LID practices to capture pollutants from stormwater streams. Treatment control BMPs should be placed as close to the source of pollutant as possible.
- Use conventional “end of pipe” treatments as the last option.

Chapter 5 provides information on source controls appropriate for varying types of development. Chapter 6 (when completed) will provide information on ways to reduce the volume of runoff leaving the site. This chapter describes treatment controls including LID practices that can be used to capture pollutants from runoff as well as conventional “end of pipe” treatments. This chapter also contains ancillary devices that can be incorporated into designs to provide enhanced treatment. Projects discharging to Clean Water Act 303(d) listed water bodies must address all constituents that will contribute to the impairment of the water body. Structural treatment control stormwater BMPs should be implemented close to pollutant sources to maximize pollutant removal. Such BMPs may be located onsite or offsite, used singly or in combination, or shared by multiple new developments.

7.2 Treatment Control BMPs

Each project has unique features that make it particularly well suited for a specific BMP or which can eliminate specific BMPs from consideration. Characteristics that may influence the selection of a treatment control BMP include tributary area to the BMP, land use, site slopes, soils, cost, etc. This section discusses some of the physical constraints that might influence the selection of a treatment control BMP. To create a list of viable treatment controls for a particular site, begin the initial review with the list of acceptable treatment control BMPs below.

Infiltration Trench (TC-10)	Constructed Wetland (TC-21)
Retention Basin (TC-11)	Detention Basins (TC-22)
Vegetated Swale (TC-30)	Vegetated Filter Strip (TC-31)
Bioretention (TC-32)	Surface Sand Filters
Media Filters (TC-40)	Oil & Water Separators (TC-50)
Catch Basin Inserts	Proprietary Systems

Treatment control BMPs are not meant to be isolated components, rather they should be part of an integrated stormwater management treatment train.

Infiltration Trenches (TC-10)

An infiltration trench is an excavated trench, backfilled with a stone aggregate, and lined with filter fabric. Pollutants are filtered out of the runoff as it infiltrates the surrounding soils. Infiltration trenches are highly effective at removing sediment, nutrients, trash, metals, bacteria, oil and grease, organics and oxygen demanding constituents.

For additional information regarding infiltration trenches.

<http://www.cabmphandbooks.com/Documents/Municipal/TC-10.pdf> or
<http://www.epa.gov/owmitnet/mtb/infiltrenc.pdf>

Constructed Wetlands (TC-21)

Constructed wetlands are excavated basins with an undulating bottom into which wetland vegetation is purposely placed to enhance pollutant removal from stormwater runoff. Constructed wetland remove solids and coarse organic material, soluble nutrients and some dissolved nutrients.

For additional information regarding constructed wetlands.

<http://www.cabmphandbooks.com/Documents/Municipal/TC-21.pdf>

Retention Basins (TC-11)

Infiltration facilities store runoff until it gradually infiltrates into the soil. Retention basins are highly effective at removing sediment, nutrients, trash, metals, bacteria, oil and grease, organics and oxygen demanding constituents.

For additional information regarding retention basins.

<http://www.cabmphandbooks.com/Documents/Municipal/TC-11.pdf>

Detention Basins (TC-22)

Detention basins are basins where outlets have been designed to detain stormwater runoff from a storm for some minimum time (e.g., 72 hours) to allow particles and associated pollutants to settle out. Detention basins are less effective than retention basins at removing sediment, metals, bacteria, oil and grease, organics and oxygen demanding constituents. The efficiency removal rate corresponds to detention time, with higher removal efficiency rates with longer detention times.

For additional information regarding detention basins.

<http://www.cabmphandbooks.com/Documents/Municipal/TC-22.pdf>

Vegetated Swales (TC-30)

Vegetated swales are shallow channels with vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. They are designed to treat runoff through filtering by the vegetation in the channel, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Swales are moderately effective at trapping particulate pollutants (suspended solids and trace metals). Swales can contribute to increased nutrient loads if over-fertilized.

For additional information regarding vegetated swales.

<http://www.cabmphandbooks.com/Documents/Municipal/TC-30.pdf>

Vegetated Filter Strip (TC-31)

Vegetated filter strips are vegetated surfaces that are designed to treat sheet flow from adjacent surfaces. Filter strips function by slowing runoff velocities and allowing sediment and other pollutants to settle out. They are highly effective at removing sediment, metals and oil and grease. They are not very efficient at removing nutrients and bacteria.

For additional information regarding vegetated filter strips.

<http://www.cabmphandbooks.com/Documents/Municipal/TC-31.pdf>

Bioretention (TC-32)

Bioretention facilities remove pollutants through a variety of physical, biological, and chemical treatment processes that are soil and plant-based. Bioretention facilities are highly effective at removing sediment, trash, metals, bacteria, oil and grease, organics and oxygen demanding constituents. Nutrients can be effectively removed by properly maintained bioretention facilities; however, over fertilized bioretention facilities can introduce nutrients into the system.

For additional information regarding bioretention facilities.

<http://www.cabmphandbooks.com/Documents/Municipal/TC-32.pdf>

Surface Sand Filters

Sand filter systems consist of two or three chambers or basins. The first is the sedimentation chamber, which removes floatables and heavy sediments. The second is the filtration chamber which removes additional pollutants by filtering the runoff through a sand bed. The third is the discharge chamber. Sand filters are able to achieve high removal efficiencies for sediment, biochemical oxygen demand (BOD), and fecal coliform bacteria; however, removal efficiencies for metal, is moderate, and nutrient removal is often low.

For additional information regarding surface sand filters.

<http://www.epa.gov/owmitnet/mtb/sandfltr.pdf>

Media Filters (TC-40)

Media filters are usually two-chambered filtering structures consisting of a pretreatment settling basin and a filter bed filled with sand or other absorptive filtering media. Media filters are highly efficient at removing sediment, trash, metals, oil and grease and organic constituents; however, removal efficiencies are moderate for bacteria and low for nutrients. They are often used where the site precludes the use of surface BMPs.

For additional information regarding media filters.

<http://www.cabmphandbooks.com/Documents/Municipal/TC-40.pdf> or
http://www.deq.state.id.us/water/data_reports/storm_water/catalog/sec_4/bmps/7.pdf

Oil/Water Separators (TC-50)

Regional Water Quality Control Board Region 2 (August 5, 2004 Letter entitled "Use of storm drain inlet filters and oil/water separators to meet the requirements of NPDES Municipal Stormwater Permits"), indicates that vault based oil-water separators are generally ineffective at removing pollutants at concentrations seen in urban runoff. While their removal rates are low, the pollutants captured in one storm are likely to be flushed out in a subsequent storm. The Region 2 Board recommends that oil/water separators only be used as part of a treatment train and on projects where oil and grease concentrations are

expected to be very high. Oil and water separators are also commonly called water quality inlets or oil and grit separators.

For additional information oil/water separators.

<http://www.cabmphandbooks.com/Documents/Municipal/TC-50.pdf>

Catch Basin Inserts

According to Regional Water Quality Control Board Region 2 (August 5, 2004 Letter) storm drain filters (also known as catch basin inserts) are discouraged because they are subject to clogging and binding, are rarely maintained, have rapidly decaying effectiveness rates over a time frame that is significantly shorter than the typically recommended replacement or maintenance intervals, are ineffective at removing dissolved pollutants, and are easily bypassed if fouled to prevent flooding.

Proprietary (Manufactured) Systems

Proprietary systems are generally “end of pipe” treatment systems and are discouraged. Applicants are encouraged to research the BMP effectiveness based on independent studies.

For scientifically sound information to improve the design, selection and performance of BMPs. <http://www.bmpdatabase.org/index.htm>

7.3 Stormwater Pollutants

It is important that stormwater treatment control BMPs address the pollutants generated by the project. Review the tables in this section to eliminate unsuitable or incompatible treatment control measures from the list. As a treatment control BMP is eliminated, note the criteria that justified its removal on the checklist provided in Table 7-6. **Use this checklist during the development review process.** Table 7.1 provides a matrix of the categories of pollutants corresponding to various land uses.

Table 7-1: Pollutant Categories Associated with Various Types of Development

GENERAL POLLUTANT CATEGORIES	PROJECT CATEGORY							
	SINGLE FAMILY RESIDENTIAL	MULTI-FAMILY RESIDENTIAL	COMMERCIAL/ INDUSTRIAL	AUTO REPAIR SHOPS	RESTAURANT	HILLSIDE DEVELOPMENTS	PARKING LOTS	STREETS/ROADS
Pathogens	X	P	P ⁽³⁾		X			
Metals				X			X	X
Nutrients	X	X	P ⁽¹⁾			X	P ⁽¹⁾	P ⁽¹⁾
Pesticides	X	X	P ⁽¹⁾			X	P ⁽²⁾	
Organic Compounds			P ⁽²⁾	X ⁽⁴⁾⁽⁵⁾				X ⁽⁴⁾

Sediments	X	X	X			X	P ⁽¹⁾	X
Trash & Debris	X	X	X	X	X	X	X	X
Oxygen Demanding Substances	X	P ⁽¹⁾	P ⁽¹⁾		X	X	P ⁽⁵⁾	P ⁽⁵⁾
Hydrocarbons	X	P ⁽²⁾	X	X	X	X	X	X

Source: CASQA, 2003

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.

Understanding the sources of pollutants associated with development is useful in selecting appropriate site, source and treatment control measures. The sources of pollutants commonly found in urban runoff are provided in Table 7-2.

Table 7-2: Sources of Pollutants Commonly Found in Urban Runoff

POLLUTANT	MAJOR SOURCES	POTENTIAL EFFECTS
Nutrients <ul style="list-style-type: none"> • Nitrogen • Phosphorus 	<ul style="list-style-type: none"> • Fertilizers • Animal Waste • Detergents • Atmospheric deposition • Leaking sewage pipes 	<ul style="list-style-type: none"> • Lowers oxygen levels • Destroys habitat • Promotes algal blooms • Limits recreation • Interferes with navigation
Pathogens <ul style="list-style-type: none"> • Bacteria • Viruses 	<ul style="list-style-type: none"> • Animal waste • Illicit connections between storm sewers and sewage lines • Leaking sewage pipes 	<ul style="list-style-type: none"> • Poses human health risks • Closes beaches • Closes shellfish harvesting areas
Hydrocarbons <ul style="list-style-type: none"> • Oil • Grease • Petroleum-based products • Polycyclic aromatic hydrocarbons (PAHs) 	<ul style="list-style-type: none"> • Parking Lots • Roads • Automobile emissions • Improper disposal of used motor oil • Illicit connections to drain systems 	<ul style="list-style-type: none"> • Lowers levels of dissolved oxygen in receiving waters • Causes toxic impacts • Damages habitat
Toxic Organics <ul style="list-style-type: none"> • Pesticides • Polychlorinated biphenyls (PCBs) 	<ul style="list-style-type: none"> • Lawn care • Agricultural lands • Industrial uses • Illicit connections to drain systems 	<ul style="list-style-type: none"> • Causes toxic impacts • May lead to human and animal reproductive abnormalities • Increases animal mortality rates
Sediments	<ul style="list-style-type: none"> • Construction sites • Agricultural lands • Logged forest lands • Eroded stream banks 	<ul style="list-style-type: none"> • Increases water turbidity • Alters water flows • Destroys benthic habitat • Blocks sunlight • Attracts particulate forms of metals and nutrients
Metals <ul style="list-style-type: none"> • Lead • Copper 	<ul style="list-style-type: none"> • Illicit connections to drain systems • Automobile emissions, Brake 	<ul style="list-style-type: none"> • Increases toxicity of sediment and water column

POLLUTANT	MAJOR SOURCES	POTENTIAL EFFECTS
<ul style="list-style-type: none"> • Cadmium • Zinc • Mercury • Chromium • Selenium • Nickel 	<ul style="list-style-type: none"> • pad residues • Atmospheric deposition • Industrial activities • Commercial activities 	<ul style="list-style-type: none"> • Adds toxins to food chain • Causes genetic defects, reproductive abnormalities and increased mortality rates among fish and wildlife • Increases risks of cancer, neurological disorders and birth defects among humans
Trash & Debris	<ul style="list-style-type: none"> • Human activities 	<ul style="list-style-type: none"> • Aesthetic impacts • Impairs recreational uses • Threatens aquatic life
Elevated Temperatures	<ul style="list-style-type: none"> • Industrial sources • Removal of trees next to streams and rivers • Impervious surfaces and conveyances 	<ul style="list-style-type: none"> • Threat to insects, fish and other temperature sensitive aquatic species

Sources: Terrene Institute, 1996; U.S. EPA, 1995

7.4 Treatment Control BMP Considerations

Site and land use categories can be used to further refine the list of suitable treatment controls.

Effectiveness

This category addresses how well the treatment control BMP is able to reduce the pollutants of concern in the stormwater. Eliminate treatment control BMPs that have a low effective removal rate for the pollutant of concern(s) associated with the project.

TREATMENT CONTROL BMPs	POLLUTANT CATEGORY						
	METALS	NUTRIENTS	SEDIMENT	TRASH AND DEBRIS	OIL AND GREASE	ORGANICS	PATHOGENS
Infiltration Trench (TC-10)	H	H	H	H	H	H	H
Constructed Wetland (TC-21)	H	M	H	H	H	H	H
Retention Basin (TC-11)	H	H	H	H	H	H	H
Detention Basin (TC-22)	M	L	M	H	M	M	M
Vegetated Swale (TC-30)	M	L	M	M	M	M	L
Vegetated Filter Strips (TC-31)	H	L	H	M	H	M	L

Bioretention (TC-32)	H	M	H	H	H	H	H
Surface Sand Filters	L	M	H	L	H	M	L
Media Filter (TC-40)	H	L	H	H	H	H	M
Oil Water Separators (TC-50)	L	L	L	M	M	L	L
Catch Basin Inserts	L	L	L	M	L	L	L

Source: xxxxxx

L=Low, M=Medium, H=High

Probability of Failure

Infiltration systems without adequate pre-treatment to remove sediment from runoff are at risk of premature failure due to clogging.

Proximity to Hot Spots

Hot spots are areas that have higher concentrations of pollutants than is typically found in urban runoff. Treatment control facilities that discharge to groundwater should not be used at hot spot locations. Therefore, projects that generate hot spot type pollutants should not use infiltration trenches, retention basins, dry wells, permeable pavements with underground recharge beds.

Receiving Waters

Projects discharging to Clean Water Act 303(d) listed water bodies must address all constituents that will contribute to the impairment of the water body.

Tributary Area

Some practices require a minimum area to ensure sufficient flows to the BMP, while others are limited to the maximum runoff they can handle. When considering the removal of a potential treatment control BMP based on tributary area, be sure to remember that large areas can be subdivided into smaller catchment areas to facilitate treatment or flow splitters that can be installed to capture and treat the first flush while by-passing larger storm events.

Additional information regarding flow splitters is available at the Minnesota Urban Small Sites BMP Handbook at:

http://www.metrocouncil.org/environment/Watershed/BMP/CH3_STFlowSplitters.pdf

Table 7-3 provides a list of treatment practices where effectiveness is based on the size of the tributary area draining to it.

Table 7-3. Applicability of treatment practices relative to BMP Tributary area

PRACTICE	FEASIBLE (ACRE)	MARGINAL (ACRE)
Infiltration Trench (TC-10)	0-5	5
Constructed Wetlands (TC-21)	25-100	10-25
Retention Basin (TC-11)	5 acre and/or base flow	5-10
Detention Basin (TC-22)	5-25	<5

Vegetated swales (TC-30)	0-5	5-50
Vegetated Filter Strips (TC-31)	0-5	5-10
Bioretention facilities (TC-32)	4-20	0.5-4 and 20-50
Surface Sand Filters	1-10	10-25
Media Filters (TC-40)	0-2	>2
Oil water separators (TC-50)	0-5	5-7.5

Slopes

The slope of a BMP is a consideration in the Treatment Control BMP selection process. Larger BMPs, such as detention and retention basins, may require impractically large embankment heights if they were to be situated on a steep slope. Steep slopes may cause erosion or provide inadequate hydraulic residence times for vegetated strips and swales. When an entire site has steep slopes, it may be best to provide a number of smaller BMPs that can fit into the existing contours of the site.

Water Tables and Bedrock

Treatment control BMPs that rely on the chemical, biological and physical properties of soil to achieve treatment goals may be limited due to high groundwater or shallow bedrock elevations.

Available Land

Densely developed sites may have inadequate space to incorporate some treatment control BMPs. Some treatment control BMPs require a significant amount of land for installation.

Poorly Drained Soils

Some treatment control BMPs, such as wetlands, thrive with poorly drained soils, while others treatment control BMPs are precluded for use unless under drains are incorporated into the treatment area.

Grade Differences

Most infiltration BMPs must be at a lower elevation than the adjacent areas from which they will receive runoff. Some filtering systems have modest head requirements that might preclude their use in some areas.

Table 7-4 provides a list of treatment practices that are influenced by the conditions listed above and that are typical of development sites.

Table 7-4 Treatment Practices Site Condition Considerations

PRACTICE	HOT SPOT RUNOFF	STEEP SLOPES	HIGH WATER TABLE	SHALLOW BEDROCK	PROXIMITY TO FOUNDATION	POORLY DRAINED SOILS
Infiltration Trench (TC-10)	No	No	No	No	D	No
Constructed Wetland (TC-21)	Ok	Ok	Ok	D	Ok	No

Retention Basin (TC-11)	No	No	No	No	D	No
Detention Basin (TC-22)	D	No	No	No	D	Ok
Vegetated Swale/(TC-30)	D	D	No	Ok	D	D
Vegetated Filter Strips (TC-31)	No	No	No	No	No	Ok
Bioretention (TC-32)	D	Ok	No	No	D	Ok
Surface Sand Filter	Ok	No	No	No	No	No
Media Filter (TC-40)	Ok	Ok	Ok	Ok	Ok	Ok
Oil Water Separators (TC-50)	Ok	Ok	Ok	D	D	D
Catch Basin Inserts	Ok	Ok	Ok	Ok	Ok	Ok

Ok – compatible site conditions

No – Site condition that precludes treatment control BMP use

D – Site condition will require additional engineering to use treatment control BMP

Additional Considerations

There are additional considerations beyond the site considerations and targeted pollutant criteria described above, including cost, difficulty to maintain, community acceptance, habitat value and public safety.

Costs

The costs associated with initial construction and ongoing operation and maintenance (O&M) may influence the selection of one treatment control BMP over another.

Difficulty to Maintain

BMPs that are not properly maintained are ineffective.

Community Acceptance

Public understanding of a BMP’s function is helpful in alleviating BMP concerns. BMPs that blend well into the existing landscape are generally favored over more structurally based BMPs.

Habitat Value

Treatment control BMPs that improve habitat for aquatic, terrestrial and recreational uses, as well as address stormwater pollutants of concern are encouraged. Treatment control facilities may encourage adoption by endangered or threatened species—thereby eliminating the ability to perform routing operation and maintenance activities without benefit of environmental permits unless a “Safe Harbor Agreement” can be formalized in advance.

For additional information on safe harbor agreements.

<http://www.mde.state.md.us/assets/document/wetlandswaterways/safeharbor.pdf>

Safety

BMP installations in areas frequented by community members, particularly children, such as parks, schools, or other recreation areas, should be selected with safety

concerns in mind. For areas where there is potential for the BMP to be disturbed or vandalized, consideration should be given to selecting a BMP that is less obvious and less likely damaged.

Table 7-5 provides a list of treatment practices ranked by the considerations mentioned in this section.

Table 7-5 Other Considerations.

PRACTICE	COST		EASE OF MAINTENANCE	COMMUNITY ACCEPTANCE	HABITAT VALUE	SAFETY
	INITIAL	O&M				
Infiltration Trench (TC-10)	H	H	H	M	L	H
Constructed Wetland (TC-21)	H	M	M	H	H	M
Retention Basin (TC-11)	M	M	M	M	M	L
Detention Basin (TC-22)	L	L	L	L	L	M
Vegetated Swale (TC-30)	M	M	L	H	H	H
Vegetated Filter Strips (TC-31)	L	L	L	M	L	H
Bioretention (TC-32)	M	L	L	H	M	H
Surface Sand Filters	H	M	M	M	L	H
Media Filter (TC-40)	H	M	L	L	L	H
Oil Grit Separators (TC-50)	L	M	H	M	L	H
Catch Basin Inserts	L	M	M	M	L	H

L – Low
M – Medium
H - High

Table 7-6 - Treatment Control Feasibility Checklist

TREATMENT CONTROL BMP	CONSIDERED FOR USE	REJECTED BASED ON
Infiltration Trench (TC-10)		
Constructed Wetland (TC-21)		
Retention Basin (TC-11)		

Detention Basin (TC-22)		
Vegetated Swale (TC-30)		
Vegetated Filter Strip (TC-31)		
Bioretention (TC-32)		
Surface Sand Filter		
Media Filter (TC-40)		
Oil & Water Separator (TC-50)		
Catch Basin Insert		
Proprietary Systems		

Ch 8: Maintenance

8.1 Introduction to Stormwater Facility Maintenance

Stormwater facilities typically consist of a series of collection and conveyance systems, stormwater quantity control (detention/retention), and treatment facilities. A maintenance program is essential to ensure that the facilities continue to function as designed to maintain water quality and prevent possible flooding and property damage. To help understand stormwater facility maintenance requirements, it is useful to have a general knowledge of how they function.

Collection and conveyance systems

Collection and conveyance systems intercept and transport stormwater. They typically consist of curb cuts or inlets that collect water and swales or pipes that move water. Stormwater conveyance systems are designed to accept a specific maximum flow rate, as determined by the runoff generated during the design storm and the tributary area to the facility.

Typical failures include reduced capacity due to clogged surface grates and pipes. Plugging commonly occurs due to sediment and large debris washed from adjacent surfaces. Reduced conveyance system capacity results in localized flooding and possible property damage.

Quantity Control (detention/retention)

The intent of stormwater quantity control facilities is to reduce the peak flow and/or volume discharged from developed sites.

Detention facilities mitigate the site's increased runoff rate by providing temporary storage and controlling the release rate from the site through the use of orifice plates. The intent of the detention basin is to match the pre-developed runoff rates for several specific storm events in the developed condition (i.e. store the volume associated with the 50-year storm under developed conditions and release it at the 2-year pre-developed discharge rate). The runoff leaving the basin is metered from the basin to reduce potential stormwater impacts to surface waters or pipe networks located downstream of the development. While some detention facilities are able to reduce the volume of runoff released, they mainly serve to control the release rate of storms.

Retention facilities do not discharge to pipes or surface water bodies, rather they provide temporary storage until the collected runoff is able to soak into the ground.

Detention and retention facilities may be designed as basins or as underground facilities.

When infiltration devices fail, it is usually as a result of:

1. An inaccurate estimation of the Design Infiltration Rate;
2. An inaccurate estimation of the seasonal high water table;
3. Excessive compacting or sediment loading during construction;
4. No pretreatment for post-development and lack of maintenance.

Treatment facilities

Treatment facilities seek to remove oils, chemicals, metals, and sediment from stormwater runoff prior to being discharged from the property. They achieve this goal through a combination of filtration, sediment settling, plant nutrient uptake and physical separation and may consist of landscape and structural components.

Typical failures are dependent on the type of treatment facility specified. Facilities that are underground or difficult to access are at greater risk of neglect due to the “out of site, out of mind” factor. Passive, surface types of treatment facilities are generally considered easier to identify and address small problems before they become big problems.

Each of these types of facilities requires ongoing operational and maintenance activities to be done to ensure they continue to meet the purpose for which they were installed.

This chapter provides insight into the maintenance requirements for each types of facility, although multiple types of facilities may be present at each site. Some maintenance needs are common to all types of facilities, while others depend on the specific facility.

Example maintenance checklists are provided for the common types of stormwater facilities used in San Luis Obispo County shown in the list below.

Infiltration Trench (TC-10)	Wetlands (TC-21)
Retention Basin (TC-11)	Detention Basin (TC-22)
Vegetated Swale (TC-30)	Vegetated Filter Strip (TC-31)
Bioretention (TC-32)	Surface Sand Filter
Media Filter (TC-40)	Oil & Water Separator (TC-50)
Catch Basin Insert	Proprietary System

Facility owners should incorporate the use of maintenance procedures and checklists that apply to their facilities into their Operation and Maintenance Plans. Structural or treatment control BMPs located within a public area proposed for transfer will be the responsibility of the developer until they are accepted for transfer by the County or other appropriate public agency.

8.2 Operation and Maintenance (O&M) Plans

Private stormwater facility owners are responsible for ensuring that the facilities are maintained and continue to function as designed. As part of the project application, the property owner shall complete an O&M maintenance agreement. The private stormwater facility owner will draft an O&M Plan and will provide a self-certification statement ensuring compliance with the Plan.

The Operation and Maintenance (O&M) plan must:

- Identify who is responsible for maintenance and how the maintenance will be funded. A copy of the maintenance agreement must be included with the O&M Plan.
- Include an overview of site drainage patterns, including all discharge points and the location of each treatment BMP.
- Document design parameters, features, methods and materials of construction, intended mode of operation and other key characteristics of stormwater treatment BMPs on the site.
- Include BMP manufacture data and handbooks for proprietary BMP systems.

- Identify the maintenance program and schedule to ensure treatment BMPs continue to operate as intended. Maintenance is required at least once per year.
- A checklist to be used during verification inspections.

The O&M Plan and self-certification must be filed as a covenant to the recorded deeds for all lots to enforce the imposition of any special tax assessment that may be necessary to maintain stormwater treatment facilities if the responsibility party fails or is unable to perform any of the obligations in the Maintenance Agreement.

8.3 Transferring O&M Responsibility for Stormwater Facilities

There are two ways to transfer O&M responsibilities:

- Structural or treatment control BMPs located within a public area proposed for transfer will be the responsibility of the developer until they are accepted for transfer by the County or other appropriate public agency.
- The responsibility of private ownership of stormwater facilities can also be transferred to another private entity when the property is sold, transferred, or leased to another person or entity by including O&M responsibility as a condition in the sales, transfer or lease agreement. The first deed transfer or any lease agreements shall include the details of these requirements and information about the BMP such as the following:
 - BMP location;
 - How and when to perform the necessary inspections and maintenance; and
 - How long to keep all inspection and maintenance records.

The transfer of this information is required with any subsequent sale of the property.

8.4 Example Stormwater BMP Maintenance and Inspection Checklists

Example Maintenance Checklist for Infiltration Trench BMP (TC-10)

ROUTINE MAINTENANCE ACTIVITIES FOR INFILTRATION TRENCHES		
No.	MAINTENANCE TASK	FREQUENCY OF TASK
1	Remove obstructions, debris and trash from infiltration trench and dispose of properly.	Monthly, or as needed after storm events
2	Inspect trench to ensure that it drains between storms, and within 5 days after rainfall. Check observation well 2-3 days after storm to confirm drainage.	Monthly during wet season, or as needed after storm events
3	Inspect filter fabric for sediment deposits by removing a small section of the top layer.	Annually
4	Monitor observation well to confirm that trench has drained during dry season.	Annually, during dry season
5	Mow and trim vegetation around the trench to maintain a neat and orderly appearance.	As needed
6	Remove any trash, grass clippings and other debris from the trench perimeter and dispose of properly.	As needed
7	Check for erosion at inflow or overflow structures.	As needed
8	Confirm that cap of observation well is sealed.	At every inspection
9	Inspect infiltration trench using the Trench inspection checklist.	Monthly, or after large storm events, and after removal of accumulated debris or material

Prohibitions:

Trees and other large vegetation should be prevented from growing adjacent to the trench to prevent damage. Standing water shall not remain in the trench for more than three days, to prevent mosquito generation. Should any mosquito issues arise, consult the County Health Department for proper vector control measures.

Example Maintenance Checklist for Detention Basin BMP (TC-22)

Routine Maintenance Activities for Extended Detention Basins		
No.	Maintenance Task	Frequency of Task
1	Conduct annual vegetation management during the summer, removing weeds and harvesting vegetation. Remove all grass cuttings and other green waste.	Once a year
2	Trim vegetation at beginning and end of wet season to prevent establishment of woody vegetation, and for aesthetics and mosquito control.	Twice a year (spring and fall)
3	Evaluate health of vegetation and remove and replace any dead or dying plants. Remove all green waste and dispose of properly.	Twice a year
4	If turf grass is included in basin design, conduct regular mowing and remove all grass cuttings. Avoid producing ruts when mowing.	As needed
5	Remove sediment from fore bay when the sediment level reaches the level shown on the fixed vertical sediment marker and dispose of sediment properly.	As needed
6	Remove accumulated sediment and regrade when the accumulated sediment volume exceeds 10% of basin volume and dispose of sediment properly.	Every 10 years, or as needed
7	Remove accumulated trash and debris from the extended detention basin at the middle and end of the wet season and dispose of trash and debris properly.	Twice a year (Before and after the rainy season)
8	Inspect extended detention basin using the attached inspection checklist.	Quarterly, or as needed

Prohibitions:

The use of pesticides and quick release fertilizers shall be minimized, and the principles of integrated pest management (IPM) followed.

Example Wetland and Basin BMP Inspection Checklist

Inspection Items	Satisfactory (S) or Unsatisfactory (U)	Comments/Corrective Action
General		
Dead, diseased, or dying vegetation present?		
Poisonous vegetation, noxious weeds or excessive weeds present?		
Does tree growth interfere with required maintenance activities?		
Any evidence of oil, gasoline, contaminants or other pollutants?		
Is vegetation sparse or are there bare or eroded patches occurring in more than 10% of the swale bottom or 30% of swale side slopes?		
Embankment and Emergency Spillway		
Any evidence of rodent holes if facility is acting as a dam or berm?		
Is erosion damage within basin over 2 inches deep with the cause of damage or potential for continued erosion still present?		
Is erosion present in/around emergency spillway?		
Cracking, sliding, bulging of embankment or spillway? Any part of berm settled 4 or more inches lower than the design elevation?		
Any discernable water flow through embankments?		
Any obstructions of spillway(s)?		
Inlet/Outlet Structures and Channels		
Clear of debris and functional?		
Accumulated sedimentation in fore bay or inlet structure?		
For concrete structures, any cracks wider than 1/2-inch and longer than 1-foot with evidence of soil particles entering the structure through the cracks?		
Pipes, plates in good condition?		
Outfall channels functional and not eroding?		
Basin Bottom		
Accumulated sedimentation?		
Hazards		
Have there been complaints from residents or public hazards notes?		

Example Maintenance Checklist for Vegetated Swale BMP (TC-30)

Routine Maintenance Activities for Vegetated Swales		
No.	Maintenance Task	Frequency of Task
1	Mow turf grass	As needed
2	Remove obstructions and trash from vegetated swale.	Monthly, or as needed
3	Inspect swale to check for erosion and sediment and debris accumulation and dispose of sediment and debris properly.	Twice a year: 1) one inspection should occur at the end of the wet season in order to plan and schedule summer maintenance, 2) the other inspection should occur after periods of heavy runoff
4	Remove sediment accumulating near culverts and in channels and dispose of sediment properly.	As needed.
5	Inspect swale using the inspection checklist.	As needed

Prohibitions:

The use of pesticides and quick release fertilizers shall be minimized, and the principles of integrated pest management (IPM) followed.

Example Maintenance Checklist for Vegetated Filter Strip BMP (TC-31)

Routine Maintenance Activities for Vegetated Buffer Strips		
No.	Maintenance Task	Frequency of Task
1	Mow turf grass remove grass cuttings.	As needed
2	Remove obstructions and trash from vegetated buffer strip and dispose of properly.	Monthly, or as needed
3	Inspect buffer strip to check for erosion and sediment and debris accumulation. Dispose of sediment and debris properly.	Twice a year: 1) one inspection at the end of the wet season in order to plan and schedule summer maintenance, 2) the other inspection after periods of heavy runoff
4	Remove sediment accumulating near culverts and if it covers vegetation. Dispose of sediment properly.	As needed
5	Inspect buffer strip using the inspection checklist.	As needed

Prohibitions:

The use of pesticides and quick release fertilizers shall be minimized, and the principles of integrated pest management (IPM) followed.

Example Maintenance Checklist for Bioretention BMP (TC-32)

Routine Maintenance Activities for Bioretention Areas		
No.	Maintenance Task	Frequency of Task
1	Remove obstructions, debris and trash from bioretention area and dispose of properly.	Monthly, or as needed after storm events
2	Inspect bioretention area to ensure that it drains between storms and within five days after rainfall.	Monthly, or as needed after storm events
3	Inspect inlets for channels, soil exposure or other evidence of erosion. Clear obstructions and remove sediment.	Monthly, or as needed after storm events
4	Remove and replace all dead and diseased vegetation.	Twice a year
5	Maintain vegetation and the irrigation system. Prune and weed to keep bioretention area neat and orderly in appearance.	Before wet season begins, or as needed
6	Check that mulch is at appropriate depth (3 inches per soil specifications) and replenish as necessary before wet season begins.	Monthly
7	Inspect bioretention area using the attached inspection checklist.	Monthly, or after large storm events, and after removal of accumulated debris or material

Prohibitions:

The use of pesticides and quick release fertilizers shall be minimized, and the principles of integrated pest management (IPM) followed.

Example Maintenance Inspection Checklist for Bioretention BMP Facilities

Inspection Activities	Suggested Schedule
Inspect for: trash and debris; yard waste, excessive erosion; sediment accumulation in the basin; tree growth on overflow structure; the presence of burrowing animals; standing water where there should be none; vigor and density of the grass turf. Note signs of pollution, such as oil sheens, discolored water, or unpleasant odors.	Annually
Maintenance Activities	Suggested Schedule
Clean and remove debris from bioretention area and contributing areas Mow Prune and weed planted areas.	Monthly or as needed

Proprietary Treatment Systems

Manufactured Stormwater Treatment Measures are proprietary treatment devices that tend to be installed below ground and operate using some type of proprietary filter media, hydrodynamic separation, or sedimentation and screening. Common examples of manufactured treatment measures include manufactured media filters, inlet filters or drain inserts, oil/water separators and hydrodynamic separators.

Routine Maintenance Activities

The principal maintenance objective is to prevent sediment buildup and clogging, which reduces pollutant removal efficiency and may lead to failure of the manufactured treatment measure.

Example Maintenance Checklist for Proprietary System BMPs

Routine Maintenance Activities for Manufactured Treatment Measures		
No.	Maintenance Task	Frequency of Task
1	Inspect for standing water, sediment, trash and debris.	Monthly during rainy season
2	Remove sediment, trash and debris from sedimentation basin, riser pipe and filter bed, using vactor truck method. Dispose of sediment, trash, filters and debris properly.	As needed
3	Ensure that manufactured treatment measure drains completely within three days.	After major storm events and as needed.
4	Inspect outlets to ensure proper drainage.	Monthly during rainy season, or as needed after storm events
5	Follow manufacturer's guidelines for maintenance and cartridge replacement.	As per manufacturer's specifications.
6	Inspect manufactured treatment measure, using the attached inspection checklist.	Monthly, or after large storm events, and after removal of accumulated debris or material

Prohibitions:

Trees and other large vegetation shall be prevented from growing adjacent to the manufactured treatment measure to prevent damage. Standing water shall not remain in the treatment measures for more than three days, to prevent mosquito generation.

GLOSSARY

Glossary

The following are the terms and acronyms used frequently in this handbook.

ADT— Average daily traffic

Base flow — Streamflow which results from precipitation that infiltrates into the soil and eventually moves through the soil to the stream channel. This is also referred to as groundwater flow, or dry-weather flow.

Biofilter— Any of a number of devices used to control pollution using living materials to filter or chemically process pollutants.

Bioretention— A technique that uses parking lot islands, planting strips, or swales to collect and filter urban stormwater, that includes grass and sand filters, loamy soils, mulch, shallow ponding and native trees and shrubs.

Best Management Practices (BMPs) —Schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of “waters of the United States.” BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw materials storage. BMPs include structural and nonstructural controls, and operation and maintenance procedures, which can be applied before, during, and/or after pollution producing activities.

Buffer— A zone created or sustained adjacent to a shoreline, wetland or stream where development is restricted or prohibited to minimize the negative effects of land development on animals and plants and their habitats.

CCRWQCB— Central Coast Regional Water Quality Control Board

Cluster Development — The principle of cluster development incorporates grouping new homes onto part of a development parcel so that the remaining land can be preserved as open space.

Commercial Development — Any development on private land that is not heavy industrial or residential. The category includes, but is not limited to hospitals, laboratories and other medical facilities, educational institutions, recreational facilities, plant nurseries, car wash facilities, mini-malls, business complexes, shopping malls, hotels, office buildings, public warehouses, and light industrial complexes.

Commercial/Industrial Facility — Any facility involved and/or used in the production, manufacture, storage, transportation, distribution, exchange or sale of goods and/or commodities, and any facility involved and/or used in providing professional and non-professional services. This category of facilities includes, but is not limited to, any facility

defined by the SIC Code. Facility ownership (federal, state, municipal, private) and profit motive of the facility are not factors in this definition.

Connected Impervious Area — An impervious area is considered connected if runoff from it flows directly into the drainage system. It is also considered connected if runoff from it occurs as concentrated shallow flow that runs over a pervious area and then into a drainage system.

Construction — Clearing, grading, excavating, building and related activities that result in soil disturbance. Construction includes structure teardown. It does not include routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of facility; emergency construction activities required to immediately protect public health and safety; interior remodeling with no outside exposure of construction material or construction waste to stormwater; mechanical permit work; or sign permit work.

Control — To minimize, reduce, eliminate, or prohibit by technological, legal, contractual or other means, the discharge of pollutants from an activity or activities.

Control Structure — A device used to hold back or direct a calculated amount of stormwater to or from a stormwater management facility. Typical control structures include vaults or manholes fitted with baffles, weirs, or orifices.

Conveyance — The transport of stormwater from one point to another.

Design Storm — Rainfall runoff data or where rainfall runoff data is not available, data based on a synthetic rainstorm, as defined by rainfall intensities and durations.

Detention — The collection of runoff in a ponding area, depression, or storage chamber followed by its gradual release through an outlet into a receiving water body. Detention is one way to reduce a site's peak runoff rate to its pre-development peak rate for the storm event of a given magnitude, but is not an effective way to reduce the runoff volume. The detention process allows sediment and associated pollutants to settle out of the runoff.

Development — Any construction, rehabilitation, redevelopment or reconstruction of any public or private residential project (whether single-family, multi-unit or planned unit development); industrial, commercial, retail and other non-residential projects, including public agency projects; or mass grading for future construction. It does not include routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of facility, nor does it include emergency construction activities required to immediately protect public health and safety.

Development Standards — Standards that the County has developed for new development and significant redevelopment projects to control the discharge of stormwater pollutants in post-construction stormwater.

Directly Adjacent — Situated within 200 feet.

Directly Connected Impervious Area or Surface — The area of impervious surface which drains directly into the storm drain system without first allowing flow across a pervious area (e.g. lawn).

Discharging directly to — An outflow from a drainage conveyance system that is composed entirely of flow from the subject development or redevelopment site and not commingled with flows from adjacent land.

Disconnected impervious area or surface — An impervious area or surface that drains across a pervious area prior to discharge to a storm drain system.

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

Drywell — A structural subsurface facility with perforated sides or bottom, used to infiltrate stormwater into the ground.

Effective Imperiousness Area (EIA) — Impervious area not directly connected to a stream or drainage system during the specified design storm.

Environmentally Sensitive areas (ESA) — Areas that include but are not limited to all Clean Water Act Section 303(d) impaired water bodies; areas designated as special biological significance by the State Water Resource Control Board, water bodies designated with the habitat-related uses EST, WET, MAR, WILD, BIO, RARE, SPWN by the State Water Resource Control Board, areas designated as preserves within the County of San Luis Obispo.

Evapotranspiration — The combined loss of water from a given area, occurring during a specified period of time, by evaporation from the soil surface and transpiration from plants into the atmosphere.

Erosion — (1) The loosening and transportation of rock and soil debris by wind, rain, or running water. (2) The gradual wearing away of the upper layers of earth.

Feasible— Capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental and technological factors. Infeasibility must be supported by substantial evidence developed through good faith efforts to investigate alternatives that would result in less adverse impacts. A substantial modification to the configuration of a development, or reduction in density or intensity, would not be considered infeasible unless support by the above factors.

Flow-Based Treatment Control Measures — Stormwater quality treatment measures that rely on flow capacity to treat stormwater. These measures remove pollutants from a moving

stream of water through filtration, infiltration, adsorption, and/or biological processes. Examples: vegetated swales and filter strips.

General Construction Activities Stormwater Permit (Construction General Permit) — The general NPDES permit adopted by the State Regional Water Quality Control Board, which authorizes the discharge of stormwater from construction activities under certain conditions.

General Industrial Activities Stormwater Permit (Industrial General Permit) — The general NPDES permit adopted by the State Board which authorizes the discharge of stormwater from certain industrial activities under certain conditions.

Habitat-Related Uses — Several habitat-related beneficial uses defined by the Regional Water Quality Control Board that include warm and cold freshwater habitats; estuarine, wetland and marine habitats; wildlife habitat; biological habitats (including Areas of Special Biological Significance); habitats that support rare, threatened, or endangered species; habitats that support migration of aquatic organisms; and habitats that support spawning, reproduction, and/or early development of fish.

Head (hydraulic head) — 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

Heat Island Effect — The increase in ambient temperatures generated by heat radiating from paved surfaces exposed to sunlight.

Hillside — Lands that have a natural gradient of 10 percent or greater.

Hot Spots — A land use or activity that produces higher concentrations of trace metals, hydrocarbons or priority pollutants than normally found in urban runoff. Hot spots are typically associated with auto recyclers, vehicle service, maintenance and washing facilities, industrial facilities with outdoor storage or loading docks.

Hydrograph — Runoff flow rate plotted as a function of time.

Hydromodification — Hydromodification is the alteration of hydrologic characteristics (i.e. flow duration, magnitude, recharge rates and runoff volumes) within a watershed.

Hydraulic Residence Time — The average time required to completely renew a waterbody's water volume.

Hydrologic Soil Group (HSG) — A group of soils having similar runoff potential under similar storm and cover conditions. Natural Resource Conservation Service (NRCS) HSG information for a given site can be used to identify the likelihood that native soils can be used for infiltration BMPs (<http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>). There are four types of HSG's.

1. (Low runoff potential). The soils have a high infiltration rate even when thoroughly wetted. They chiefly consist of deep, well drained to excessively drained sands or gravels. They have a high rate of water transmission (1 to 8.3 inches per hour).
2. The soils have a moderate infiltration rate when thoroughly wetted. They chiefly are moderately deep to deep, moderately well drained to well drained soils that have moderately fine to moderately coarse textures. They have a moderate rate of water transmission (0.5 to 1 inch per hour).
3. The soils have a slow infiltration rate when thoroughly wetted. They chiefly have a layer that impedes downward movement of water or have moderately fine to fine texture. They have a slow rate of water transmission (0.17 to 0.27 inches per hour).
4. (High runoff potential). The soils have a very slow infiltration rate when thoroughly wetted. They chiefly consist of clay soils that have a high swelling potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. They have a very slow rate of water transmission (0.02 to 0.1 inches per hour).

Typically those designated as Type 1 and Type 2 are more readily available for use with infiltration BMPs

Illicit Connection — Any man-made conveyance that is connected to the storm drain system without a permit, excluding roof drains and other similar type connections. Examples include channels, pipelines, conduits, inlets, or outlets that are connected directly to the storm drain system.

Illicit Discharge — Any discharge to the storm drain system that is prohibited under local, state, or federal statutes, ordinances, codes, or regulations. The term illicit discharge includes all non storm-water discharges except discharges pursuant to an NPDES permit, discharges that are identified as "allowable" in NPDES Municipal Stormwater Permits, and discharges authorized by the Regional Board.

Impervious Surface — Any material that prevents or substantially reduces infiltration of water into the soil.

Impervious Surface Area — The ground area covered or sheltered by an impervious surface, measured in plan view, i.e., the impervious surface of a pitched roof is equal to the ground ware it shelters, rather than the surface area of the roof itself.

Infiltration — The downward entry of water into the surface of the soil. Infiltration rate (or infiltration capacity) is the maximum rate at which a soil in a given condition will absorb water.

Inspection — Entry and the conduct of an on-site review of a facility and its operations, at reasonable times, to determine compliance with specific municipal or other legal requirements.

Integrated Management Practices (IMPs) — A LID practice or combination of practices that are the most effective and practicable (including technological, economic, and institutional considerations) means of controlling the predevelopment site hydrology, point or non-point source pollutants at levels compatible with environmental quality goals. They are small-scale structural stormwater practices distributed through out a site or drainage area for the purpose of managing or influencing the site hydrology.

Low Impact Development (LID) — An approach to site design and stormwater management that seeks to maintain the site's pre-development rates and volumes of runoff. LID accomplishes this through the minimization of impervious cover, strategic placement of buildings, pavement and landscaping, and the use of small-scale distributed runoff management features that are collectively called "Integrated Management Practices" (IMPs). LID emphasizes conservation and use of existing natural site features.

Maximum Extent Practicable (MEP) — Section 402(p)(3)(B) of the Clean Water Act (CWA) directs the Regional Board to issue NPDES Municipal Stormwater Permits which require the dischargers to develop and implement programs with the goal of reducing the discharge of pollutants in stormwater runoff to the maximum extent practicable (MEP). The SWRCB through a State Board's Office of Chief Counsel (OCC) issued memorandum (dated 11 February 1993) defined MEP to include *technical feasibility, cost, and benefit derived with the burden being on the municipality to demonstrate compliance with MEP by showing that a BMP is not technically feasible in the locality or that BMP costs would exceed any benefit to be derived* (dated 11 February 1993).

Municipal Separate Storm Sewer System (MS4) — A conveyance or system of conveyances (including roads with drainage systems, municipal streets, alleys, catch basins, curbs, gutters, ditches, manmade channels, or storm drains) owned by a State, city, county, town or other public body, that is designed or used for collecting or conveying stormwater, which is not a combined sewer, and which is not part of a publicly owned treatment works, and which discharges to waters of the United States.

National Pollutant Discharge Elimination System (NPDES) — The national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits under Clean Water Act §307, 402, 318, and 405.

Natural Drainage System — An unlined or unimproved (not engineered) creek, stream, river or similar waterway.

New Development — Land disturbing activities; structural development, including construction or installation of a building or structure, creation of impervious surfaces; and land subdivision.

Nonpoint Source Pollution— Pollution that enters water from dispersed and uncontrolled sources, such as rainfall, moving over and through the ground rather than a single, identifiable source.

Non-Stormwater Discharge — Any discharge to a storm drain that is not composed entirely of stormwater. Certain non-stormwater discharges are authorized per the NPDES Municipal Stormwater Permits.

Non-Structural Practices — Natural features or directed activities specifically utilized for the purpose of managing or influencing the site hydrology and/or improving water quality. Non-structural practices can include pollution prevention, preservation of open space and natural flow paths, street sweeping, etc.

Not Directly Connected Pavement — See Disconnected Pavement.

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

Peak Runoff — The maximum stormwater runoff rate (cfs) determined for the design storm, or design rainfall intensity

Performance Standard — A narrative or measurable number specifying the minimum acceptable outcome for a pollution control practice.

Permeable — A type of material that allows passage of water.

Permitting Agency — The entity responsible for issuing grading, building and encroachment permits for new and redevelopment projects.

Pervious Pavement — See Porous Pavement.

Pollutants — Any introduced gas, liquid, or solid that makes a resource unfit for its normal or usual purpose and substances defined in CWA §502(6) (33.U.S.C.§1362(6)), and incorporated by reference into California Water Code §13373.

Pollutants of Concern (POC) — Biochemical oxygen demand (BOD), sediment or a parameter that addresses sediment (such as total suspended solids, turbidity or siltation), pathogens, oil and grease, and any pollutant that has been identified as a cause of impairment in any water body to which the MS4 discharges.

Point Source Pollution — A source of pollutants from a single point of conveyance, such as a pipe. For example, the discharge from a sewage treatment plant or a factory is a point source pollutant.

Porous Pavements (Pervious pavements) — Pavements for roadways, sidewalks, parking lots or plazas that are designed to infiltrate runoff, such as: pervious concrete, pervious asphalt, unit pavers- on-sand, and crushed gravel.

Post-Construction Stormwater Quality Plan — A plan specifying and documenting permanent site features and control measures that are designed to control pollutants for the life of the project. The plan should include sufficient design detail and calculations to demonstrate the adequacy of the stormwater quality control measures to control pollution from the developed site. This plan may be required prior to issuance of certain development permits; check with your local permitting agency.

Pre-Developed Condition — Native vegetation and soils that existed at a site prior to any development. The pre-developed condition may be assumed to be an area with the typical vegetation, soil, and stormwater runoff characteristics of open space areas typical of California's central coast unless reasonable historic information is provided that the area was atypical.

Priority Development Project — Any development project that falls within any of the following categories:

- Single-family hillside residence
- Commercial development where the land area for development is $\geq 100,000$ sf
- Automotive repair shop defined in any of the following standard industrial classification codes: 5013, 5014, 5541, 7532-7534, or 7536-7539.
- Retail Gasoline Outlet
- Restaurant where the land area for development or redevelopment \geq or 5,000 sf. (SIC Code 5812)
- Detached residential development of 10 or more units
- Attached residential development of 10 or more units
- Parking lots $\geq 5,000$ sf or with at least 25 parking spaces AND potentially exposed to stormwater runoff
- Discharging to receiving waters within defined *Environmentally Sensitive Areas*. All development and redevelopment located within or directly adjacent to or discharging directly to an environmentally sensitive areas.

Rain Event or Storm Event — Any rain event greater than 0.1 inch in 24 hours except where specifically stated otherwise.

Rainy Season — For San Luis Obispo County, the calendar period beginning October 15 and ending April 15.

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

Receiving Waters — All surface water bodies identified in the Basin Plan (<http://www.swrcb.ca.gov/rwqcb3/BasinPlan/Index.htm>) prepared by the Central Coast Regional Water Quality Control Board.

Recharge— Infiltration of surface water to groundwater.

Redevelopment — Land-disturbing activity that results in the creation, addition, or replacement of 5,000 square feet or more of impervious surface area on an already developed site. Redevelopment includes, but is not limited to: the expansion of a building footprint; addition or replacement of a structure; replacement of impervious surface area that is not part of a routine maintenance activity; and land disturbing activities related to structural or impervious surfaces. Where redevelopment results in an increase of less than 50% of the impervious surface of a previously existing development, and the existing development was not subject to the Design Standards, the Design Standards apply only to the addition, and not to the entire development. It does not include routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of facility, nor does it include emergency construction activities required to immediately protect public health and safety.

Regional Stormwater Quality Treatment Facility (Regional Facility) — A facility that treats runoff from more than one project or parcel. A regional facility may be in lieu of on-site treatment controls to treat urban runoff prior to discharge to Waters of the State, subject to the approval of the applicable permitting agency.

Regional Water Quality Control Board (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. San Luis Obispo County is within the Central Coast Regional Water Quality Control Board (Region 3).

Restaurant — A 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).

Retail Gasoline Outlet — Any facility engaged in selling gasoline and lubricating oils.

Retention — The practice of holding stormwater in ponds or basins and allowing it to slowly infiltrate to groundwater. Some portion will evaporate. Also see infiltration. Retention reduces the volume of runoff from a site and can also be effective in reducing the peak runoff rate if the retention volume is sufficiently large.

Runoff — See Urban Runoff

Runoff Coefficient — A measure of the permeability that is used to estimate the portion of the rainfall that will run off the watershed.

SIC Code — Standard Industrial Classification Codes as defined by the U.S. Department of Labor (see http://www.osha.gov/pls/imis/sic_manual.html)

Setback— The required distance between a structure and a lot line.

Sheet flow — A flow condition during a storm where the depth of stormwater runoff is shallow and informally spread over the land surface.

Significant Redevelopment — Includes, but is not limited to: expansion of a building footprint; replacement of a structure; replacement of impervious surface that is not part of routine maintenance activity; and land-disturbing activities related to structural or impervious surfaces. For redevelopment projects subject to this manual, the applicable design standards apply only to the redeveloped area, and not to the entire site, except in cases where untreated drainage from the existing developed portion is allowed to enter/flow through the redeveloped portion. In such cases, any new required treatment control measures must be designed for the entire contributing drainage area. Redevelopment and infill project applicants should check with the local permitting agency at the start of project design to verify whether or not the manual requirements apply.

Significant Tree— Any tree which is more than 12-inches in diameter measured four and one-half feet above the root crown; or any (list specific tree and size).

Source Control Measure — Any schedule of activities, prohibition of practices, maintenance procedure, managerial practice or operational practice that aims to prevent stormwater pollution by reducing the potential for contamination at the source of pollution.

Steep Slope — An area of land that has a slope angle of 10% or greater.

Stormwater — Stormwater runoff, snowmelt runoff, and surface runoff and drainage.

Stormwater Quality Plan — See Post-Construction Stormwater Quality Plan

Storm Runoff — Surplus surface water generated by rainfall that does not seep into the earth and flows overland to flowing or stagnant bodies of water.

Structural Control Measure — Any structural facility designed and constructed to mitigate the adverse impacts of stormwater and urban runoff pollution (e.g. canopy, structural enclosure). The category may include both source and treatment control measures.

Structural Practices — Any man made stormwater practice or feature that requires maintenance in order to function or provide the hydrologic benefit as designed. Structural practices include, but are not limited to, rain gardens, stormwater bioretention basins, stormwater infiltration facilities, stormwater retention and detention facilities, engineered vegetated filter strips, and any other features that are designed, constructed and maintained in order to managing or influencing the site hydrology and/or improve runoff water quality.

Target Pollutants — Pollutants identified by the County or RWQCB as most likely to impair local receiving waters, based on evaluation of available monitoring data and other information.

Time of Concentration (Tc) – The time for runoff to travel from the hydraulically most distant point of the development site to the watershed outlet or study point.

Treatment — The application of engineered systems that use physical, chemical, or biological processes to remove pollutants. Such processes include, but are not limited to, filtration, gravity settling, media absorption, biodegradation, biological uptake, chemical oxidation, and UV radiation.

Treatment train — A stormwater technique in which several treatment types (filtration, infiltration, retention, evaporation) are used in conjunction with one another and are integrated into a comprehensive runoff management system.

Treatment Control Measure — Any engineered system designed to remove pollutants by simple gravity settling of particulate pollutants, filtration, biological uptake, media absorption or any other physical, biological, or chemical process.

Urban Runoff — Any runoff from urbanized areas including stormwater and dry weather flows from a drainage area that reaches a receiving water body or subsurface. During dry weather, urban runoff may be comprised of groundwater base flow and/or nuisance flows, such as excess irrigation water.

Vector— Any insect or organism that is capable of harboring or transmitting a causative agent of human disease.

Volume-Based Treatment Control Measures — Stormwater quality treatment measures that rely on volume capacity to treat stormwater. These measures detain or retain runoff and treat it primarily through settling or infiltration. Examples: detention and infiltration basins, porous pavement and stormwater planters (bioretention).

Water Board(s) — Generic reference to the State Water Resources Control Board (SWRCB) and/or the nine Regional Water Quality Control Boards (RWQCBs).

Water Table— The upper surface of groundwater or the level below which the soil is saturate with water. The water table indicates the uppermost extent of groundwater.

Water Quality Volume (WQV) — For stormwater treatment BMPs 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.

Appendix A

Stormwater Project Permit Designation Checklist

Measures Homeowners Can Take to Reduce Stormwater Impacts

STORMWATER PROJECT DESIGNATION CHECKLIST

Post-construction stormwater management is required for all projects. The required documentation and level of processing varies based on the project designation: “Priority”, “Standard” or “Exempt”. The checklist below is provided to assist you in determining the designation of your project.

ITEM	DEVELOPMENT AND REDEVELOPMENT CATEGORY	YES	NO
1.	Single-family hillside residence on slope greater than 10%?		
2.	Commercial development where the land area for development is \geq 100,000 square feet?		
3.	Automotive repair shop?		
4.	Retail Gasoline Outlet?		
5.	Restaurant where the land area for development or redevelopment greater than or equal to 5,000 square feet?		
6.	Detached residential development of 10 or more units?		
7.	Attached residential development of 10 or more units?		
8.	Parking lots greater than or equal to 5,000 square feet or with at least 25 parking spaces AND potentially exposed to storm water runoff?		
9.	Discharging to 303(d) receiving waters, Sensitive Resource Area (SRA), Sensitive Riparian Vegetation (SRV) or Wetlands (WET) Overlays?		

If you answered **YES** to any of the above questions, then your project is considered a **PRIORITY PROJECT** and will be required to submit a **Stormwater Quality Plan** and a **Stormwater Quality Priority Project Application**.

If you answered **NO** to all of the above, and your project disturbs greater than or equal to one acre, including projects less than one acre that are part of a larger common plan of development or sale, your project is considered a **STANDARD PROJECT** and you are required to develop and implement strategies that include a combination of structural and/or non-structural BMPs. Standard projects must submit a completed **Stormwater Quality Standard Project Application**.

If your project does not meet any of the above criteria, your project may be an **EXEMPT PROJECT**. Consult with Planning and Building Department staff to verify that your project meets the criteria to be considered “Exempt.” Exempt projects are encouraged to implement practices that will reduce stormwater impacts associated with development and redevelopment. A list of practices appropriate for homeowners is included on the back of this sheet.

Specific information regarding these requirements is provided in the County of San Luis Obispo LID Handbook.

Measures Homeowners Can Take to Reduce Stormwater Impacts

Everyone is strongly encouraged to reduce stormwater impacts associated with development and redevelopment by taking these actions:

- Protect soils from compaction that will ultimately be used in planted areas
- Amend soils designated to be used as planted areas
- Sumped planted areas are preferred over mounded planting areas to better retain irrigation and rain water.
- Direct driveway runoff and runoff from roof downspouts at least 10-feet away from foundations and towards planting beds and lawns where water can safely soak into the ground. Plant rain gardens.
- Protect existing trees from construction impacts by placing safety fence around the root zone of the tree (minimally the shadow of the tree canopy at high noon) and/or plant new trees
- Use permeable pavers for walkways, driveway and patios instead of concrete
- Through minor grading, encourage water retention on site (but away from foundations)
- Install rain cisterns and/or rain barrels to capture and re-use roof rain water

Appendix B

Stormwater Quality Plan Application for Priority Projects and Required Checklists

Stormwater Quality Plan Application for Priority Projects

Applicant Information Check box for contact person assigned to this project

<input type="checkbox"/>	Landowner Name Mailing Address Email Address Phone
<input type="checkbox"/>	Applicant Name Mailing Address Email Address Phone
<input type="checkbox"/>	Agent Name Mailing Address Email Address Phone

Since the SWQP is a living document, revisions may be necessary during various stages of approval by the County. Please provide the approval information requested below.

Project Review Stage	Does the SWQP need revisions?		If YES, provide revision date
	Yes	No	

Attachments

	Attachment	Completed	N/A
A	Project Location Map (scale 1" = 250')		
B	Site Map (scale 1" = 40') with easements and rights-of-way depicted.		
C	Stormwater Quality Plan		
D	Treatment BMP Location Map		
E	Operation and Maintenance Plan for Treatment BMPs		

Stormwater Quality Plan Checklist

The submittal requirements checklist is intended to aid the design engineer in preparing a stormwater quality plan.

Exhibits

- Existing natural hydrologic features (depressions, watercourses, relatively undisturbed areas) and significant natural resources with drain areas and sub-areas (if applicable) delineated and with arrows showing flow direction of stormwater. If applicable, show 100-year flood elevations.
- Soil types and depth to groundwater. If applicable, show monitoring well locations, soil boring locations.
- Existing and proposed site drainage network and connections to drainage offsite.
- Proposed design features and surface treatments used to minimize imperviousness.
- Entire site divided into separate drainage areas, with each area identified as self-retaining (zero discharge), self-treating, or draining to a treatment/flow control facility.
- For each drainage area, types of impervious surface area proposed (roof, plaza/sidewalk, and streets/parking) and area for each.
- Proposed locations and sizes of infiltration, treatment, or flow-control facilities. Include tributary area and basis for sizing (rational C, NRCS CN value, Tc, etc)
- 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 Table 3-7.

Report

- Table of Contents
- Project and applicant name, location (address and APN No.), and description (type of project)
- List of permits requested and other permits required (401, 404, Caltrans Encroachment, etc)
- List of water bodies that will receive runoff from the site. (Step 1)
- Table of minimum requirements that apply to the project (Step 1)
- 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 2)
- Narrative description and/or tabulation of site design characteristics, building features, and pavement selections that reduce imperviousness of the site. (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. (Step 4).

- Applicable flowcharts for determining minimum requirements with decision path clearly marked. (Step 4, 5 and 6)
- Identification of any conflicts with codes or requirements or other anticipated obstacles to implementing the Stormwater Quality Plan. (Step 7)
- Tabulation of proposed pervious and impervious area, showing self-treating areas, self-retaining areas, and areas tributary to each infiltration, treatment, or flow-control facility. (Step 7)
- Preliminary designs, including calculations, for each infiltration, treatment, or flow-control facility. Elevations should show sufficient hydraulic head for each. (Step 8)
- General maintenance requirements for infiltration, treatment, and flow-control facilities. (Step 9)
- Means by which facility maintenance will be financed and implemented. (Step 9)
- Statement accepting responsibility for operation & maintenance of facilities (Step 9)
- Certification by a civil engineer, architect, and landscape architect

Checklist for Source Controls

Please complete the following checklist for Source Control BMPs. If the BMP is not applicable for this project, then check N/A only at the main category.

BMP		Yes	No	N/A
1.	Provide Storm Drain System Marking			
	a. All storm drain inlets and catch basins within the project area shall have prohibitive language (such as: "NO DUMPING – DRAINS TO WATERBODY") and graphical icons to discourage illegal dumping.			
2.	Design Outdoors Material Storage Areas to Reduce Pollution Introduction			
	a. This is a detached single-family residential project. Therefore, personal storage areas are exempt from this requirement.			
	b. Outdoor equipment and materials storages areas are either: (1) placed in an enclosure such as, but not limited to, a cabinet, shed, or similar structure that prevents contact with runoff or spillage to the stormwater conveyance system; or (2) protected by secondary containment structures such as berms, dikes, or curbs.			
	c. Non hazardous storage areas are paved and sufficiently impervious to contain leaks and spills.			
	d. The storage areas have a roof or awning to minimize direct precipitation within the secondary containment area.			
3.	Design Trash Storage Areas to Reduce Pollution Introduction			
	a. Paved with an impervious surface, designed not to allow run-on from adjoining areas, screened or walled to prevent off-site transport of trash; or,			
	b. Provide attached lids on all trash containers that exclude rain, or roof or awning to minimize direct precipitation.			
4.	Use Efficient Irrigation Systems & Landscape Design			
	a. Irrigation system has a rain shutoff device to prevent irrigation after precipitation.			
	b. Irrigation system is programmed for each landscape area's specific water requirements.			
	c. Irrigation system utilizes flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.			
	d. Plant material selected shall be appropriate to site specific characteristics such as soil type, topography, climate, amount and timing of sunlight, prevailing winds, rainfall, air movement, patterns of land use, ecological consistency and plan iterations.			

	e.	Existing native trees, shrubs and ground cover retained and incorporated in the landscape plan.			
	f.	Proper maintenance and landscaping is the responsibility of the owner.			
5.	Private Roads				
	a.	Rural swale system: street sheet flows to vegetated swale or gravel shoulder, curbs at street corners, culverts under driveways and street crossings.			
	b.	Urban curb/swale system: street slopes to curb, periodic swale inlets drain to vegetated swale/biofilter.			
	c.	Dual drainage system: First flush captured in street catch basins and discharged to adjacent vegetated swale or gravel shoulder, high flows connect directly to stormwater conveyance system.			
6.	Residential Driveways & Guest Parking				
	a.	Design driveways with shared access, flared (single lane at street) or wheelstrips (paving only under tires); or, drain into landscaping prior to discharging to the stormwater conveyance system.			
	b.	Uncovered temporary or guest parking on private residential lots paved with a permeable surface; or, designed to drain into landscaping prior to discharging to the stormwater conveyance system.			
7.	Dock Areas				
	a.	Loading dock areas are covered and/or graded to minimize run-on and runoff from the loading area.			
	b.	Loading docks use for the loading and unloading of liquids in containers shall be provided with an inlet with a shutoff valve and have enough capacity to hold a spill while the valve is closed.			
		Direct connections to storm drains from depressed loading docks (truck wells) are prohibited.			
8.	Maintenance Bays				
	a.	Repair/maintenance bays shall be indoors; or, designed to preclude urban run-on and runoff.			
	b.	Design a repair/maintenance bay drainage system to capture all wash water, leaks and spills. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited.			
9.	Vehicle Wash Areas				
	a.	Wastewater from vehicle washing operations is not discharged to a storm drain system (without a permit).			

	b.	Commercial/industrial facilities wash areas are self-contained; or covered with a roof or overhang, be equipped with a clarifier, grease trap or other pretreatment facility, as appropriate and properly connected to a sanitary sewer (with a permit)			
10.	Outdoor Processing Areas				
	a.	Cover or enclose areas that would be the most significant source of pollutants; or, slope the area toward a dead-end sump; or, discharge to the sanitary sewer system following appropriate treatment in accordance with conditions established by the applicable sewer agency.			
	b.	Grade or berm area to prevent run-on from surrounding areas.			
	c.	Installation of storm drains in areas of equipment repair is prohibited.			
11.	Equipment Wash Areas				
	a.	Be self-contained; or covered with a roof or overhang.			
	b.	Sink and cleanings area are equipped with a clarifier, grease trap or other pretreatment facility, prior to discharge to the sanitary sewer.			
	c.	Interior floor drains shall be properly connected to a sanitary sewer.			
	d.	Food service facilities, including restaurants and grocery stores, have a sink or other area for cleaning floor mats, containers, and equipment. The cleaning area is located on a paved surface and has secondary containment, and is large enough to clean the largest mat or piece of equipment that needs cleaning.			
12.	Parking Areas				
	a.	Where landscaping is proposed in parking areas, incorporate landscape areas into the drainage design.			
	b.	Overflow parking (parking stalls provided in excess of the minimum parking requirement) are constructed with permeable paving materials.			
	c.	Interior level parking garage floor drains shall be connected to a water treatment device approved by the County prior to discharging to the sanitary sewer system.			
	d.	Parking lots are swept regularly to prevent the accumulation of litter and debris.			
13.	Fueling Area				
	a.	Fuel dispensing areas have an overhanging roof structure or canopy that extends a minimum of ten feet in each direction from each pump. The cover's minimum dimensions are equal to or greater than the area within the grade break. The cover does not drain onto the fuel dispensing area and the downspouts are routed to prevent drainage across the fueling area. The fueling area drain to the project's treatment control BMP(s) prior to discharging to the stormwater conveyance system.			

	b.	Fuel dispensing areas are paved with Portland cement concrete (or equivalent smooth impervious surface) and graded at the minimum slope to prevent ponding. Fueling areas are separated from the rest of the site by a grade break that prevents run-on of stormwater.			
	c.	Have an appropriate slope to prevent ponding, and must be separated from the rest of the site by a grade break that prevents run-on of urban runoff.			
	d.	At a minimum, the concrete fuel dispensing area must extend 6.5 feet from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 foot, whichever is less.			
14.	Pool / Spa / Fountain Discharge				
	a.	Swimming pool, hot tub, spa and fountain discharge drains...			
15.	Miscellaneous Drain/Wash water				
	a.	Building roof drains discharge away from the building to an unpaved or vegetated area.			

Checklist for Site Design Controls

Table 3-5: Commonly Needed Site Information

Item	Site Design Options	Yes	No	N/A
1.	Can the project be relocated or realigned to avoid/reduce impacts to receiving waters or to increase the preservation of critical (or problematic) areas such as floodplains, steep slopes, wetlands, and areas with erosive or unstable soil conditions?			
2.	Can the project be designed to minimize impervious footprint?			
3.	Are natural areas conserved where feasible?			
4.	Where landscape is proposed, can rooftops, impervious sidewalks, walkways, trails and patios be drained into adjacent landscaping?			
5.	For roadway projects, can structures and bridges be designed or located to reduce work in live streams and minimized construction impacts?			
6.	Can any of the following methods be utilized to minimize erosion from slopes?			
	a. Minimize slope disturbance?			
	b. Shorten slope length or steepness with retaining walls?			
	c. Provide benches or terraces on high cut and fill slopes to reduce concentration of flows?			
	d. Can the slopes be rounded to reduce concentration of flows?			
	e. Can concentrated flows be collected and conveyed in stabilized drains and channels?			
7.	Are stormwater facilities located outside of streams and wetlands?			

For projects that include work in channels, consider site design measures.

Table 3-6: Channel Site Design Impact Table

Item	Criteria	Yes	No	N/A	Comments
1.	Will the project increase velocity or volume of downstream flow?				If YES, go to 5.
2.	Will the project discharge to unlined channels?				If YES, go to 5.
3.	Will the project increase potential sediment load or downstream flow?				If YES, go to 5.
4.	Will the project encroach, cross, realign, or cause other hydraulic changes to a stream or affect upstream and/or downstream stability?				If YES, go to 7.
5.	Review channel lining materials and design for streambank erosion.				Continue to 6.
6.	Consider channel erosion control measures within the project limits as well as downstream. Consider scour velocity.				Continue to 7.
7.	Include, where appropriate, energy dissipation devices at culverts.				Continue to 8.
8.	Ensure all transitions between culvert outlets/headwalls/wingwalls and channels area smooth to reduce turbulence and scour.				Continue to 9.
9.	Include, if appropriate, detention facilities to reduce peak discharges.				
10.	"Hardening" natural downstream areas to prevent erosion is not an acceptable technique for protecting channel slopes, unless pre-development conditions are determined to be such that that hardening would be required even in the absence of the proposed development.				Continue to 11.
11	Provide other design principles that are comparable and equally effective.				

Treatment Control Feasibility Checklist

TREATMENT CONTROL BMP	CONSIDERED FOR USE	REJECTED BASED ON
Infiltration Trench (TC-10)		
Constructed Wetland (TC-21)		
Retention Basin (TC-11)		
Detention Basin (TC-22)		
Vegetated Swale (TC-30)		
Vegetated Filter Strip (TC-31)		
Bioretention (TC-32)		
Surface Sand Filter		
Media Filter (TC-40)		
Oil & Water Separator (TC-50)		
Catch Basin Insert		
Proprietary System		

Appendix C

Stormwater Quality Plan Application for Standard Projects and Required Checklists

Stormwater Quality Plan Application for Standard Projects

Applicant Information Check box for contact person assigned to this project

<input type="checkbox"/>	Landowner Name Mailing Address Email Address Phone
<input type="checkbox"/>	Applicant Name Mailing Address Email Address Phone
<input type="checkbox"/>	Agent Name Mailing Address Email Address Phone

Since the SWQP is a living document, revisions may be necessary during various stages of approval by the County. Please provide the approval information requested below.

Project Review Stage	Does the SWQP need revisions?		If YES, provide revision date
	Yes	No	

Item A. Post-Construction Phase

<input type="checkbox"/>	My project is not defined as a Priority Project (Refer to Step 1)
--------------------------	--

Indicate the post-construction BMPs that will be used:

- There will be permanent landscaping as part of this project. The property owner will maintain the landscaping.
- Outlet protection/ velocity dissipation devices will be placed at storm drain outfalls to reduce the velocity of the flow.
- Other

Attachments

	Attachment	Completed	N/A
A	Project Location Map		
B	Site Map		

Treatment Control Feasibility Checklist

TREATMENT CONTROL BMP	CONSIDERED FOR USE	REJECTED BASED ON
Infiltration Trench (TC-10)		
Constructed Wetland (TC-21)		
Retention Basin (TC-11)		
Detention Basin (TC-22)		
Vegetated Swale (TC-30)		
Vegetated Filter Strip (TC-31)		
Bioretention (TC-32)		
Surface Sand Filter		
Media Filter (TC-40)		
Oil & Water Separator (TC-50)		
Catch Basin Insert		
Proprietary System		

Appendix D

Low Impact Development Consistency Analysis

Consistency with the Low Impact Design Handbook

All Priority and Standard projects as identified in this manual must be consistent with the Low Impact Design Handbook. To achieve consistency, a project must earn a minimum of 15 credits (18 credits for rural development).

Consistency	Credits Single Family Residence	Credits Urbanized Development	Credits Rural Development
Inconsistent. The project is inconsistent with the LID Handbook.	0-14	0-14	0-17
Consistent. The project is consistent with the LID Handbook.	15-25	15-25	18-25
Exemplary. The project meets and exceeds compliance with the LID Handbook.	26+	26+	26+

Single Family Residence – is any Priority or Standard Project proposing a single family residence, secondary residence, and/or residential accessory structures. Subdivisions of 10 or more units do not fall under this category

Urbanized Development – includes any Priority or Standard Project (other than a single-family residence) occurring within an urban or village reserve line.

Rural Development – includes any Priority or Standard Project (other than a single-family residence) occurring outside of urban and village reserve lines.

Inconsistent

If the project earns less than 15 credits (18 credits for rural development), the project would be considered inconsistent with the LID Handbook. The project must incorporate additional LID measures to achieve 15 (or 18) credits, or may pursue waiver or modification (see “Waiver or Modification” heading on the following page). Projects which fail to meet one or more of the prerequisites would also be considered inconsistent. Prerequisites include the following:

- *Construction Activity Pollution Prevention* – see Prerequisite A.1 in Part A
- *Mark Public Storm Drain Inlets* – see Prerequisite C.1 in Part C
- *Biological, Archaeological, and Geological Special Areas* – see Prerequisite D.1 in Part D
- *Treatment Design Standards* – see Prerequisite E.1 in Part E (does not apply to Standard Projects)
- *Receiving Water Limitations (TMDLs)* – see Prerequisite E.2 in Part E
- *Basins: Peak Storm Water Discharge Runoff Rates* – see Credit E.5.1 in Part E (does not apply to Standard Projects)
- Source Control Credits C.2 through C.8 are required for Priority Projects where applicable to the proposed use.

Consistent

Projects earning between 15 and 25 credits (between 18 and 25 credits for rural development) are considered consistent with the LID Handbook. To qualify as consistent, the project must also meet all of the prerequisite requirements. All LID techniques proposed by the applicant to qualify for these credits will be carried over through the project's conditions of approval. While projects earning 18 or more credits are considered consistent with the LID Handbook, the Review Authority does retain its ability, through the discretionary review process, to require incorporation of additional LID techniques.

Exemplary

Projects earning 26 or more credits (in addition to prerequisites) are considered *exemplary*. These projects not only meet, but exceed compliance with the LID Handbook. Exemplary status will be noted in project staff reports, and a certificate from the Department of Planning and Building will be awarded upon final inspections. Applicants awarded exemplary status may reference this feature in the marketing of their developments, and may, at their option and expense, install a placard with the County logo noting that the project has been certified by the County as an exemplary LID project. County Planning may explore other incentives for exemplary projects.

Waiver or Modification

In certain circumstances, a project may not be able to achieve the minimum required 15 credits (18 credits for rural development) to qualify as consistent with the LID Handbook. This can be due to such issues as site constraints. In these circumstances, the applicant may request that the Review Authority process a waiver or modification of the standard LID requirements. The waiver or modification shall follow the procedure identified in LUO Section 22.10.155I and CZLUO Section 23.04.450.i.

In order to authorize the waiver or modification, the Review Authority must first find that:

- All other structural or treatment Best Management Practices (BMPs) have been considered and rejected as infeasible; and
- Adherence to LID Handbook consistency is impracticable for the project site because of one or more of the following reasons:
 - Extreme limitations of space for treatment on a redevelopment project.
 - Soil conditions at a site, which are unstable or unfavorable for infiltration.
 - Risk of groundwater contamination because a known unconfined aquifer lies beneath the land less than 10 feet from the soil surface.
 - Strict application of LID Measures would not result in an enhancement of water quality, and where other appropriate treatment control and/or source control measures will be used.

Examples of cases where waiver or modification may be suitable include the following;

- Projects where the site has only clayey soils which are impermeable and non-conductive to using such practices as retention basins and biofiltration, and where there is no other suitable alternative.
- A change in use in an existing development – such as a new restaurant occupying a tenancy in an existing commercial development. In these cases, BMPs must be put in place to control for use-specific pollutants (e.g. oils, greases, etc.), but larger site design measures may not be warranted.

All waiver of modification requests must be accompanied by written justification, including a description of cause for rejecting individual BMPs as infeasible.

LID Scorecard

As specified in Chapter 3, the applicant is required to submit an LID Scorecard and associated information to demonstrate how the project will obtain the requisite number of credits. The LID Scorecard (Pages D-4 and D-5) should be used throughout the design and development of your building project to track your anticipated LID score.

This scorecard will also be available in spreadsheet format on County Planning's website. The spreadsheet automatically dates each printout to give you a snapshot of your LID score as your project progresses. The active spreadsheet sums the credit points for each category and provides a total score for the project. Do not input values in the category subtotal or in the project total fields as this will be done automatically.

The prerequisites are required and must be achieved. Thus, a "Y" appears in the appropriate column for each prerequisite. Beside each credit are three boxes to indicate the likelihood of achieving each credit. To score the project appropriately, input the number of points for that credit into the first column labeled "Y" if this credit will be pursued. Input the number of points in the second column labeled "?" if it is unsure if this credit will be pursued. Finally, input the number of points in the third column labeled "N" if this credit will not be pursued or is not applicable to the project. The possible points available for each credit are shown in the far right column in each category.

For each credit, provide a brief discussion of strategies considered for obtaining the credit, and reference the location within the project plans (i.e. sheet number) where the measure can be found. If the credit is not being pursued, provide justification for limitations of the project that prevent the credit from being achieved.

A more detailed discussion of each of the credits, what submittals are required, and what criteria are used to determine whether the credit has been earned, is provided starting on page D-6.

Determination of Credits

The applicant is responsible to demonstrate how they comply with the criteria specified in this document in order to earn each credit. County Planning and Building staff will review the applicant's documentation in consultation with the Department of Public Works. During the 30-day completeness review period, staff will request any additional information necessary to confirm whether or not the project qualifies for each credit. Prior to acceptance of a project for processing, staff will inform the applicant of which credits they have successfully earned or what design modifications would be necessary to achieve the credit. Staff's determinations will serve as a recommendation to the Review Authority. The ultimate determination pertaining to credits rests with the Review Authority.

In some cases, multiple credits may be earned under one credit heading. In these cases, credits are cumulative unless otherwise specified. For example, a project proposing roof catchment of 90 percent would earn three credits: Credits B.6.1, B.6.2, and B.6.3. In other cases, one design feature may qualify for multiple different credits. For example, a project using roof catchment (Credit B.6) may also earn a credit for segregation of clean water (Credit C.13).

LID Registered Project Checklist **PRELIMINARY DRAFT** (December 2009)

Project Name

Project Location

Instructions

Yes	?	No		Priority Projects	Standard Projects	Reference
			A. Soils	9 Points	9 Points	
Y			Prereq 1 Construction Activity Pollution Prevention	Required	Required if >1 ac	N/A
			Credit 1.1 Conserve Top Soil, 50%	1	1	4.2.5
			Credit 1.2 Conserve Top Soil, 75%	1	1	4.2.5
			Credit 2.1 Restore Top Soil, 50%	1	1	4.2.5, 4.4.3
			Credit 2.2 Restore Top Soil, 75%	1	1	4.2.5, 4.4.3
			Credit 3 Conserve Well Draining Soils	1	1	N/A
			Credit 4.1 Retention Grading, 75%	1	1	4.4.4a
			Credit 4.2 Retention Grading, 90%	1	1	4.4.4a
			Credit 4.3 Retention Grading, Distribution	1	1	4.4.4a
			Credit 5 Landform Grading	1	1	4.2.2
Yes	?	No				
			B. Impervious Surfaces	17 Points	17 Points	
			Credit 1.1 Rational Coefficient, Proposed = Existing	1	1	Appendix F (Part 2)
			Credit 1.2 Rational Coefficient, Proposed < Existing	1	1	Appendix F (Part 2)
			Credit 1.3 Rational Coefficient, Proposed = Pre-developed	1	1	Appendix F (Part 2)
			Credit 1.4 Rational Coefficient, Proposed < Pre-developed	1	1	Appendix F (Part 2)
			Credit 2.1 Alternative Parking Arrangements, Covered Parking	1	1	4.2.4
			Credit 2.2 Alternative Parking Arrangements, Reduce Parking Area	1	1	4.2.4, 4.3.5
			Credit 3.1 Disconnect Impervious Surfaces, 50%	1	1	4.3.2 - 4.3.4, 4.4.2, 4.4.4c, 4.4.4e, 4.4.5
			Credit 3.2 Disconnect Impervious Surfaces, 75%	1	1	4.3.2 - 4.3.4, 4.4.2, 4.4.4c, 4.4.4e, 4.4.5
			Credit 3.3 Disconnect Impervious Surfaces, >90%	1	1	4.3.2 - 4.3.4, 4.4.2, 4.4.4c, 4.4.4e, 4.4.5
			Credit 4.1 Cluster Development/Street Layout	1	1	4.2.3
			Credit 4.2 Cluster Development/Street Layout	1	1	4.2.3
			Credit 4.3 Cluster Development/Street Layout	1	1	4.2.3, 4.3.1
			Credit 5 Reduce Building Footprint/Foundation Excavation	1	1	4.4.1
			Credit 6.1 Roof Catchment Systems, 50%	1	1	4.4.4, 4.4.4b, 4.4.4d
			Credit 6.2 Roof Catchment Systems, 75%	1	1	4.4.4, 4.4.4b, 4.4.4d
			Credit 6.3 Roof Catchment Systems, >90%	1	1	4.4.4, 4.4.4b, 4.4.4d
			Credit 7 Day Lighting Stormwater Conveyance Facilities	1	1	4.3.2
Yes	?	No				
			C. Source Controls	6 Points	14 Points	
Y			Prereq 1 Mark Public Storm Drain Inlets	Required	Required	5.2.1
			Credit 1 Public Education	1	1	N/A
			Credit 2 Proof of Maintenance	Required	1	Chapter 8
			Credit 3 Fueling Areas	Required*	1	5.3.1
			Credit 4 Maintenance Bays	Required*	1	5.3.2
			Credit 5 Loading Docks	Required*	1	5.3.2

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 6	Trash and Recycling Areas	Required*	1	5.3.3
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 7	Vehicle and Equipment Wash Areas	Required*	1	5.3.4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 8	Material Storage Areas	Required*	1	5.3.5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 9	Pools, Spas and Fountains	1	1	5.3.6
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 10	Alternative Building Materials	1	1	4.4.6, 5.2.2
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 11	Efficient Irrigation Systems and Landscape Designs	1	1	5.2.4
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 12	Outlet Energy Dissipaters	Required*	1	N/A
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 13	Clean Water Segregation	1	1	4.4.4b, 4.4.4d, 5.2.3
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 14	Non-Structural Policy Implementation	1	1	5.3.8

Yes ? No

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	D. Natural Systems		8 Points	9 Points	
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<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Prereq 1	Biological, archeological and geological special areas	Required	Required	4.2.1
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 1	Open Channels	1	1	4.3.2, 4.4.4c
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 2.1	Riparian Setbacks, 10%	1	1	N/A
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 2.2	Riparian Setbacks, 20%	1	1	N/A
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 3	In-Stream Improvements	1	1	N/A
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 4.1	Plant Interceptor Trees, 10%	1	1	4.3.6
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 4.2	Plant Interceptor Trees, 30%	1	1	4.3.6
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 5.1	Basins: Peak Storm Water Runoff Discharge Rates	Required	1	4.3.3.c
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 5.2	Basins: Mult-Stage Discharge	1	1	4.3.3.c
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 6	Time of Concentration	1	1	Appendix F (Part 3)

Yes ? No

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	E. Water Quality		4 Points	6 Points	
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<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Prereq 1	Treatment Design Standards	Required	1	Chapter 7
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Prereq 2	Receiving Water Limitations (TMDLs)	Required	Required	N/A
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 1	Additional WQ Treatment	1	1	Chapter 7
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 2.1	Natural, Passive Treatment, 50%	1	1	Chapter 7
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 2.2	Natural, Passive Treatment, 75%	1	1	Chapter 7
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 2.3	Natural, Passive Treatment, distribution per acre	1	1	Chapter 7
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 3	Self-Treatment Areas	1	1	N/A
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 4	CPSWQ or other County approved training	1	1	N/A

Yes ? No

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	F. Innovation & Design Process		6 Points	6 Points	
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<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 1.1	Innovation in Design - Soils	1	1	N/A
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 1.2	Innovation in Design - Impervious Surfaces	1	1	N/A
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 1.3	Innovation in Design - Source Controls	1	1	N/A
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 1.4	Innovation in Design - Natural Systems	1	1	N/A
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 1.5	Innovation in Design - Water Quality	1	1	N/A
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit 2	Team Trained in LID	1	1	N/A

Yes ? No

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Project Totals (pre-certification estimates)		50 Points	61 Points	
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Summary of LID Scorecard Credits

PART A SOILS

PREREQUISITE A.1

CONSTRUCTION ACTIVITY POLLUTION PREVENTION

Priority: **REQUIRED**

Standard: **REQUIRED**

Reference – LUO Sections 22.52.110 through 22.52.150; CZLUO Sections 23.05.040 through 23.05.048.

Applicability – All projects.

Submittals – Applications should include the following submittals:

- Drainage plan.
- Erosion and sedimentation control plan.
- Stormwater Pollution Prevention Plan (SWPPP) [if required].
- Grading Plan (as applicable).

Criteria – Projects must be designed to ensure against construction-related stormwater discharge. Compliance will be verified through review of the above referenced submittals. Criteria for compliance are as established in Titles 22 and 23.

Exceptional Performance – An extra point under Credit F.1.1 may not be earned solely for exceptional performance concerning the construction-phase pollution prevention. The point may be earned for projects using exceptional construction-phase pollution prevention techniques only in combination with other exceptional and innovative techniques concerning Soils (Part A).

CREDIT A.1 CONSERVE TOP SOIL

Priority: **Voluntary (1-2 Points)**

Standard: **Voluntary (1-2 Points)**

Reference – Section 4.2.5

Applicability – All projects.

Submittals – Applications proposing to use Credit A.1 should include the following submittals:

- An area map and calculations showing the areas to be conserved, the areas slated for landscaping or designated as open space and the areas to be built upon.
- Project plans with construction fencing details and plan view that will bar vehicle access to top soil conservation areas.
- Records of inspection over the life of the project demonstrating that the Contractor protected the area so designated.

Criteria – Up to two credits may be earned under Credit A.1.

To earn Credit A.1.1, a project must conserve soil in place over at least 50 percent of the site and meet the following criteria:

- Stage project to limit equipment and stockpiling impacts to those areas that will be ultimately be converted to impervious areas as part of the project or concentrate development on previously disturbed sites.
- Use orange construction fencing to delineate work areas from conservation areas.

- Include soil conservation area as a topic in the pre-construction meeting with the Contractor.

To earn Credit A.1.2, a project must meet conserve soil in place over at least 75 percent of the site and meet the criteria specified above under Credit A.1.1.

Failure to Meet Criteria – Projects that conserve soil in place over less than 50 percent of the site will fail to meet this requirement. Soils that have been previously disturbed and do not share characteristics with of healthy native soils are ineligible to earn Credits 1.1 and 1.2 and should instead seek to restore the damaged soils through Soil Credit 2.1 and 2.2.

Exceptional Performance – An extra point under Credit F.1.1 may not be earned solely for exceptional performance concerning the protection of top soil. The point may be earned for projects preserving top soil over more than 75 percent of the site only in combination with other exceptional and innovative techniques concerning Soils (Part A).

Other Resources – *Protecting Urban Soil Quality: Examples for Landscape Codes and Specifications*¹ by Dallas Hanks and Ann Lewandowski, USDA-NRCS.

CREDIT A.2 RESTORE TOP SOIL

Priority: **Voluntary (1-2 Points)**

Standard: **Voluntary (1-2 Points)**

Reference – Sections 4.2.5 and 4.4.3

Applicability – All projects.

Submittals – Applications proposing to use Credit A.2 should include the following submittals:

- An area map and calculations showing the areas to be conserved, the areas slated for landscaping or designated as open space and the areas to be built upon.
- Project plans with delineation of areas to be amended.
- Provide records of inspection over the life of the project demonstrating that the Contractor restored the site soils over the area so designated.

Criteria – Up to two credits may be earned under Credit A.2.

To earn Credit A.2.1, a project must save and restore top soil, and incorporate soil amendments over at least 50 percent of the area with compacted soils (excluding structures). Additionally, the following criteria must be met:

- Cuts should have native top soil removed and stockpiled for replacement.
- Stockpile depths should not exceed 3 feet if left in place for more than 6 months.
- Top soil should be spread on slopes that have been tilled to a depth of 6 inches.
- Top soil should be placed in lifts not exceeding 1 foot.
- Compaction should be limited to the density of existing undisturbed areas.
- Soils that have been compromised due to overuse of pesticides and fertilizers or compacted as a result of previous land uses should be amended to restore the texture, structure and biology to that of undisturbed soils. Amended soils increase the infiltration capacity of the soil and can reduce runoff, the need for fertilizers, pesticides and irrigation.
- Existing undisturbed soils should not be amended.
- Avoid amending site soils during period of high rain or wind.
- Prevent and control erosion during the construction period through the use of an erosion and sediment control plan.

To earn Credit A.2.2, a project must meet earn Credit A.2.1, but the area of top soil to be amended must be at least 75 percent of the area with compacted soils (excluding structures).

Failure to Meet Criteria – Projects that do not save and restore topsoil and projects that amend soils over less than 50 percent of the compacted soils area will fail to earn these credits.

Exceptional Performance – An extra point under Credit F.1.1 may not be earned solely for exceptional performance concerning the restoration of top soil. The point may be earned for projects restoring top soil over more than 75 percent of the disturbed area only in combination with other exceptional and innovative techniques concerning Soils (Part A).

CREDIT A.3 CONSERVE WELL DRAINING SOILS

Priority: **Voluntary (1 Point)**

Standard: **Voluntary (1 Point)**

Reference – No reference.

Applicability – All projects where development on well-draining soils can be avoided. This credit can be earned where development can be accommodated on poorly draining soils or in previously developed areas.

Submittals – Applications proposing to use Credit A.3 should include the following submittals:

- A site plan showing the extent and location of NRCS hydrologic soil groups.
- A site plan showing the extent of previous development.

Criteria – To earn Credit A.3, a project must comply with one or more (or a combination) of the following:

- Development occurs entirely on soils in hydrologic soils group C or D; or
- Development occurs entirely in previously developed areas.

Failure to Meet Criteria – Projects that fail to earn this credit might involve development on soils in hydrologic soils group A or B, in a previously undeveloped area.

Exceptional Performance – An extra point under Credit F.1.1 may not be earned solely for exceptional performance concerning development on poorly drained soils. The point may be earned only in combination with other exceptional and innovative techniques concerning Soils (Part A).

CREDIT A.4 RETENTION GRADING

Priority: **Voluntary (1-3 Points)**

Standard: **Voluntary (1-3 Points)**

Reference – Section 4.4.4a; Appendix F, Part 1

Applicability – Projects in areas with permeable soils.

Submittals – Applications proposing to use Credit A.4 should include the following submittals:

- A grading plan showing the location of all proposed retention devices.
- An estimate of the volume of stormwater to be retained for each proposed retention device.
- An estimate of the area of the site being drained to retention devices.
- Support documentation to demonstrate that Steps 1 through 4 (Appendix F, Part 1) have been followed to determine appropriate retention grading design.
- Calculations showing stormwater retention volumes in the drainage report.
- Calculations as specified in the criteria section below.

Criteria – Up to three credits may be earned for retention grading.

Credit A.4.1 may be earned for projects retaining at least 75 percent of water. This percentage is to be based on project size and average annual rainfall (refer to calculation below). Additionally, retention devices must be designed in compliance with Appendix F, Part 1 of this document.

CALCULATION (A.4.1 and A.4.2)

1. Calculate the entire site area and the runoff generated from the depth of storm shown in the table in Appendix F, Part 1 (see “Hydrograph Analysis” heading).
2. Locate potential retention grading devices and delineate their tributary areas.
3. Size potential earthworks based on the volume of runoff anticipated. Use 40% void ratio for (uniformly graded) rock basins, mulch areas and for runoff retained in porous concrete or unit paver stone recharge beds. The volume of water that fills the soils pore space is not included in this credit.
4. Calculate the percent of runoff retained through retention grading efforts under this credit as follows:

$$[\text{Runoff Retained}] / [\text{Runoff Generated}] \times 100 = \text{Percent of runoff retained on site}$$

Credit A.4.2 may be earned in addition to A.4.1 for projects retaining at least 90 percent of water based on project size and average annual rainfall.

In order to earn Credit A.4.3, you must first earn Credit A.4.1, and must also design the project to disperse rainwater such that the average area drained to retention devices is less than 1 acre. The average area drained to retention devices may be calculated by taking the sum of the area drained to retention devices and dividing it by the number of retention devices.

Projects earning points under this credit may also be eligible for Credits D.5 (Basins) and D.6 (Time of Concentration).

Failure to Meet Criteria – Projects that fail to earn this credit might retain less than 75 percent of their drainage. Additionally projects in locations where retention is impracticable would not qualify for this credit.

Exceptional Performance – Projects which employ exceptional and innovative retention grading techniques may qualify to earn an extra point under Credit F.1.1. To qualify for this credit, 100 percent of water must be retained and design must be fully compliant with the specifications in Appendix F, Part 1.

CREDIT A.5 LANDFORM GRADING

Priority: **REQUIRED**

Standard: **REQUIRED**

Reference – Section 4.2.2

Applicability – All projects.

Submittals – Applications proposing to use Credit A.5 should provide grading plans, including estimated earthwork quantities.

Criteria – These criteria (as applicable) must be met to earn Credit A.5.

- Small pads or stepped foundations should be used for hillside development.
- Slopes should be rounded and natural-appearing.

- Cut and fill slopes should be designed to reduce velocity of flow (e.g. planted slopes, retaining walls, short slope runs, etc.).
- Pads should not be significantly raised above existing topography.
- Directly connected impervious areas should be avoided.
- Areas receiving runoff should be disked or amended prior to planting.
- Concentrated flow paths should have stable outlets.

Failure to Meet Criteria – Projects that fail to earn this point might have one or more the following features:

- Unnatural-appearing grading features, such as sharp angular cut and fill slopes.
- Large, flat, level pads in areas with steeply sloping natural terrain.
- Steep, unbroken cut and fill slopes.
- A large portion of the drainage to be conveyed through directly connected impervious surfaces.
- Inappropriately designed drainage systems.

Exceptional Performance – Projects which employ exceptional and innovative landform grading techniques may qualify to earn an extra point under Credit F.1.1. To qualify for this credit, the applicant must demonstrate how the grading design goes above and beyond the criteria in Section 4.2.2 and will result in an overall long-term improvement in water quality. Additionally, Prerequisite A.1 and Credits A.1.1, A.1.2, A.2.1, and A.2.2. (Protection of Top Soil) must also have been earned.

Other Resources – Schor, H. June 1980, “Landform Grading: Building Nature’s Slope.” Pacific Coast Builder, pp. 80-83²; *City of Encinitas Design Guidelines*, April 2005³

PART B IMPERVIOUS SURFACES

CREDIT B.1 RATIONAL COEFFICIENT

Priority: **Voluntary (1-4 Points)**

Standard: **Voluntary (4 Points)**

Reference – Appendix F, Part 2

Applicability – All projects.

Submittals – Applications proposing to use Credit B.1 should include the following submittals:

- Documentation of the percent of soil protected from compaction during construction activities.
- A spreadsheet of the composite rational coefficients based on an analysis of the site in discrete units such as driveways, roads, roofs, lawns, and natural vegetation areas (instead of larger categories) for the pre-developed condition, current condition, and post-developed condition.

Criteria – Up to four credits can be earned under Credit B.1.

Credit B.1.1 may be earned if the rational coefficient for the post-development condition is equal to the rational coefficient for the current condition.

Credit B.1.2 may be earned if the rational coefficient for the post-development condition is less than the rational coefficient for the current condition.

Credit B.1.3 may be earned if Credit B.1.2 is earned and the rational coefficient for the post development condition is equal to the rational coefficient for the pre-development condition.

Credit B.1.4 may be earned if Credit B.1.3 is earned and the rational coefficient for the post-development condition is less than the rational coefficient for the pre-development condition.

Failure to Meet Criteria – Projects that fail to earn this credit would have a post-development rational coefficient that is greater than the current rational coefficient.

Exceptional Performance – Projects which substantially reduce the post-development rational coefficient to a level that is less than 85 percent of the pre-development rational coefficient may qualify to earn an extra point under Credit F.1.2.

CREDIT B.2 ALTERNATIVE PARKING ARRANGEMENTS

Priority: **Voluntary (1-2 Points)**

Standard: **Voluntary (1-2 Points)**

Reference – Section 4.2.4 and 4.3.5

Applicability – All projects, but particularly applicable for urban infill development.

Submittals – Applications proposing to use Credit B.2 should include the following submittals:

- Site plan showing parking lot layout.
- Required parking calculations based on Title 22 or Title 23.
- Justification for any reductions in parking calculations, and any applications/submittals required by Titles 22/23 in order to reduce required parking (B.2.2 only).
- Calculations showing the percentage of parking area that is covered (B.2.1 only).
- Calculations showing the percentage of parking area using pervious surfacing (B.2.2 only).
- A drainage plan showing how parking lot/area drainage is being handled.

Criteria – Up to two credits may be earned under Credit B.2.

To earn Credit B.2.1 (Covered Parking), a project must meet these criteria (as applicable):

- 75 percent of parking spaces should be covered or enclosed.
- Downspouts should not discharge to impervious areas.

To earn Credit B.2.2 (Reduce Parking Area), a project must meet at least one of these three criteria:

- Reduce parking to 20 percent below the standard parking requirements established in Titles 22 and 23.
 - To qualify for parking reduction, a project must comply with the procedures established to waive or modify parking requirements in Titles 22 and 23.
 - Reducing parking areas may also be accomplished through shared parking agreements amongst uses which have different peak hour parking demands.
- Use pervious surfaces for all parking areas.
- Use bioretention areas in parking lots (i.e. concave planted areas) to the maximum extent practicable.

Failure to Meet Criteria – Projects that fail to earn these credits might have one or more the following features.

- All parking is uncovered. (Credit B.2.1)
- Carport downspouts drain to directly connected impervious areas. (Credit B.2.1)
- Parking lots are surfaced with impervious surfacing and do not drain to areas with treatment control measures (Credit B.2.2)
- The number of parking spaces has not been reduced to at least 20 percent below the number required by Title 22 and 23 (Credit B.2.2).

Exceptional Performance – Projects which employ exceptional and innovative alternative parking techniques may qualify to earn an extra point under Credit F.1.2. To qualify for this credit, the applicant must earn Credit B.2.2, and all of three of the criteria in Credit B.2.2 must be met. If also earning Credit B.2.1, only the uncovered spaces must use pervious surfacing.

CREDIT B.3 DISCONNECT IMPERVIOUS SURFACES

Priority: **Voluntary (1-3 Points)**

Standard: **Voluntary (1-3 Points)**

Reference – Section 4.4.2; additionally some techniques are discussed in Sections 4.3.2 through 4.3.4 and in Appendix F, Part 3.

Applicability – All projects.

Submittals – Applications proposing to use Credit B.3 should include the following submittals:

- Grading and drainage plans with delineated and quantified areas that drain to vegetation, the area draining to a MS4 system, and overland escape calculations.
- A spreadsheet with the basis for the percentage of impervious area that discharges to a vegetated area versus impervious area that discharges to a MS4 system.

Criteria – Up to three points can be earned under Credit B.3.

To earn Credit B.3.1, drainage on at least 50 percent of the impervious surfaces of a project must be directed to a vegetated area. Additionally the following criteria must be met:

- Roofing downspouts should be directed towards yards, gardens, or swales.
- Runoff from driveways should not drain directly to roads. Instead driveways should be constructed from pervious materials or sloped to drain on stabilized groundcover, or designed to be intercepted and dispersed to adjacent vegetated areas.
- Sidewalk and street runoff should drain to stabilized vegetated areas.
- Some techniques that may be employed include:
 - Vegetated open channels as discussed in Section 4.3.2;
 - Concave planted areas, as discussed in Section 4.3.3.a;
 - Vegetated filter strips, as discussed in Section 4.3.3.b;
 - Detention and retention basins, as discussed in Section 4.3.3.c; and
 - Curb and gutter alternatives, as discussed in Section 4.3.4.
 - Bioswales, as discussed in Section 4.4.4.c
 - Infiltration trenches, as discussed in Section 4.4.4.e
 - Level spreaders, as discussed in Section 4.4.5

To earn Credit B.3.2, drainage on at least 75 percent of the impervious surfaces of a project must be directed to a vegetated area. The criteria provided in Credit B.3.1 must also be met.

To earn Credit B.3.3, drainage on at least 90 percent of the impervious surface of a project must be directed to a vegetated area. The criteria provided in Credit B.3.1 must also be met.

Failure to Meet Criteria – Projects in which less than 50 percent of impervious surfaces will drain towards vegetated areas will fail to earn points under this credit.

Exceptional Performance – An extra point under Credit F.1.2 may not be earned solely for exceptional performance concerning disconnected impervious areas. The point may be earned for projects where more than 90 percent of the impervious surfaces are drained to vegetated area, only in combination with other exceptional and innovative techniques concerning Impervious Surfaces (Part B).

Other Resources – Stormwater Center “Performance Criteria: Open Channel Systems”⁴; Bay Area Stormwater Management Agencies Association *Start at the Source*⁵ CASQA “Vegetated Swale”⁶; CASQA “Vegetated Buffer Strip”⁷ EPA Stormwater Fact Sheet: Vegetated Swales⁸; San Diego County LID Handbook Fact Sheet (curb cuts)⁹; Lower Columbia River Field Guide to Water Quality Friendly Development¹⁰

CREDIT B.4 CLUSTERED DEVELOPMENT / STREET LAYOUT

Priority: **Voluntary (1-3 Points)**

Standard: **Voluntary (1-3 Points)**

Reference – Section 4.2.3 and Section 4.3.1

Applicability – All projects, but generally more appropriate to subdivisions of large parcels.

Submittals – Applications proposing to use Credit B.4 should include the following submittals:

- A site plan showing sensitive areas and areas with high infiltration capacity.
- Building envelopes and clusters identified on the site plan.
- A drainage plan.
- Justification for street design and layout (B.4.3 only)

Criteria – Up to three credits may be earned under Credit B.4.

To earn the first credit (Credit B.4.1), a project must meet these criteria (as applicable):

- Preserve areas within or adjacent to identified sensitive areas, or with high infiltration capacity.
- Run-on to preserved areas should mimic natural drainage patterns.
- Bioretention and open swales should be integrated into the landscaping.
- Road and driveway runoff should be dispersed to adjacent landscaped areas.
- Pre-development flow path links should be maintained.
- Native vegetation and soils should be preserved to disperse, store, and infiltrate stormwater.

To earn Credit B.4.2, you must earn Credit B.4.1 and meet these criteria (as applicable):

- For subdivision projects, the project is a cluster division pursuant to LUO Section 22.22.140 or CZLUO Section 23.04.036.
- For non-subdivision projects, all existing and proposed development is clustered on 50 percent of the site or within a 2.5 acre envelope (whichever is lesser in area).
 - Multiple cluster “pods” are acceptable where necessary to avoid significant natural features, and where the aggregate area meets the above standard.

To earn Credit B.4.3, you must earn Credit B.4.1 and meet these criteria (as applicable):

- Provide pedestrian and bike path connections, without adding significant impervious areas.
- Reduce the length of residential streets or explore alternative street layouts.
- Reduce width of streets to the minimum necessary for emergency services.
- Streets should be located with consideration of natural drainage patterns and soil permeability.

Failure to Meet Criteria – Projects that fail to earn these credits might have one or more the following features.

- Areas of significant native vegetation are removed to accommodate development.
- Waterways are altered or modified to accommodate development, which would increase runoff rates.
- Impervious surfacing covers all or most of the site.
- Streets are excessively wide and are not designed in consideration of natural drainage conditions.

Exceptional Performance – Projects which employ exceptional and innovative clustered development techniques may qualify to earn an extra point under Credit F.1.2. To qualify for this credit, the applicant must earn all three B.4 credits, and the project will substantially enhance significant native vegetation or riparian areas, resulting in an improvement in water quality conditions.

Other Resources – Public Improvement Standard Section 5.2.2 “Basins”; See California Stormwater BMP Handbook Infiltration Basin and Extended Detention Basin Treatment Control Fact Sheets at Detention basins¹¹.

CREDIT B.5 REDUCE BUILDING FOOTPRINT/FOUNDATION EXCAVATION

Priority: **Voluntary (1 Point)**

Standard: **Voluntary (1 Point)**

Reference – Section 4.4.1

Applicability – All projects, but may be more amenable to projects in rural areas.

Submittals – Applications proposing to use Credit 4.4.1 should include the following submittals:

- Description of the foundation system proposed.
- Calculation of the area of disturbance required to accommodate the foundation system.
- Total gross structural area broken down by floor.

Criteria – A project may earn Credit 4.1.1, in one of two ways:

- *Reduce building footprint* – Reduce the building footprint such that at least 40 percent of the gross structural area is located on an upper floor.
- *Use an alternative foundation system* – Use a foundation system that minimizes ground disturbing activities, such as:
 - Stem wall foundation
 - Pin foundation
 - Stepped foundation
 - Pillar foundation

Failure to Meet Criteria – Projects that fail to earn this credit might have a slab-on-grade foundation and more than 60 percent of the gross structural area on the ground floor.

Exceptional Performance – An extra point under Credit F.1.2 may not be earned solely for exceptional performance concerning reduction of footprints and foundation area. The point may be earned for projects exceeding the above requirements only in combination with other exceptional and innovative techniques concerning Impervious Surfaces (Part B).

CREDIT B.6 ROOF CATCHMENT SYSTEMS

Priority: **Voluntary (1-3 Points)**

Standard: **Voluntary (1-3 Points)**

Reference – Section 4.4.4.b and 4.4.4.d

Applicability – All projects.

Submittals – Applications proposing to use Credit B.6 should include the following submittals:

- Rainwater collection and reuse plans.

- A spreadsheet with the basis for the percentage of design storm intercepted.

Criteria – Up to three credits may be earned for roof catchment systems.

To earn Credit B.6.1, a minimum of 50 percent of design storm roof runoff must be intercepted. This is typically accomplished by directing downspouts towards rain barrels, cisterns, or rain gardens.

- Rain gardens should be designed in compliance with Section 4.4.4.b
- Rain cisterns and barrels should be designed in compliance with Section 4.4.4.d

To earn Credit B.6.2, the project shall meet the requirements of B.6.1, except that the minimum percentage described in B.6.1 shall be 75 percent.

To earn Credit B.6.3, the project shall meet the requirements of B.6.1, except that the minimum percentage described in B.6.1 shall be 90 percent.

Projects using roof catchment may also be eligible for Credit B.13 – Clean Water Segregation.

Failure to Meet Criteria – Projects in which less than 50 percent of roof runoff (based on the design storm) is not intercepted will fail to earn points under this credit.

Exceptional Performance – An extra point under Credit F.1.2 may not be earned solely for exceptional performance concerning disconnected impervious areas. The point may be earned for projects where more than 90 percent of the impervious surfaces are drained to vegetated area, only in combination with other exceptional and innovative techniques concerning Impervious Surfaces (Part B).

Other Resources -- Rain Barrel Guide¹²; Aquabarrel Rain Barrel¹³.

CREDIT B.7 DAY LIGHTING STORMWATER CONVEYANCE FACILITIES

Priority: **Voluntary (1 Point)**

Standard: **Voluntary (1 Point)**

Reference – Section 4.3.2 and 4.4.4.c

Applicability – All projects.

Submittals – Applications proposing to use Credit B.7 should include the following submittals:

- Drainage plan.
- An estimate of the percentage of drainage from the design storm that will be conveyed to vegetated stormwater devices (e.g. bioswales, vegetated channels, etc.)
- For redevelopment projects, an estimate of the linear length of existing drainage pipes.

Criteria – To earn this credit, a project must incorporate the following criteria (as applicable):

- New development projects should have at least 75 percent of runoff from the design storm directed towards a vegetated drainage conveyance system (e.g. bioswales, vegetated channels, etc.)
- Redevelopment project should alter the drainage system such that at least 50 percent of the existing pipe length is day lighted.

Project's earning Credit B.7 may also be eligible to earn Credit D.1.

- Drainage plan showing the location of public storm drain inlets, and including a note showing the location of storm drain markers and referencing Public Improvement Specification M-6 for storm drain marker design.

Criteria – Compliance with Public Improvement Specification M-6.

CREDIT C.1 PUBLIC EDUCATION

Priority: **Voluntary (1 Point)**

Standard: **Voluntary (1 Point)**

Reference – No reference.

Applicability – All projects.

Submittals – Applications proposing to use Credit C.1 should include the following submittals:

- A sample of public education materials proposed for distribution.

Criteria – To earn this credit, a project must provide written materials to prospective owners and tenants discussing LID and the importance of protecting water quality. Content and format of the materials should be easily accessible and understandable by the general public. The materials should, at a minimum, include the following:

- Background information on LID and stormwater pollution prevention.
- A description of the owner/tenant’s responsibilities to maintain and monitor BMPs.
- Guidance on how best to maintain the BMPs.
- Direction on how additional information and resources can be obtained.

Additionally, a mechanism must be in place to ensure that subsequent owners and tenants would also receive this information.

Alternative means of achieving public education may be considered on a case-by-case basis where it can be anticipated that the same or better end result will be achieved.

Failure to Meet Criteria – Projects that fail to earn this credit might have one or more the following features:

- No educational materials will be provided.
- Written materials provided are overly technical and difficult to interpret.
- Contents of the written materials do not effectively convey the information.
- There is no means to ensure that future owners and tenants will receive the information.

CREDIT C.9 POOLS, SPAS, AND FOUNTAINS

Priority: **Voluntary (1 Point)**

Standard: **Voluntary (1 Point)**

Reference – Section 5.3.7

Applicability – Any project with a pool, spa, or fountain.

Submittals – Applications proposing to use Credit C.9 should include the following submittals:

- A site plan showing:
 - The location of pools, spas, and fountains.
 - The location of the land area that will be used to drain pools, spas, and fountains (if draining on land).

- The method used to connect pool/spa/fountains to the sanitary sewer system or septic system (if this is the proposed means).
- A service letter from the wastewater provider allowing pools/spas/fountains to be drained to the sanitary sewer system, or documentation that the septic system can handle the drainage of the pool/spa/.fountain (if this is the proposed means).

Criteria – To earn this credit, the applicant must demonstrate that there is adequate land area for pools/spas/fountains to drain to. Alternatively, the applicant may demonstrate that the pool/spa/fountain may be feasibly drained to a wastewater system.

Failure to Meet Criteria – Projects that fail to earn this credit might be designed such that pools, spas, and fountains drain to the street or stormwater system.

CREDIT C.10 ALTERNATIVE BUILDING MATERIALS

Priority: **Voluntary (1 Point)**

Standard: **Voluntary (1 Point)**

Reference – Sections 5.2.2 and 4.4.6

Applicability – All projects.

Submittals – Applications proposing to use Credit C.10 should include the following submittals:

- A list of materials proposed to be used in building construction, and any potential contaminants associated with these materials.
- A signed statement from the project architect asserting that the materials were selected to ensure that they would not leach toxic compounds or require toxic compounds to maintain their integrity. A supplemental statement from the architect will be required before final building inspections to ensure that materials installed remain in compliance with the provisions of this credit.

Criteria – To earn this credit, a project must incorporate the following criteria:

- Building materials must not be prone to leach toxic compounds.
- Building materials must not require application of toxic compounds to maintain their integrity.

Failure to Meet Criteria – Projects that fail to earn this credit might have one or more the following features:

- Building materials include toxic compounds or require treatment with toxic compounds.

CREDIT C.11 EFFICIENT IRRIGATION SYSTEMS AND LANDSCAPE DESIGNS

Priority: **Voluntary (1 Points)**

Standard: **Voluntary (1 Points)**

Reference – Section 5.2.4

Applicability – All projects.

Submittals – Applications proposing to use Credit C.11 should include the following submittals:

- Landscape plans, including a planting plan and irrigation plan.

Criteria – To earn this credit, a project must incorporate the following criteria:

- Landscaping should include a minimum of 50 percent native plants.
- Landscaping requiring minimal or no irrigation is encouraged.

- Irrigated areas should include irrigation controllers with evapotranspiration, high wind, and rainfall sensors to prevent over- or under-watering.
- A “smart” irrigation controller with master valve should be used to allow detection and shut-off in the case of leaks.

Failure to Meet Criteria – Projects that fail to earn this credit might have one or more the following features:

- Less than 50 percent native landscaping.
- No use of specialized irrigation controllers.

CREDIT C.12 OUTLET ENERGY DISSIPATERS

Priority: **REQUIRED**

Standard: **Voluntary (1 Point)**

Reference – Public Improvement Standards Section 5.2.5.C

Applicability – All projects.

Submittals – Applications proposing to use Credit C.12 should include the following submittals:

- Drainage plan showing energy dissipaters.

Criteria – To earn this credit, a project must include outlet energy dissipaters designed in compliance with CASQA¹⁴ specification EC-10.

Failure to Meet Criteria – Projects that do not incorporate outlet energy dissipaters or project’s with dissipaters not designed in compliance with CASQA specification EC-10 would fail to achieve this credit.

CREDIT C.13 CLEAN WATER SEGREGATION

Priority: **Voluntary (1 Point)**

Standard: **Voluntary (1 Point)**

Reference – Section 5.2.3

Applicability – All projects with roof drains or vegetated areas.

Submittals – Applications proposing to use Credit C.13 should include the following submittals:

- Drainage plan demonstrated the methods used to segregate clean water. .

Criteria – Runoff originating from roof and landscaped areas is generally considered “clean.” To earn this credit, a project must incorporate a combination of any of the following measures (as applicable) to retain clean water at the source and/or keep it separated from water requiring treatment:

- Retain runoff on-site.
- Direct runoff into vegetated areas.
- Connect roof and landscaped area runoff into a separate storm drain system.
- Connect roof and landscaped area runoff into the site’s storm drain system at a point after treatment control BMPs have been implemented.
- Detain roof and landscape runoff long enough for first flush of parking lot runoff to be treated and then send it to the project’s common storm drain system.

Failure to Meet Criteria – Projects that fail to earn this credit would be designed to direct runoff from roofs and landscaped areas towards treatment control devices (necessitating additional capacity).

CREDIT C.14 NON-STRUCTURAL POLICY IMPLEMENTATION

Priority: **Voluntary (1 Point)**

Standard: **Voluntary (1 Point)**

Reference – No reference.

Applicability – All projects.

Submittals – Applications proposing to use Credit C.14 should include the following submittals:

- A detailed description of the non-structural policies that will be employed to reduce potential stormwater contaminants at their source.
- A detailed description of how the policies will be implemented, monitored, and enforced.

Criteria – To earn this credit, a project must incorporate policies which would reduce pollutant sources. These policies may be implemented in one or more of the following ways:

- A source of pollutants will be avoided through non-structural project features .
 - *Example:* contamination by washing cars will be avoided by not providing accessible outdoor hose bibs in a multi-family residential project.
- A source of pollutants will be avoided through enforceable written policies.
 - *Example:* tenant lease agreements and/or CC&Rs which prohibit draining of pools to the stormwater system.

Failure to Meet Criteria – Projects that fail to earn this credit might have one or more the following features:

- Infeasible or unenforceable policies.
- Design features which meet the criteria, but can be easily circumvented.

PART D NATURAL SYSTEMS

PREREQUISITE D.1

BIOLOGICAL, ARCHAEOLOGICAL, AND GEOLOGICAL SPECIAL AREAS

Priority: **REQUIRED**

Standard: **REQUIRED**

Reference – Section 4.2.1

Applicability – All projects.

Submittals – Applications should include the following submittals:

- A site plan showing the boundaries of any biologically sensitive areas, archaeological sites, or geologically unique areas.
- A grading and drainage plan.
- Justification for locating development features in any environmentally sensitive area and proposed mitigation to offset the impacts.

Criteria – Projects must seek to avoid impacts to biologically, culturally, or geologically sensitive areas to the maximum extent feasible. Ideally, drainage facilities should not be located in these areas. Additionally, special consideration should be given for how drainage might impact environmental resources (such as redirecting runoff away from an oak woodland). In cases where environmentally sensitive areas cannot feasibly be avoided, appropriate mitigation shall be applied through the environmental review process.

Failure to Meet Criteria – Projects that fail to comply with this prerequisite might have one or more of the following characteristics:

- Development located in environmentally sensitive areas, when this can be reasonably avoided.
- Impacts to environmental sensitive areas which are not appropriately mitigated.
- Alteration of drainage which might affect biological resources, without appropriate mitigation.

Exceptional Performance – An extra point under Credit F.1.4 may not be earned solely for exceptional performance concerning environmentally sensitive areas. The point may be earned only in combination with other exceptional and innovative techniques concerning Natural Systems (Part D).

Other Resources – Various sections in Title 22 (Land Use Ordinance), Title 23 (Coastal Zone Land Use Ordinance), and planning area standards, apply requirements and limitations for projects occurring in environmentally sensitive areas.

CREDIT D.1 OPEN CHANNELS

Priority: **Voluntary (1 Point)**

Standard: **Voluntary (1 Point)**

Reference – Section 4.3.2 and 4.4.4.c

Applicability – All projects with ground slopes less than 4 percent. Please refer to Section 4.3.2 for limitations.

Submittals – Applications proposing to use Credit D.1 should include the following submittals:

- Drainage plan.

Criteria – To earn this credit, a project should incorporate the use of a concave vegetated swale, as specified in Section 4.3.2, meeting the following criteria:

- Swales should be sized to maintain low velocity during small storms and to accommodate larger storms without significant erosion.
- Swales should have shallow depths and gentle side slopes.
- Swales should be planted with appropriate native vegetation.
- Pipes or subsurface recharge beds should be used where driveways or roads cross the swale.

Failure to Meet Criteria – Projects that fail to earn these credits might have one or more the following features.

- No swales are proposed as part of the project.
- Swales do not meet the above-specified design criteria.
- Swales are designed in a manner that would not effectively achieve water quality results.

Exceptional Performance – An extra point under Credit F.1.4 may not be earned solely for exceptional performance concerning open channels. The point may be earned only in combination with other exceptional and innovative techniques concerning Natural Systems (Part D).

CREDIT D.2 RIPARIAN SETBACKS

Priority: **Voluntary (1-2 Points)**

Standard: **Voluntary (1-2 Points)**

Reference – No reference.

Applicability – Projects adjacent to creeks and areas of riparian vegetation.

Submittals – Applications proposing to use Credit D.2 should include the following submittals:

- Site plan showing stream centerline, top-of-bank, extent of riparian vegetation, and setback distance.

Criteria – Two credits may be earned under Credit D.2

To earn the first credit (Credit D.2.1), a project must exceed the required riparian setback by 10 percent. In areas where no required riparian setback has been established, projects set back a minimum of 30 feet from top-of-bank may also earn this credit.

To earn the second credit (Credit D.2.2), a project must exceed the required riparian setback by 20 percent. In areas where no required riparian setback has been established, projects set back a minimum of 50 feet from top-of-bank may also earn this credit.

For projects that do not have riparian setbacks established by ordinance or planning area standard, riparian setbacks shall be measured from top-of-bank to the edge of development (as defined in Titles 22 and 23) to qualify for these credits.

Failure to Meet Criteria – Projects that fail to earn this credit might have one or more the following features:

- Projects do not meet the established riparian setbacks (i.e. variance, waiver, or modification) or do not exceed the required riparian setbacks by at least 10 percent.
- Projects do not have a riparian setback of at least 30 feet (where no riparian setback is otherwise required).
- Structures comply with the riparian setback criteria, but impervious surfacing, fill slopes, and other project features (falling under the definition of “development”) fail to meet the criteria.

Exceptional Performance – In addition to earning Credits D.2.1 and D.2.2, projects which exceed riparian setback requirements by more than 30 percent may qualify to earn an extra point under Credit F.1.4. For projects where no riparian setback is established, adhering to a 100-foot riparian setback would also qualify the project to earn the extra point under Credit F.1.4.

CREDIT D.3 IN-STREAM IMPROVEMENTS

Priority: **Voluntary (1 Points)**

Standard: **Voluntary (1 Points)**

Reference – No reference.

Applicability – Project's with streams located on-site or nearby.

Submittals – Applications proposing to use Credit D.3 should include the following submittals:

- Riparian restoration and revegetation plan prepared by a registered civil engineer in consultation with a qualified biologist.

Criteria – To earn this credit, a project must include restoration of a degraded stream in accordance with the recommendations of an engineer and biologist. Restoration may include:

- Removing impediments such as dams or impoundments.
- Removing invasive species and replacing with riparian species (i.e. willow staking).
- Provide grade controls where headcutting is occurring.
- Other riparian improvements that would promote water quality.

Failure to Meet Criteria – Projects would fail to earn this credit in the following circumstances:

- No streams are located on site or nearby.
- Streams proposed for restoration are already in pristine condition.
- Proposed restoration would not effectively improve water quality.

Exceptional Performance – Projects which employ exceptional and innovative techniques for stream restoration and improvement may qualify to earn an extra point under Credit F.1.4. To qualify for this credit, the applicant must demonstrate how the proposed restoration goes above and beyond the above-listed criteria and will result in an overall long-term improvement in water quality.

CREDIT D.4 PLANT INTERCEPTOR TREES

Priority: **Voluntary (1-2 Points)**

Standard: **Voluntary (1-2 Points)**

Reference – Section 4.3.6

Applicability – All projects.

Submittals – Applications proposing to use Credit D.4 should include the following submittals:

- Preliminary landscaping plans.
- Calculations to establish the percentage of interceptor tree area (as discussed below)

Criteria – Up to two credits can be earned for the planting of interceptor trees.

To earn the first credit (Credit D.4.1), a project must plant interceptor trees such that the percentage of project area dedicated to interceptor trees (using the calculation below) is 10 percent or greater. Please refer to Section 4.3.6 for design criteria and preferred species.

To earn the second credit (Credit D.4.2), the percentage of project area dedicated to interceptor trees must be 30 percent or greater.

CALCULATION:

1. Calculate the total interceptor tree area.
 - Trees used in this calculation must be planted within 15 feet of impervious surfaces.
 - Evergreen trees are assigned 200 square feet of interceptor tree area. Evergreen trees must be a minimum of 5 feet in height to qualify.
 - Deciduous trees are assigned 100 square feet of interceptor tree area. Deciduous trees must have a minimum of 7 feet in height and a minimum diameter at breast height of 1.5 inches to qualify.
 - One-half of the canopy coverage of existing on-site trees may be used toward this calculation for any trees within 30 feet of impervious surfaces which have a diameter at breast height of at least 4 inches.
2. Calculate the total project area located within 15 feet of an impervious surface or creek bank.

3. Divide the interceptor tree area (calculated in Step 1) by the project area (calculated in Step 2) to arrive at the percent of project allocation towards interceptor trees.

Failure to Meet Criteria – Projects that fail to earn this credit would have less than 10 percent area dedicated to interceptor trees.

Exceptional Performance – Projects with a project allocation towards interceptor trees of 50 percent or more are eligible to earn an extra point under Credit F.1.4.

Other Resources – Cal Poly Urban Forest Ecosystems Institute¹⁵

CREDIT D.5 BASINS

Priority: **REQUIRED (D.5.1)**
Voluntary (D.5.2 – 1 point)

Standard: **Voluntary (1-2 Points)**

Reference – Section 4.3.3.c

Applicability – All projects; however basins may not be appropriate in areas with clayey soils, on steep terrain, or in areas with high groundwater.

Submittals – Applications proposing to use Credit D.5 should include the following submittals:

- A grading and drainage plan showing the location of all proposed basins.
- Drainage calculations supporting the sizing of the basin(s)

Criteria – Credit D.5.1 is required for Priority Projects, but an extra point may be earned for Credit D.5.2. For Standard Projects, up to two points may be earned.

To earn Credit D.5.1, the project must include basins (or alternative retention grading practices) sized adequately to maintain the peak stormwater runoff discharge rates, and meeting the following criteria:

- Controls must be developed for the 2-year and 10-year 24-hour storm events. The 100-year 24-hour storm event must be evaluated to demonstrate that there will not be increased flooding impacts offsite.
- Measurement of peak discharge rates must be calculated using the point of discharge or downgradient property boundary. The topography of the site may require evaluation at more than one location if flow leaves the property in more than one direction. An applicant may demonstrate that a feature beyond the property boundary (e.g. culvert) is more appropriate as a design point.

To earn Credit D.5.2, the project must first comply with Credit D.5.1 criteria, and also employ the use of a multi-staged basin system meeting the following criteria:

- Drainage should be designed to pass through more than one basin before leaving the site.
- Basins should be situated along natural flow paths, acknowledging pre-development drainage patterns.
- Conveyance of drainage from multiple discharge areas to a single point should be avoided.

Failure to Meet Criteria – Projects that fail to earn this credit might have one or more the following features:

- Project is not designed to maintain pre-development peak discharge.

- Project is not designed with a multi-stage basin system (D.5.2).

Exceptional Performance – An extra point under Credit F.1.4 may not be earned solely for exceptional performance concerning open channels. The point may be earned only in combination with other exceptional and innovative techniques concerning Natural Systems (Part D).

CREDIT D.6 TIME OF CONCENTRATION

Priority: **Voluntary (1 Points)**

Standard: **Voluntary (1 Points)**

Reference – Appendix F, Part 3 (“Maintain or Increase the Time of Concentration” heading)

Applicability – All projects.

Submittals – Applications proposing to use Credit D.6 should include the following submittals:

- Documentation showing how the project will maintain or increase the time of concentration.

Criteria – To earn this credit, a project must maintain or increase the time of concentration (i.e. the time it takes for runoff to travel across the site), when compared to existing conditions. Some measures that can be used to increase the time of concentration include:

- Roughening the travel path surface (vegetation vs pavement or pipes)
- Incorporating check dams and grade changes to allow interim ponding
- Lengthening the flow path
- Converting concentrated flow back into sheet flow
- Disconnecting impervious areas (*see also Credit B.3*)

Failure to Meet Criteria – Projects that fail to earn this credit would result in a reduction in the time of concentration.

Exceptional Performance – An extra point under Credit F.1.4 may not be earned solely for exceptional performance concerning time of concentration. The point may be earned only in combination with other exceptional and innovative techniques concerning Natural Systems (Part D).

PART E WATER QUALITY

PREREQUISITE E.1 TREATMENT DESIGN STANDARDS

Priority: **REQUIRED**

Standard: **Voluntary (1 Point)**

Reference – Chapter 7

Applicability – All projects.

Submittals – Applications demonstrating compliance with Prerequisite E.1 should include the following submittals:

- Stormwater Quality Plan (SWQP)
- Plans and calculations showing the tributary area for water quality best management practices used on site.
- Design criteria for each individual treatment control BMP used (i.e. hydraulic residence times, WQ depths, etc).

Criteria – To earn this credit, a project must follow the procedures outlined Step 6 (Chapter 3) and follow the guidelines provided in Chapter 7.

Failure to Meet Criteria – Projects that do not include appropriate treatment control BMPs to treat for potential pollutants would fail to earn this credit.

Exceptional Performance – Projects performing exceptionally with regards to treatment may be considered for a point under Credit E.1 (see below).

PREREQUISITE E.2 RECEIVING WATER LIMITATIONS (TMDLs)

Priority: **REQUIRED**

Standard: **REQUIRED**

Reference – No reference.

Applicability – All projects draining to an impaired watercourse (i.e. a watercourse appearing on the list maintained by the Regional Water Quality Control Board under Section 303(d) of the Clean Water Act)

Submittals – Projects should include the following submittals:

- A list of receiving waters that the site drains to.
- Reference to any pollutants for which total maximum daily loads (TMDLs) are established on the 303(d) list for the receiving waters.
- A list of the pollutants potentially generated from the site, both during construction (short-term) and operation of the use (long-term).
- A stormwater quality plan showing all BMPs proposed which will address potential pollutants.
- A sampling/monitoring plan, if required as part of a Stormwater Pollution Prevention Plan (i.e. for “Risk Level 3” projects).

Criteria – Projects must not result in receiving waters exceeding their total maximum daily load (TMDL) for any specified pollutants appearing on the 303(d) list. A TMDL is the amount of a pollutant that a water body can receive and still safely meet water quality standards. Projects discharging to Clean Water Act 303(d) listed water bodies must address all constituents that will contribute to impairment of the water body.

Failure to Meet Criteria – Projects will fail to meet the criteria for this prerequisite if they would result in receiving waters exceeding the total maximum daily load (TMDL) for any specified pollutants appearing on the 303(d) list.

Exceptional Performance – An extra point under Credit F.1.5 may not be earned solely for exceptional performance concerning total maximum daily loads. The point may be earned only in combination with other exceptional and innovative techniques concerning Water Quality (Part E).

CREDIT E.1 ADDITIONAL WATER QUALITY TREATMENT

Priority: **Voluntary (1 Point)**

Standard: **Voluntary (1 Point)**

Reference – Chapter 7

Applicability – All projects.

Submittals – Applications proposing to use Credit E.1 should include the following submittals:

- Stormwater Quality Plan (SWQP)

- Plans and calculations showing the tributary area for water quality best management practices used on site.
- Design criteria for each individual treatment control BMP used (i.e. hydraulic residence times, WQ depths, etc).

Criteria – A project seeking to earn Credit E.1 may achieve compliance using a combination of the methods below (as applicable):

- *For volumetric treatment control*
 - Projects should exceed the volumes determined through hydrograph analysis using the stormwater depths provided in Table F-2 (Appendix F, Part 1) by 10 percent on average for all BMPs sized using volume design criteria.
- *For flow-based treatment control*
 - Projects should use the peak flow rates determined through the Rational Formula using a rainfall intensity of 0.31 inches per hour for all BMPs sized using volume design criteria.

Failure to Meet Criteria – Projects that will fail to earn this credit if BMPs are not designed to exceed the

-

Exceptional Performance – An extra point under Credit F.1.5 may not be earned solely for exceptional performance regarding treatment. The point may be earned only in combination with other exceptional and innovative techniques concerning Water Quality (Part E).

CREDIT E.2 NATURAL PASSIVE TREATMENT

Priority: **Voluntary (1-3 Points)**

Standard: **Voluntary (1-3 Points)**

Reference – Chapter 7

Applicability – All projects.

Submittals – Applications proposing to use Credit E.2 should include the following submittals:

- Plans and calculations showing the tributary area for water quality BMPs used on the site.
 - Highlight and quantify areas where water quality BMPs will be achieved through natural, passive systems.

Criteria – Up to three credits may be earned under Credit E.2

To earn the first credit (Credit E.2.1), a project must use natural, passive systems to meet volume and rate design standard requirements for more than 50 percent of the tributary area producing runoff.

To earn the second credit (Credit E.2.2), a project must use natural, passive systems to meet volume and rate design standard requirements for more than 75 percent of the tributary area producing runoff.

To earn Credit E.2.3, a project must first earn Credit E.2.1. Additionally passive systems would need to be distributed throughout the site, such that the average impervious tributary area to each system is less than 0.5 acres. The average area drained to each system may be calculated by taking the sum of the impervious tributary area drained and dividing it by the number of separate drainage systems.

Failure to Meet Criteria – Projects that fail to earn this credit might have one or more the following features:

- A majority of drainage is handled through conventional means and not through natural systems.
- For Credit E.2.3, all drainage over a large area is directed through a single drainage system rather than being dispersed through multiple systems.

Exceptional Performance – An extra point under Credit F.1.5 may not be earned solely for exceptional performance concerning natural, passive treatment. The point may be earned only in combination with other exceptional and innovative techniques concerning Water Quality (Part E).

CREDIT E.3 SELF TREATMENT AREAS

Priority: **Voluntary (1 Point)**

Standard: **Voluntary (1 Point)**

Reference – No reference.

Applicability – All projects with self treatment areas (i.e. natural areas, large landscaped areas).

Submittals – Applications proposing to use Credit E.3 should include the following submittals:

- Grading and drainage plan labeling self treatment areas.

Criteria – Self treatment areas are areas where the runoff is naturally treated without any other measures being applied. Examples include conserved natural areas and large landscaped areas (such as lawns). To earn this credit, a project must direct drainage from self treatment areas away from other areas of the site that do require treatment. Doing so will reduce the volume of water requiring treatment.

Failure to Meet Criteria – Projects that fail to earn this credit would direct drainage from self treatment areas to portions of the site that require treatment.

Exceptional Performance – An extra point under Credit F.1.5 may not be earned solely for exceptional performance concerning natural, passive treatment. The point may be earned only in combination with other exceptional and innovative techniques concerning Water Quality (Part E).

CREDIT E.4 CPSWQ OR COUNTY APPROVED TRAINING

Priority: **Voluntary (1 Points)**

Standard: **Voluntary (1 Points)**

Reference – No reference.

Applicability – All projects.

Submittals – Applications proposing to use Credit E.4 should include the following submittals:

- Documentation that the preparer of the grading plan, drainage plan, erosion and sedimentation control plan, and stormwater pollution prevention plan (as needed) is a Certified Professional in Storm Water Quality (CPSWQ) or has completed County-sponsored training in stormwater quality.

Criteria – To earn this credit, a project's grading plan, drainage plan, erosion and sedimentation control plan, and stormwater pollution prevention plan shall have been prepared by a professional with CPSWQ certification. Alternatively, the preparer of these plans may have completed County-sponsored training in stormwater quality within the last two years.

Failure to Meet Criteria – Projects with a grading plan, drainage plan, erosion and sedimentation control plan, and stormwater pollution prevention plan (if needed) that were prepared by an individual who is not CPSWQ-certified and who has not completed county-sponsored training within the previous two years would not be eligible for this credit.

Exceptional Performance – An extra point under Credit F.1.5 is not available for exceptional performance.

PART F INNOVATION AND DESIGN PROCESS

CREDIT F.1 INNOVATION IN DESIGN

Up to five additional points can be earned for a project where exceptional and innovative design techniques are employed to result in an overall water quality improvement. The five points are divided as follows:

- Credit F.1.1 – One point may be earned for exceptional performance for soils-based techniques described in Part A. The point may be earned in one of two ways:
 - By meeting the exceptional criteria for Prerequisite A.1 or Prerequisite A.2.
 - By using a combination of innovative techniques concerning soils-related practices that, when considered together, constitute exceptional performance.
- Credit F.1.2 – One point may be earned for exceptional performance for impervious surface-based techniques described in Part B. The point may be earned in one of two ways:
 - By meeting the exceptional criteria for any one of the credits in Part B.
 - By using a combination of innovative techniques which would reduce impervious surfacing, which, when considered together, would constitute exceptional performance.
- Credit F.1.3 – One point may be earned for exceptional performance for source control techniques described in Part C. The point may be earned when the applicant has demonstrated that source control practices proposed as part of the project would go above and beyond source control requirements and obligations.
- Credit F.1.4 – One point may be earned for exceptional performance for techniques using natural systems, as described in Part D. The point may be earned in one of two ways:
 - By meeting the exceptional criteria for any one of the prerequisites or credits listed in Part D.
 - By using a combination of innovative techniques employing the use of natural systems, which, when considered together, would constitute exceptional performance.
- Credit F.1.5 – One point may be earned for exceptional performance for water quality treatments techniques described in Part E. The point may be earned when the applicant has demonstrated that treatment control practices proposed as part of the project would go above and beyond treatment control requirements and obligations.

Submittals – Detailed justification as to why a point should be awarded for exceptional performance.

CREDIT F.2 TEAM TRAINED IN LID

Priority: **Voluntary (1 Point)**

Standard: **Voluntary (1 Point)**

Reference – No reference.

Applicability – All projects.

Submittals – Applications proposing to use Credit F.2 should include the following submittals:

- Documentation that the person(s) designing the site plan, grading plan, and drainage plan have attended training in LID practices within the last two years.

Criteria – To earn this credit, a project's site plan, grading plan, and drainage plan must have been designed by a person who has attended training in LID practices within the last two years.

Failure to Meet Criteria – Projects will fail to earn this credit if the site plan, grading plan, or drainage plan were designed by someone who had not attended training in LID practices in the last two years.

¹ http://soils.usda.gov/sqi/management/files/protect_urban_sq.pdf

References

² <http://www.epa.gov/region3/mntop/pdf/Appendices/Appendix%20D%20Aquatic/Aquatic%20Eco%20system%20Enhanc.%20Symp/Proceedings/Support%20Info/Schor/Landform.pdf>

³ <http://www.ci.encinitas.ca.us/NR/rdonlyres/3FC9E1F4-EAF4-4447-9D8E-36C7DFAC15A6/0/Chapter3DRGFINALCC041305.pdf>

⁴ http://www.stormwatercenter.net/Manual_Builder/Performance%20Criteria/Open%20Channels.htm

⁵ http://scvurppp-w2k.com/pdfs/0203/c3_related_info/startatthesource/Start_At_The_Source_Full.pdf

⁶ www.cabmphandbooks.com/Documents/Development/TC-30.pdf

⁷ <http://www.cabmphandbooks.com/Documents/Development/TC-31.pdf>

⁸ <http://www.epa.gov/owm/mtb/vegswale.pdf>

⁹ <http://www.co.san-diego.ca.us/dplu/docs/LID-Handbook.pdf>

¹⁰ <http://www.lcrep.org/fieldguide/examples/curbalternatives.htm>

¹¹ <http://www.cabmphandbooks.com/Documents/Municipal/TC-22.pdf> and

<http://www.cabmphandbooks.com/Documents/Development/TC-11.pdf>

¹² <http://www.rainbarrelguide.com/>

¹³ <http://www.aquabarrel.com/>

¹⁴ <http://www.cabmphandbooks.com/Documents/Construction/EC-10.pdf>

¹⁵ <http://selectree.calpoly.edu/>

Appendix E

Plant List & Guidelines for Landscape-Based Stormwater Measures

Plant List & Guidelines for Landscape-Based Stormwater Measures

Introduction

Of the list of Best Management Practices published by the EPA, the following depend on plant material for their success:

- Infiltration Basin;
- Grassed Channel;
- Infiltration Trench;
- Vegetated Filter Strip;
- Dry Swale;
- Bioretention;
- Dry Detention Pond;
- Wet Swale;
- Wet Pond;
- Storm Water Wetland.

Therefore, the careful selection of plant species is a critical step in successful LID design and implementation. Plants facilitate natural infiltration of surface runoff, increase evapotranspiration, reduce the 'heat island' effect of urbanized areas, and reduce the rate, volume, and pollutant loading of urban runoff that ultimately ends up in local waterways or in local aquifers.

For the drainage features to function optimally, several plant characteristics need to be considered to determine their appropriateness for that particular BMP, and more specifically, the zone at which they are located within it. Most of these characteristics are included in the LID Plant List table, but basically for each plant selection, the following need to be looked at: water requirements; tolerance for inundation; root and leaf structure; and the ability to filter pollutants.

California native plants make up the entire LID Plant List, and this is the case for several reasons: they are perfectly adapted to local environmental conditions; they generally require less water and fertilization; and they limit the impact to native habitats. Native plants are also less susceptible to pests and diseases. There are a vast number of plants native to San Luis Obispo County that should provide designers with enough choices for virtually every scenario likely to be encountered. While the list does not include every suitable plant species for use

within the County, it provides a good basis point for developing project specific plant palettes. Non-native species are inappropriate because they can become invasive, and water can quickly spread their occurrence and alter downstream habitats. Turf grass is also discouraged for LID drainage features due to its tendency to require large amounts of supplemental water, fertilizers, and regular maintenance.

The Planting Zones

Low Zone

The area at the bottom of the drainage feature where water temporarily ponds during either a rain event, or an upstream activity such as washing or irrigation. The low zone should not be designed to hold water, but should completely drain within 72 hours. However, during rainy seasons, this zone may be inundated for extended periods of time. Species planted in this zone should have the following characteristics:

- Water tolerant;
- Dense root structure and vegetative cover to discourage erosion, slow runoff velocities, and provide maximum pollutant filtration.
- Native grasses and groundcovers are excellent choices for this zone.

Mid Zone

The mid zone is the side slopes of the drainage feature, whose primary function is to slow down runoff velocity. While water passes through this area and saturates the soil, it does not stand for any period of time during typical storm events. Species planted in this zone should have the following characteristics:

- Tolerant of periodic inundation;
- Tolerant of periods without water;
- Dense root structure to provide erosion protection of side slopes.

High Zone

The top of the drainage feature will not see any standing water. Species planted in this zone should have the following characteristics:

- Deep roots to provide structural stability to the drainage feature;
- Tolerant of extended periods without water;
- Tolerant of occasional inundation.

and the vegetation itself. These situations occur where features receive a concentrated flow, and may include such elements as gabions, weirs, or cobblestones. Where conditions absolutely demand, small areas of hardscape may be used.

Planting Design Criteria

There are numerous conditions to consider when choosing plant species for LID drainage features. Not surprisingly, many of the species on the LID Plant List have native habitats that mimic the various and (sometimes) disparate conditions that these features employ.

The purpose of the LID Plant List is to provide a cross section of suitable plant species as a base point for the development of project specific plant palettes. Designers and property owners are encouraged to propose other species that meet the spirit of these guidelines; the County will have the discretionary right to permit or deny their use. The following characteristics should be considered when proposing new plants:

- The planting zone(s) where the plant will be located (see Planting Zones Diagram); The size of the planting area and the size of the plant species at maturity;
- Native to California, preferably to San Luis Obispo County (non-native plants are inappropriate);
- Tolerant of San Luis Obispo County's climatic patterns (such as prolonged dry periods);
- Tolerant of seasonal flooding/inundation;
- Low maintenance requirements;
- Adaptability.

Plant species should aim to control erosion and wick water from soils. Some of the best choices for the low zone are groundcovers and grasses that quickly cover exposed soil. Low shrubs, grasses and groundcovers are suitable for the mid zone, depending on the area, gradient, soil type, and drainage patterns (sheet flow vs. concentrated flow, or flooding). Trees and larger shrubs are best planted in the high zone where their deeper roots can provide reinforcement to the drainage feature, and absorb the infiltration.

Energy dispersion devices may be required to be installed or constructed in certain situations to protect the integrity of the drainage feature,

Plant Layout

Some rules of thumb for planting layout of LID drainage features are:

- The smallest practical area of land should be exposed at any one time during development to minimize erosion. Erosion control measures should be integrated into planting designs, such as biodegradable erosion control mats. Plant mixes applied through a hydroseeding process should include erosion control specifications, which may be via a mulching process, or an integral part of the seed mix;
- Vegetation should be installed as soon as possible after soil is exposed;
- Plants should be laid out in staggered rows, and spaced so 100% coverage is attained at two-thirds of the species mature size.

Other Requirements

Soils Test

Prior to planting, but after grading operations are substantially complete, a soils test shall be undertaken by a qualified soil laboratory. The test results shall become a part of the design review submittal. Surface soils in San Luis Obispo County vary from almost pure sand at the coast, to heavy clay for much of the inland areas. Since the soils percolation rate, ability to allow the infiltration of water, and the depth to groundwater, is critical to the design of LID drainage features, this test will help to determine which BMP(s) are appropriate for that site. The soil report should contain, at a minimum:

- Native soil composition;
- Infiltration rates;
- Texture test;
- Depth at which groundwater was encountered (if at all);
- Cation exchange capacity;
- Agricultural suitability analysis;
- Recommended amendments for plant species to survive;
- Date of test.

Prior to planting, and on the advice of the soils report, the soil shall be amended to provide premium growing conditions for the plants specified.

Mulch

Immediately after planting, all exposed soil shall be covered with mulch to minimize erosion, and aid soil moisture retention. Mulch material may be either mineral (e.g. cobble or uncompacted decomposed granite) or biodegradable (e.g. bark or wood-chips). Biodegradable erosion control mats may also be used either on their own, or in conjunction with another mulch material. Mulch materials must not inhibit infiltration, and must be stable enough to withstand occasional high velocity runoff. Bark chips that have a tendency to float are not recommended. Acceptable mulching materials are:

- Nitrogen fortified bark (1" to 2" diameter);
- Redwood bark (1" to 2" diameter);
- Chipped gravel, crushed stone, or cobbles (1/2" to 2-1/2" diameter);
- 50/50 blend of top soil and aged compost.

Shredded bark (sometimes called 'Gorilla Hair') is not acceptable due to its tendency to form a tightly woven mat that can become almost impervious, and can also encourage mold growth.

Maintenance

Good design and planning can minimize the amount of maintenance required for a drainage feature. Weeds can be suppressed by a good coverage of vegetation, native plants require little, if any fertilizing and the avoidance of over-planting will reduce the amount of pruning needed. The most critical time for the vegetation is in the period immediately following construction, when plant species are not fully established; weed control, and supplemental irrigation may be required to ensure a healthy, vigorous vegetative cover.

It is worth noting the County policy of not using any herbicides or pesticides on any of their rights-of-way. Native plants are less susceptible to pests and diseases, and are therefore often more durable choices.

Given the nature of the LID drainage features, they will likely capture trash and debris (particularly after a significant rain event) and

will need to be periodically cleaned out. Depending on the adjacent land uses, there may also be a build-up of silt that should be removed as necessary to allow optimum functionality of the feature. In the event that cleaning and maintenance operations damage the vegetation, it should be replaced as soon as possible.

Nursery Sources

Environmental Seed Producers Inc.
P.O. Box 2709
Lompoc, CA 93438
(805) 735-8888
www.espseeds.com

Las Pilitas Nursery
3232 Las Pilitas Road
Santa Margarita, CA 93453
(805) 438-5992
www.laspilitas.com

Native Sons Inc.
379 West El Campo Road Arroyo Grande, CA
93420 (805) 481-5996
www.nativeson.com

S&S Seeds
P.O. Box 1275
Carpinteria, CA 93014
(805) 684-0436
www.ssseeds.com

San Marcos Growers
125 South San Marcos Road Santa Barbara, CA
93111
(805) 683-1561
www.smgrowers.com

slo starts
1858 Los Osos Valley Road Los Osos, CA 93402
(805) 528-7533

References

Brenzel Norris, Kathleen. Sunset Western Garden Book. Menlo Park: Sunset Publishing Corporation, 2001.

Joni L. Janecki & Associates, Inc. City of Salinas Development Standards Plan - LID Development Practices for Urban Storm Drainage Management, 2007.

Bornstein, Fross & O'Brien. California Native Plants for the Garden. Cachuma Press, Los Olivos, California, 2005

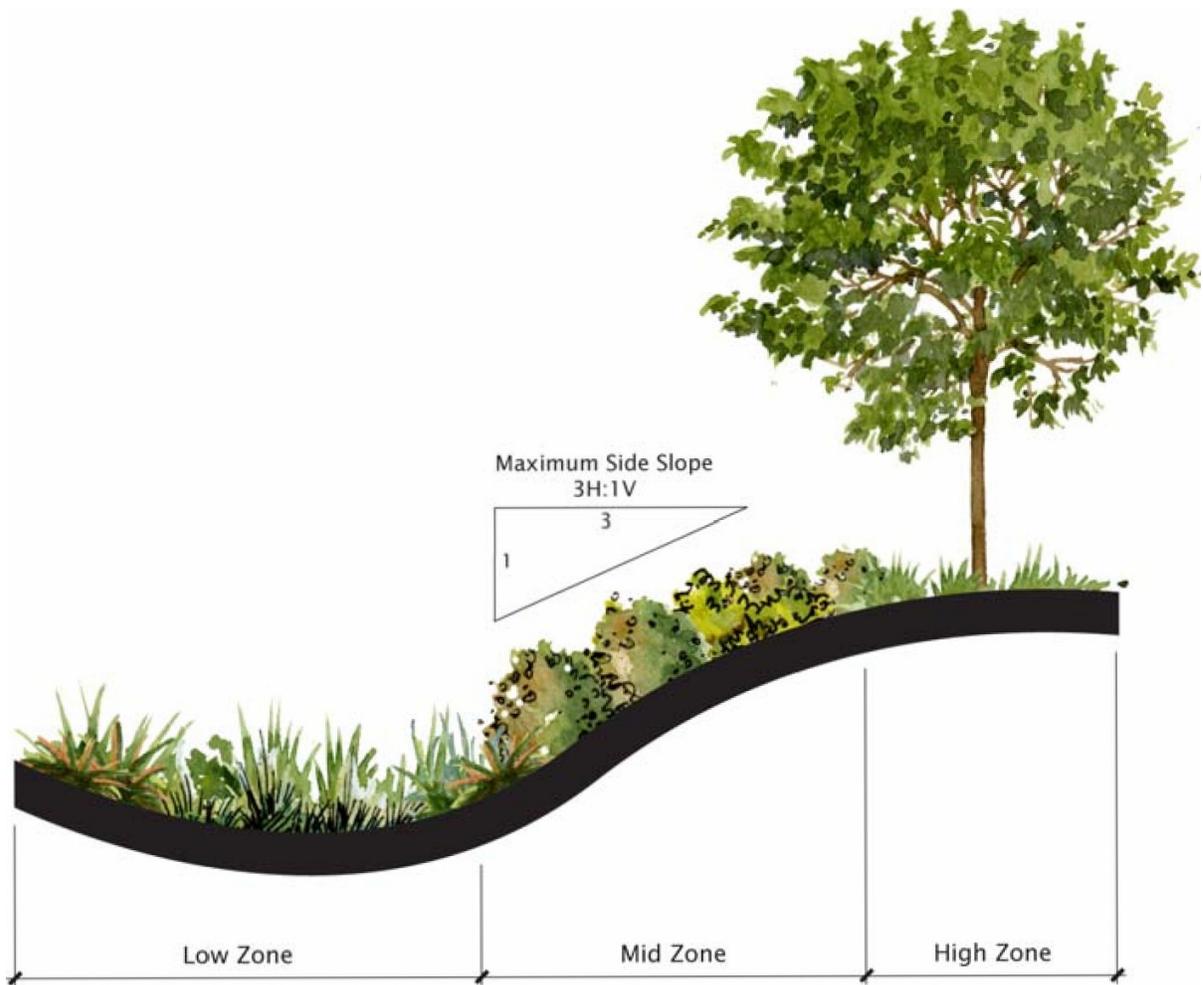
Greenlee, John. The Encyclopedia of Ornamental Grasses. Rodale Press, Pennsylvania, 1992

Las Pilitas Nursery. Online native plants information resource. Available at www.lasoilitas.com.

Native Sons Nursery. Online native plants information resource. Available at www.nativeson.com.

USDA Natural Resources Conservation Service Plants Database. Online plant information resource. Available at <http://plants.usda.gov/>

US Environment Protection Agency. Online storm water BMP resource. Available at v.nv.emcw.



Planting Zones Diagram

This diagram illustrates the three basic planting zones for landscape-based stormwater measures. Used in conjunction with the LID Plant List, it shows the general zones that are recommended for each species. Site specific conditions should also be considered, such as solar orientation and micro-climate.

Plant List for Landscape-Based Stormwater Measures

Botanical Name	Common Name ³	Planting Zones ¹			LID Design Considerations ²									Notes
		Low Zone	Mid Zone	High Zone	Small Planting Strips (< 5' Wide)	Large Planting Areas (> 5' Wide)	Tolerates Prolonged Saturation	Tolerates Periodic Flooding	Tolerates Prolonged Dry Periods	Requires Good Drainage	Tolerates Mowing	Phytoremediation Capabilities	Tolerates Clay Soils	
GRASSES, GROUNDCOVERS, FERNS & BULBS														
<i>Achillea millefolium</i>	Yarrow		✓	✓	✓	✓				✓	✓		✓	Good erosion control
<i>Agulegia formosa</i>	Western Columbine	✓			✓	✓	✓	✓	✓					
<i>Arctostaphylos app.</i>	Manzanita		✓	✓	✓	✓			✓	✓				
<i>Bothriochloa barbinodis</i>	Cane Bluestem		✓	✓	✓	✓		✓	✓	✓				Good erosion control
<i>Bromus carinatus</i>	California Brome		✓	✓	✓				✓					
<i>Calamagrostis nutkaensis</i>	Pacific Reedgrass		✓		✓	✓		✓	✓					
<i>Calochortus albus</i>	White Fairy Lantern		✓		✓	✓		✓	✓					
<i>Carex pansa</i>	California Meadow Sedge	✓	✓		✓	✓		✓		✓				Good erosion control
<i>Carex praegracilis</i>	Dune Sedge	✓	✓		✓	✓		✓	✓	✓	✓			Good erosion control
<i>Carex tumulicola</i>	Foothill Sedge	✓	✓	✓	✓	✓	✓	✓	✓		✓			Good erosion control
<i>Castilleja miniata</i>	Indian Paintbrush		✓	✓	✓	✓			✓	✓				
<i>Deschampsia caespitosa</i>	Tufted Hair Grass		✓		✓	✓		✓	✓	✓				Needs irrigation
<i>Deschampsia holciformis</i>	Pacific Hair grass	✓	✓		✓	✓	✓	✓						

Botanical Name	Common Name ³	Planting Zones ¹			LID Design Considerations ²									Notes
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<i>Dadleya puiverulenta</i>	Chalk Dudleya		✓	✓	✓	✓			✓	✓				Not in north County/ California Valley
<i>Eleocharis macrostachya</i>	Common Spike Rush	✓	✓		✓	✓	✓	✓						
<i>Eschscholcia californica</i>	California Poppy		✓	✓	✓	✓			✓	✓				
<i>Festuca californica</i>	California Fescue		✓	✓	✓	✓		✓	✓					Good erosion control
<i>Festuca idahoensis</i>	Western Fescue	✓	✓	✓	✓	✓		✓	✓					Good erosion control
<i>Fragaria chiloensis</i>	Beach Strawberry		✓		✓			✓	✓	✓				
<i>Helichera micrantha</i>	Crevice Alum Root		✓	✓	✓	✓		✓	✓	✓				
<i>Hordeum californicum</i>	California Barley		✓	✓	✓	✓		✓	✓	✓			✓	
<i>Hordeum intercedens</i>	Bobtail Barley		✓	✓	✓	✓		✓	✓	✓			✓	
<i>Iris douglasiana</i>	Douglas Iris		✓	✓	✓	✓		✓		✓				Good erosion control
<i>Juncus acutus</i>	Spiny Rush	✓	✓		✓	✓	✓	✓	✓					Good erosion control
<i>Pincus bufonius</i>	Toad Rush	✓	✓		✓	✓	✓	✓	✓					Good erosion control
<i>Juncus effusus</i>	Soft Rush	✓	✓		✓	✓	✓	✓	✓					Good erosion control
<i>Juncus mexicanus</i>	Mexican Rush	✓	✓		✓	✓	✓	✓	✓					Good erosion control
<i>Juncus patens</i>	Wire Grass	✓	✓		✓	✓	✓	✓	✓					Good erosion control

Botanical Name	Common Name ³	Planting Zones ¹			LID Design Considerations ²									Notes
		Low Zone	Mid Zone	High Zone	Small Planting Strips (< 5' Wide)	Large Planting Areas (> 5' Wide)	Tolerates Prolonged Saturation	Tolerates Periodic Flooding	Tolerates Prolonged Dry Periods	Requires Good Drainage	Tolerates Mowing	Phytoremediation Capabilities	Tolerates Clay Soils	
<i>Lasthenia californica</i>	California Goldfields	✓	✓		✓	✓	✓	✓	✓				✓	
<i>Lasthenia glabrata</i>	Yellowray Goldfields	✓	✓		✓	✓	✓	✓	✓				✓	
<i>Layia platyglossa</i>	Tidy Tips		✓	✓	✓	✓			✓					
<i>Leymus condensatus</i>	'Canyon Prince' Canyon Prince Wild Rye		✓	✓					✓					
<i>Leyrnus triticoides</i>	Creeping Wild Rye	✓	✓		✓	✓		✓	✓		✓		✓	Fast spreading
<i>Lilium pardalinum</i>	Leopard Lily		✓			✓		✓	✓	✓				
<i>Linanthus parvi florus</i>	Stardust		✓	✓	✓	✓			✓	✓				Annual
<i>Lupinus microcarpus var. densiflorus</i>	Whorled Lupine		✓	✓	✓	✓			✓	✓				Annual
<i>Melica imperfecta</i>	Coast Melic Grass		✓	✓	✓			✓						Not directly on coast
<i>Muhlenbergia rigens</i>	Deer Grass		✓	✓	✓	✓		✓	✓				✓	Good erosion control; Fast spreading
<i>Nassella pulchra</i>	Purple Needlegrass		✓	✓		✓			✓		✓			State grass of California
<i>Polystichum munitum</i>	Sword Fern		✓		✓	✓		✓						
<i>Salvia app.</i>	Sage		✓	✓	✓	✓		✓	✓					Not directly on coast; Fast growing

Botanical Name	Common Name ³	Planting Zones ¹			LID Design Considerations ²									Notes
		Low Zone	Mid Zone	High Zone	Small Planting Strips (< 5' Wide)	Large Planting Areas (> 5' Wide)	Tolerates Prolonged Saturation	Tolerates Periodic Flooding	Tolerates Prolonged Dry Periods	Requires Good Drainage	Tolerates Mowing	Phytoremediation Capabilities	Tolerates Clay Soils	
<i>Satureja douglasii</i>	Yerba Buena	✓	✓		✓			✓					✓	
<i>Scirpus californicus</i>	California Bulrush	✓				✓	✓	✓						
<i>Scirpus maritimus</i>	Saltmarsh Bulrush	✓				✓	✓	✓						
<i>Sisyrinchium helium</i>	Blue-Eyed Grass		✓	✓	✓	✓			✓		✓			
<i>Symphoricarpos monis</i>	Creeping Snowberry		✓	✓		✓			✓					Good erosion control
<i>Triteleia laza</i>	Ithuriel's Spear		✓	✓	✓	✓		✓	✓					
VINES														
<i>Clematis lasiantha</i>	Chaparral Clematis		✓	✓		✓			✓	✓				
<i>Vitis californica</i>	California Wild Grape	✓	✓	✓	✓	✓		✓	✓	✓				
SHRUBS														
<i>Arctostaphylos app.</i>	Manzanita		✓	✓	✓	✓			✓	✓				Good erosion control
<i>Baccharis pilularis</i>	Coyote Brush			✓	✓	✓		✓	✓					Good erosion control; Fast growing
<i>Baccharis salicifolia</i>	Mulefat		✓	✓		✓	✓	✓	✓					
<i>Barbaric aguifolium</i>	Oregon Grape			✓	✓	✓			✓					

Botanical Name	Common Name ³	Planting Zones ¹			LID Design Considerations ²									Notes
		Low Zone	Mid Zone	High Zone	Small Planting Strips (< 5' Wide)	Large Planting Areas (> 5' Wide)	Tolerates Prolonged Saturation	Tolerates Periodic Flooding	Tolerates Prolonged Dry Periods	Requires Good Drainage	Tolerates Mowing	Phytoremediation Capabilities	Tolerates Clay Soils	
<i>Ceanothus</i> spp.	Wild Lilac			✓		✓				✓				Good erosion control; Fast growing
<i>Cornus sericea</i>	Creek Dogwood	✓	✓	✓	✓	✓	✓	✓					✓	Good erosion control; Allergenic
<i>Fremontodendron californica</i>	Flannel Bush			✓		✓				✓				Fast growing
<i>Garrya elliptica</i>	Coast Silk-Tassel			✓	✓	✓			✓	✓			✓	
<i>Heteromeles arbutifolia</i>	Toyon			✓		✓			✓	✓				Good erosion control
<i>Lupinus albus</i>	Silver Bush Lupine		✓	✓		✓			✓	✓				Fast growing
<i>Myrica californica</i>	Pacific W. Myrtle		✓	✓		✓		✓						Fast growing
<i>Rhamnus californica</i>	Coffeeberry		✓	✓		✓		✓	✓					Good erosion control
<i>Ribes sanguineum</i>	Pink-Flowering Currant		✓	✓	✓	✓	✓	✓	✓				✓	Good erosion control
<i>Ribes speciosum</i>	Fuchsia-Flowering Gooseberry		✓		✓		✓	✓					✓	Good erosion control
<i>Ribes viburnifolium</i>	Catalina Perfume		✓	✓	✓	✓	✓	✓	✓				✓	Good erosion control
<i>Rosa californica</i>	California Wild Rose		✓	✓		✓	✓	✓	✓					Good erosion control; Potentially invasive
<i>Rubus ursinus</i>	California Blackberry		✓			✓		✓	✓				✓	

Botanical Name	Common Name ³	Planting Zones ¹			LID Design Considerations ²									Notes
		Low Zone	Mid Zone	High Zone	Small Planting Strips (< 5' Wide)	Large Planting Areas (> 5' Wide)	Tolerates Prolonged Saturation	Tolerates Periodic Flooding	Tolerates Prolonged Dry Periods	Requires Good Drainage	Tolerates Mowing	Phytoremediation Capabilities	Tolerates Clay Soils	
<i>Sambucus mexicana</i>	Elderberry		✓	✓	✓	✓	✓	✓	✓				✓	Good erosion control; Fast growing
TREES														
<i>Acer tncrophyllum</i>	Big-Leaf Maple		✓	✓		✓	✓	✓						Fast growing
<i>Aesculus californica</i>	Buckeye			✓		✓	✓	✓	✓				✓	Good erosion control
<i>Alnus rhombi folio</i>	White Alder		✓	✓		✓	✓	✓						Fast growing
<i>Cercis occidentalis</i>	Western Redbud		✓	✓	✓	✓		✓	✓	✓				Good erosion control
<i>Platanus racemosa</i>	California Sycamore		✓	✓		✓		✓						Fast growing
<i>Papules fremontii</i>	Western Cottonwood		✓	✓		✓	✓					✓		Good erosion control; Fast growing
<i>Prunus ilicifolia sap. Lyonii</i>	Catalina Cherry			✓	✓	✓	✓	✓	✓				✓	
<i>Salix laevigata</i>	Red Willow	✓	✓	✓	✓	✓	✓	✓					✓	
<i>Salix lasiolepis</i>	Arroyo Willow	✓	✓	✓	✓	✓	✓	✓					✓	
<i>Umbellularia californica</i>	California Bay Laurel			✓		✓	✓	✓						

Footnotes:

¹ See Planting Zone illustration above for zones as they relate to stormwater BMP's.

² Lid design considerations are specific factors that relate to landscape-based stormwater measures. Designers should also consider usual environmental factors such as sun/shade requirements, coastal exposure, wind tolerance, etc., when developing site specific plant lists.

³ All plant species are considered native to California to limit impact to native habitats, and take advantage of their natural suitability to San Luis Obispo County's climate. All are considered appropriate for use throughout the entire county unless noted otherwise.

Appendix F

Additional Resources

PART 1 – RETENTION GRADING STEPS

Infiltration practices work best in residential, commercial and industrial areas with NRCS type A and B hydrologic group soils. Retention grading earthworks that are distributed and sized to retain the tributary are to it wile not exceeding a berm height shown in the table below are except from completing infiltration testing specified further in this section and will not require underdrains, event in NRCS type C and D hydrologic group soils.

Bioretention projects located in NRCS type C and D hydrologic group soils may require an underdrain. Project that require an underdrain do not need to test the sites inherent infiltration rate. The NRCS soil web survey is available on-line at <http://websoilsurvey.nrcs.usda.gov/>

Regardless of which practice is used, infiltration practices should not occur in areas where:

- known geologic instability exists that would be exacerbated by increased infiltration
- where contaminates are present in the soil or aquifer below the site
- in areas with high bedrock elevations
- within 10 ft away from structure foundation unless structure foundation is protected from water damage
- high groundwater in the area may create additional problems
- on steep banks or in highly erodible soils
- over septic fields or leach lines

Infiltration rates are dependent on rainfall intensity, receiving ground slope and permeability of soils and subsoil(s), soil structure, surface vegetation, soil moisture and soil biota. To determine if a site is well suited for infiltration BMPs, the following four step process is provided.

Step 1. Initial Screening.

Eliminate areas within site with

- Existing topography and slopes greater than 20%
- Groundwater and bedrock depths shallower than 10 feet

Eliminate areas located within

- 500-ft of an area of known groundwater contamination or underground fuel tank
- FEMA defined 100-year flood plain
- 250 feet of public wells
- 100 feet of private wells and riparian corridors (Schueler,1987)
- 50 ft of septic system or leach field
- 100 ft of roadways with average daily traffic of 25,000 trips or greater for main road
- 100 ft of intersecting roadway with average daily traffic of 15,000 trips or greater

Highlight remaining areas with NRCS hydrologic soil group type A or B

To complete step 1, a to-scale site plan/map, including topography, of the entire development site plus 500-feet beyond site boundary is prepared. This map is intended to aid the development team in determining areas potentially suitable for infiltration BMPs and should also incorporate relevant information (i.e. tree conservation and archeological areas, etc) identified when the constraints map was developed (See Section 4.2.1).

Infiltration BMPs must be at a lower elevation than the adjacent areas from which they will receive runoff.

Projects located in NRCS hydrologic soil group type C and D soils are less suitable for infiltration BMPs because the soils do not allow significant volumes of runoff to infiltrate them. Projects with these slow draining soils must utilize a permeable backfill in conjunction with an underdrain or alternative BMPs such as vegetated swales and strips. As a result, these projects can skip step 2 and proceed to field testing of the proposed BMP location as specified in step 3.

Step 2. Characterize soil (structure, USDA texture, gradation, percent fines, and soil horizons) at the proposed bottom and 4-ft below the bottom of the proposed BMP. One sample must be evaluated by a licensed geotechnical engineer for each considered location, regardless of type or size.

The soil horizon information is used to identify the relative infiltration rates based on each horizon (see Table 6.3).

Table 6.3: Design Infiltration Rates for Soil Textures Receiving Stormwater

SOIL TEXTURE	INITIAL INFILTRATION RATE (IN/HR)
Coarse sand or coarser, loamy coarse sand, sand	3.600
Loamy sand	1.630
Sandy loam, fine sand, loamy fine sand, very fine sand and loamy fine sand	0.500
Loam	0.240
Silt loam	0.130
Sandy clay loam	0.110
Clay loam	0.030
Silty Clay loam	0.043
Sandy clay	0.040
Silty clay, clay	0.070

The infiltration rate of the soil texture with the least permeable soil can be used as an initial indicator of the sites infiltration rate. Infiltration rates less than 0.5-inches per hour (indirect infiltration) and 1.0-inches per hour (direct infiltration) do not drain quickly enough for use as an infiltration system without the addition of an underdrain. Infiltration rates that exceed 3-in/hr (indirect or direct) are considered at risk of introducing contaminants into groundwater supplies and should only be used where it can be demonstrated that pre-treatment of the runoff will confidently eliminate that risk. These sites will also require significant irrigation to sustain surface landscaping.

The number of potential infiltration testing locations can be reduced by the elimination of all evaluated areas that have percent fines greater than 10 percent. Sites with excessive percent fines tend to clog the pore spaces in the soil, thereby reducing its ability to function as designed.

Distributing small infiltration areas throughout the site is preferred over the use of large retention basins. Depending on the site, using a combination of small, natural stormwater retention areas can reduce the overall size of a flood control detention and piping system.

Step 3. Determine types of suitable infiltration BMPs for the location

Remaining potential infiltration sites can be preliminarily sized based on the estimated infiltration rate for the textural class identified in the samples evaluated. There are many types of infiltrating BMPs including bioretention systems, swales, retention basins, dry wells, infiltration trenches, modular pavements and rain gardens. Often site conditions point towards one BMP being more appropriate than another.

Upon completion of step 3, the anticipated footprint and its location relative to proposed structures should be included on the infiltration feasibility map. Most infiltration BMPs will require a 10-ft setback downslope of a structure, unless the structure is protected with a water/vapor barrier (Stego wrap, Mirafi 570, etc). The liner should be uv-stabilized to assure long lasting protection. A hundred (100 ft) setback should be maintained upslope from building foundations.

Each infiltration area requires an overland escape path. Having a series of smaller infiltration areas can reduce the risk of failure that is typically associated with a single site solution and has been found to reduce the water quality treatment needed at “end of pipe” locations.

Step 4. Establish Design Criteria for Infiltration BMPs

The evaluation requirements are specific to the infiltration device being proposed. Table 6.4 provides a list of testing requirements for each type of infiltration BMP currently accepted by the County.

- a. Vertical separation distance should be based on highest anticipated seasonal groundwater elevation with consideration of the potential increase in the maximum height of the water table due to the infiltration device. Groundwater mounding calculations by a geotechnical engineer shall be conducted in areas where slope stability is a concern and/or at locations with a high water table.
- b. Specific infiltration rates used in design shall be in accordance with **one** of the following:
 - i. The last field measured percolation rate, as adjusted by standard correction factors, for a 12x12x12 or a 4, 6 or 8-inch bore hole extending five feet below

the bottom of the proposed elevation of the infiltration system and based on an average of two **falling head percolation tests** with a minimum four hour soaking period. (A constant head percolation test can be used for test holes that can't maintain a pre-soak condition).

Testing frequency should be consistent with the testing frequency provided in Table 6.5. The design infiltration rate is the average of the individual test holes of each infiltration facility.

Table F-1: Design Infiltration Rates Test frequency Requirements

INFILTRATION BMP	TEST REQUIRED	MIN. NO. OF TESTS REQUIRED*
Rain Gardens	Pits or borings (5-feet or depth to limiting layer, whichever is less).	N/A
Infiltration Trench (\leq 2000 sf of contributing drainage area)		1 test/100 linear feet of trench with a minimum of 2, and sufficient to determine variability.
Infiltration Trench ($>$ 2000 sf of contributing drainage area)		1 test/50 linear feet of trench with a minimum of 2, and sufficient to determine variability.
Bioretention systems		1 test/1000 linear feet of trench with a minimum of 2, and sufficient to determine variability.
Infiltration Grassed Swales		2 pits required per infiltration area with an additional 1 pit or boring for every 10,000 sf of infiltration area and sufficient to determine variability
Retention Basins	Pits to 10-feet or depth to limiting layer. Borings to 20 feet or depth to limiting layer. Include mounding potential.	
Dry Wells		

**The depth and number of test holes, pits and samples should be increased if, in the judgment of a licensed geotechnical engineer, the conditions are highly variable and such increases are necessary to accurately estimate the performance of the system.*

- ii. One third of the field measured infiltration rate for soils five feet below the bottom of the proposed elevation of the infiltration system based on **double-ring infiltrometer** requirement of ASTM D3385.
- iii. Single family residences may use an adjusted infiltration rate based on a ratio of the initial infiltration rate associated with the samples **soil texture** and a factor of safety of 0.8. The initial design infiltration rate value is based on the soil texture of the least permeable soil below the bottom elevation of the infiltration device (see Table 6.3).

The adjusted infiltration rate used in subsequent design calculations requires the initial infiltration rate be multiplied by 0.8. The 0.8 represents a safety factor to account for potential clogging, bio-buildup and site variability.

Example.

Sand (3.6 initial infiltration rate) x 0.8 (safety factor) = 2.88 (adjusted infiltration rate)

Step 5 and 6. Test material proposed for back fill, verify system performance

Material proposed for back fill may consist of excavated material, imported material or a combination of the two and shall be subject to a textural analysis to verify it conforms to current bioretention media properties.

The last steps are included in this section for continuity and are not associated with determining if a particular site is well suited for infiltration BMPs. Step 5 is intended to verify that the material used as backfill meets the design criteria. This step should be included prior to construction. Areas designated for infiltration BMPs should be protected from construction equipment and from receiving sediment-laden construction site runoff.

Step 6 is intended to verify the system is performing as designed. It is required at the option of the county and is uses the percolation rate procedures identified in step 4.

Soils in catchment ponding areas should not be compacted. Spillways or channels can be used to link and distribute water throughout the site. Grass filter strips are excellent at pre-treating sediment laden runoff.

Shallow depressions must drain within 72 hours. See Chapter 6 for information on determining infiltration rates and tips for increasing infiltration rates.

Hydrograph Analysis

Projects shall strive to infiltrate a specific depth of rainfall from each storm based upon a hydrograph analysis using the annual average rainfall as follows:

Table F-2. Depth of Storm to Be Retained On-Site

AVERAGE ANNUAL RAINFALL	DEPTH OF RAINFALL TO BE TREATED PER ACRE
Less than or equal to 15 inches	0.50-inches
15 and less than or equal to 18 inches	0.75-inches
18 and less than or equal to 25 inches	1.00-inches
Greater than or equal to 25 inches	1.32-inches

A hydrograph analysis allows an evaluation of the relationship between runoff and rainfall over an isolated storm event. There are several commercial software packages available for use in analyzing hydrographs. Regardless of which package is used, the software should be set up as follows:

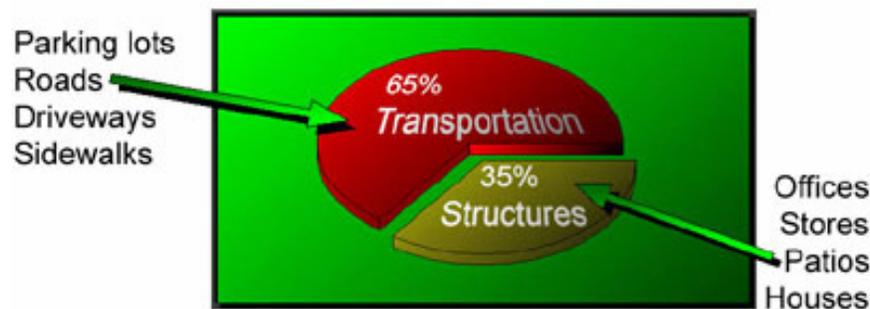
Hydrograph Method: SBUH or custom localized curve, if available*
Time Interval: 1 minute
Storm Distribution/Duration: Type I, 24-hours

Rainfall Depths:	See table above
Antecedent Moisture Condition:	AMC II
Time of Concentration:	Per TR-55 Manual

PART 2 – REDUCING IMPERVIOUS SURFACES

Reducing Impervious Surfaces

Materials that prevent or substantially reduce infiltration of water into the soil are considered impervious surfaces. Examples of common impervious surfaces associated with development include roof tops, roads, parking lots, sidewalks and driveways. Studies have shown that the majority of impervious surfaces are a result of transportation infrastructure.



Source: Nemo, based on City of Olympia ISRS Final Report

Impervious areas significantly contribute to the amount of contaminants typically found during “first flush” stormwater events.

Strategies employed to reduce impervious surfaces include:

1. Concentrating buildings on soils that are inherently less suitable for infiltration, rather than on site soils characterized with a greater infiltration rate.(See 4.2.1)
2. Clustering structures. (See 4.2.3)
3. Minimizing area dedicated to parking lots and driveways. (See Section 4.2.4)
4. Specifying the narrowest road length and width to meet (but not exceed) the needs of the development (pedestrian, cyclists and motorist safety, traffic volumes). (See Section 4.3.1)
5. Utilizing pervious materials able to fulfill the same function of impervious materials. (See Section 4.3.5)

Understanding the difference between the pre- and post-project impervious area can provide insight into the likely hydromodification effects resulting from the project.

Measuring the Imperviousness of a Site

Rational Coefficients are typically used in the Rational Formula to estimate peak runoff rates. The dimensionless Rational Coefficient can be used as a means to compare the relative absorptive nature that exists between various types of materials.

Runoff Coefficients values range between 0.0 and 1.0 where a value of 0.0 indicates that none of the rain falling on the surface will generate runoff. Conversely, a value of 1.0 indicates that all of the rain falling on the watershed will be carried offsite as runoff.

Typically, one value is selected for the site (i.e. single family residential on 1- acre lots). This approach does not encourage the use of pervious materials nor does it encourage development to take place on the most impervious soils of the site. As some soils (i.e. sand) are better able to absorb runoff than other soils (i.e. clays), purposely constructing new impervious surfaces on less impervious soils will maximize the preservation of remaining soils with higher capacity to infiltrate. The relative advantage of building on one soil type over another is negligible on site with fairly homogenous soil types. For large development tracts with contrasting soil types, however, the advantage of conserving the soils that contribute greatest to groundwater recharge could be significant.

A different method of determining pre- and post-development project rational coefficients is necessary to promote conservation of the most pervious areas and development on the areas already prone to produce runoff. This method calculates composite Rational Coefficients based on an analysis of the site in discrete units (driveways, roads, roofs, lawn and natural vegetation area) instead of larger categories.

Additionally, since some materials are able to absorb surface runoff rather than shed it, replacing impervious materials with materials that are able to serve the same function as intended and reduce the amount of runoff leaving the site. Examples of material substitutions commonly used to replace asphalt and concrete surfaces include porous concrete, vegetated pavers, wood decking or gravel.

Table 6.1 provides relative Runoff Coefficients for several materials commonly used in development projects. Where a reasonable range of runoff coefficient values is given, the actual value of runoff coefficient may vary based on the antecedent moisture condition of the soil, the type of soil, and slope of the project. Where vegetation or pervious materials are specified, an evaluation of the corresponding hydrologic soils group (HSG), as defined by the Natural Resources Conservation Service (NRCS), and the pervious material must be made to determine if the underlying soil or the pervious material is the limiting factor.

Table F-3. Rational Coefficient Table

Surface Type	Hydrologic Soil Group				Source
	A	B	C	D	
Pools, ponds, creeks and streams	1.00				3
Portland Concrete Cement, Asphalt Concrete & Roof, Conventional	0.95				1, 2
Brick (grouted)	0.85				3
Pervious Concrete/Asphalt (>6"), for < 6-inches, use runoff coefficient of the subgrade	0.05 or design rainfall intensity(in/hr) – 4.0 (in/hr)				3
Vegetated Pavers with established vegetation	0.25			0.40	5
Unit Pavers, use runoff coefficient of the subgrade if pavers are laid over an aggregate base with more than 15% void content	0.10				
Wood Decking	use subgrade runoff coefficient				
Cobbles				0.6	3
Gravel	0.30	0.45	0.50	0.50	4
Roof, Garden Roof (<4 in)	0.50				2
Roof, Garden Roof (4 – 8 in)	0.30				2
Roof, Garden Roof (8.01 - 20 in)	0.20				2
Roof, Garden Roof (> 20 in)	0.10				2
Lawns (0 < slope < 2 %)	0.05	0.10	0.13	0.17	CERM

Lawns (2 < slope < 7 %)	0.10	0.15	0.18	0.22	CERM
Lawns (slope > 7 %)	0.15	0.20	0.25	0.35	CERM
Unimproved	Use SLO County Standard Plan H-3a "Runoff Coefficients for Undeveloped Areas"				

1 Bay Area Stormwater Management Agencies Association 2 State of Minnesota Sustainable Building Guidelines
3 Menlo Park 4. Iowa Stormwater Management Handbook
CERM Civil Engineering Reference Handbook, Lindberg
5 Smith, D.R., "Evaluations of Concrete Pavements in the United States," in Proceedings of the Second International Conference on Concrete Block Paving, University of Delft, the Netherlands, April 1984, pp. 330-336 and Ferguson, B.K., Porous Pavements, CRC Press Boca Raton, Florida, 2005, p. 126.

Runoff coefficients used in calculations should be taken from Table 6-1. Coefficients that deviate from those above can be used if documented to the satisfaction of the Department of Public Works. A sample calculation for determining weighted Rational Coefficients is provided below.



Source: studio0202.files.wordpress.com

Table F-4. Comparison of Runoff Coefficients for Various Conventional and LID Scenarios Illustrating Revised Rational Coefficient Example Calculations

SCENARIO	RUNOFF COEFFICIENT	SURFACE TYPE DESCRIPTION
Pre-developed	0.31	Using SLO County Standard Plan H-3a with low relief, normal soil infiltration, excellent vegetal cover, normal surface storage.
Traditional	0.40	Residential lots 10,000 sf to 19,999 sf, 2-10%, Sand soil (per SLO County Standard Plan H-3)

Revised (Initial)	0.55	All impervious and paved areas (roof, asphalt, concrete, decking and pool) have a 0.95 rational coefficient, all vegetated areas have a 0.15 rational coefficient for lawns greater than 2% but less than 10% on Hydrologic Soil Group B.
Revised (Improved, run 1)	0.37	Replaced sidewalk with pervious concrete, uses unit pavers for driveway and pool deck area. Wood decking used underlying soil rational coefficient.
Revised (Improved, run 2)	0.27	Same scenario as Improved, run 1 but with the addition of a 4-inch green roof.

The traditional and revised approach (initial) should be comparable with each other, but in the above example, the current approach (single rational coefficient) is less than the revised approach (weighted rational coefficient). The weighted rational coefficient was reduced through the replacement of highly impervious surfaces with more pervious surfaces. All other things being equal, a lower rational coefficient will result in lower peak flows. Note that final revised run (run 2) has a runoff coefficient that is less than the runoff coefficient associated with pre-developed condition. This scenario indicates that the proposed site in run 2 is able to absorb more runoff than the site was historically able to absorb.

If the soils on the site were classified as two (or more) hydrologic soil group types, impermeable surfaces constructed on the less pervious soils would yield a lower Rational Coefficient than if the impermeable surfaces were constructed on the more pervious of the soil types.

PART 3 – MIMIC PRE-DEVELOPMENT FREQUENCY AND DURATION OF EVENTS

Small storms are responsible for most annual urban runoff and groundwater recharge. LID techniques seek to intercept rainfall, reduce the extent of directly connected impervious surfaces, and slow down the rate of runoff. These techniques best mimic the pre-development frequency and duration of small storm events and are preferred.

Section 6.3.2 discussed rainfall interception techniques and is not repeated here. This section includes recommendations to reduce the extent of effective impervious surface area and increase the time of concentration.

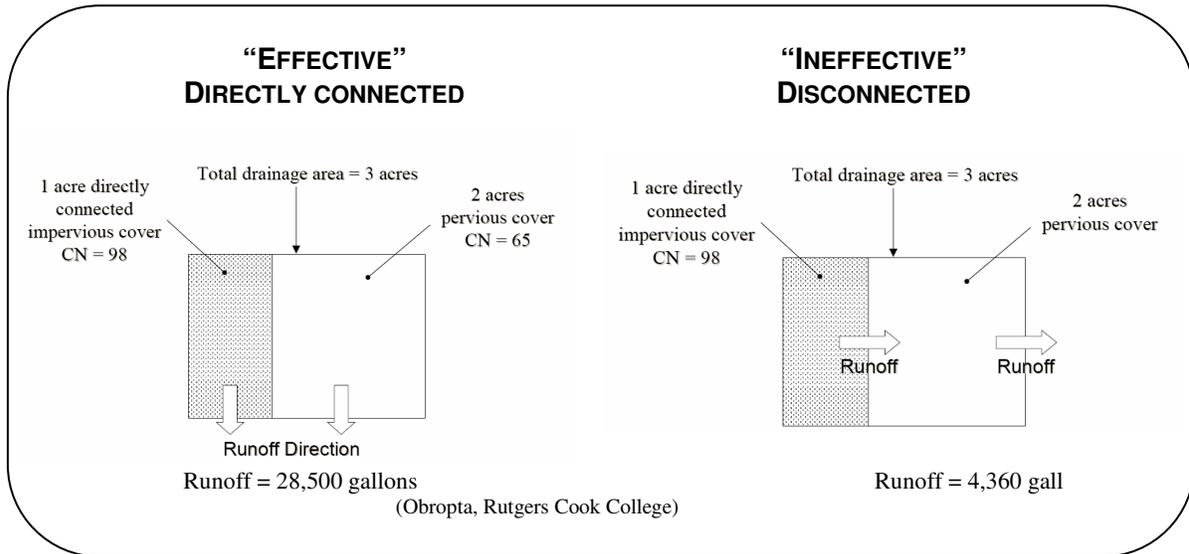
Reduce Directly Connected Impervious Areas (DCIA)

Studies have shown adverse biological impacts to surface waters in watersheds with effective impervious area (EIA) greater than 2-3% (Horner, 2007).

Effective impervious areas are areas such as rooftops, streets, sidewalks, and parking lots that drain directly to a stream or wetland system via pipes or by sheet flow. They are considered “effective” because the effectively drain the landscape.

Impervious areas that drain to landscapes, swales, parks and other impervious areas are considered “ineffective” because the water is allowed to infiltrate through the soil and into

groundwater, without a direct connection to the stream of wetland. As show in the figure below, this decreases the runoff volume and increases the time of concentration.



Reducing effective impervious area means to disconnect impervious surfaces from the drainage system so that runoff does not flow directly to streams. Disconnecting the stormwater system allows the watersheds’ hydrologic cycle to respond in a manner that more closely reflects pre-disturbed conditions (though it does not restore such condition). DCIA reduction can occur as part of new development, redevelopment, or be part of a retrofit design. The level of benefit is determined by how well the practices minimize runoff in small to mid size storm events.

Maintain or Increase the Time of Concentration

Practices that increase the time it takes for runoff to travel across a site include:

- Roughening the travel path surface (vegetation vs pavement or pipes)
- Incorporating check dams and grade changes to allow interim ponding
- Lengthening the flow path
- Converting concentrated flow back into sheet flow
- Disconnecting impervious areas

Maintaining or exceeding the existing time of concentration using the techniques discussed above will reduce peak flows during small storm events.