File No. 100102 Committee Item No. 5
Board Item No. _____

COMMITTEE/BOARD OF SUPERVISORS

AGENDA PACKET CONTENTS LIST

Committee: Land Use and Economic Development **Date** March 29, 2010

Board of Supervisors Meeting **Date** _____

Cmte	Board	
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OTHER **(Use back side if additional space is needed)**

☒	☐	PUC Resolution No. 10-0090
☒	☐	Port Commission Resolution No. 09-75
* ☒	☐	SF Stormwater Design Guidelines
☐	☐	
☐	☐	

Completed by: Alisa Somera **Date** March 25, 2010
Completed by: _____ **Date** _____

An asterisked item represents the cover sheet to a document that exceeds 25 pages.
The complete document can be found in the file and the online version.

[Requiring the Development and Maintenance of Stormwater Management Controls]

Ordinance amending the San Francisco Public Works Code by repealing Article 4.2, sections 140 – 149.4, and adding Article 4.2, sections 147 – 147.6, requiring the development and maintenance of stormwater management controls for specified activities that disturb 5,000 square feet or more of the ground surface, and are subject to building, planning and subdivision approvals.

Note: Additions are *single-underline italics Times New Roman*; deletions are ~~*strikethrough italics Times New Roman*~~. Board amendment additions are double underlined. Board amendment deletions are ~~strikethrough normal~~.

Be it ordained by the People of the City and County of San Francisco:

Section 1. Environmental Findings. The Planning Department has determined that the actions contemplated in this Ordinance are in compliance with the California Environmental Quality Act (California Public Resources Code sections 21000 et seq.). Said determination is on file with the Clerk of the Board of Supervisors in File No. 100102 and is incorporated herein by reference.

Section 2. The San Francisco Public Works Code is hereby amended by repealing Sections 140 – 149.4 of Article 4.2.

Section 3. The San Francisco Public Works Code is hereby amended by adding Sections 147 – 147.6, to Article 4.2, to read as follows:

Article 4.2. SEWER SYSTEM MANAGEMENT.

Section 147. Stormwater Management

(a) The intent of Sections 147 – 147.6 is to protect and enhance the water quality in the City and County of San Francisco's sewer system, stormwater collection system and receiving

waters pursuant to, and consistent with Federal and State laws, lawful standards and orders applicable to stormwater and urban runoff control, and the City's authority to manage and operate its drainage systems.

(b) Urban runoff is a significant cause of pollution throughout California. Pollutants of concern found in urban runoff include sediments, non-sediment solids, nutrients, pathogens, oxygen-demanding substances, petroleum hydrocarbons, heavy metals, floatables, polycyclic aromatic hydrocarbons (PAHs), trash, and pesticides and herbicides.

(c) During urban development, two important changes occur. First, where no urban development has previously occurred, natural vegetated pervious ground cover is converted to impervious surfaces such as paved highways, streets, rooftops, and parking lots. Natural vegetated soil can both absorb rainwater and remove pollutants, providing a very effective purification process. Because pavement and concrete can neither absorb water nor remove pollutants, the natural purification characteristics of the land are lost. Second, urban development creates new pollutant sources, including vehicle emissions, vehicle maintenance wastes, pesticides, household hazardous wastes, pet wastes, trash, and other contaminants that can be washed into the City's stormwater collection systems.

(d) A high percentage of impervious area correlates to a higher rate of stormwater runoff, which generates greater pollutant loadings to the stormwater collection system, resulting in turbid water, nutrient enrichment, bacterial contamination, toxic compounds, temperature increases, and increases of trash or debris.

(e) When water quality impacts are considered during the planning stages of a project, new development and redevelopment projects can more efficiently incorporate measures to protect water quality.

(f) Sections 147 – 147.6 protect the health, safety and general welfare of the City's residents by:

(1) minimizing increases in pollution caused by stormwater runoff from development that would otherwise degrade local water quality;

(3) controlling the discharge to the City's sewer and drainage systems from spills, dumping or disposal of pollutants; and

(4) reducing stormwater run-off rates, volume, and nonpoint source pollution whenever possible, through stormwater management controls, and ensuring that these management controls are safe and properly maintained.

Section 147.1. Definitions.

In addition to the definitions provided in section 119 of Article 4.1 of this Code, the following definitions shall apply:

(a) Best management practices or "BMPs." Structural devices, measures, or programs used to reduce pollution in stormwater runoff. BMPs manage the quantity and improve the quality of stormwater runoff in accordance with the Guidelines and applicable state and federal regulatory requirements.

(b) Department. The San Francisco Public Utilities Commission. With regard to stormwater management in areas of the City under the jurisdiction of the Port Commission, "Department" means the San Francisco Port Commission until the Port Commission adopts its own standards and procedures.

(c) Development Project. Any activity disturbing 5,000 square feet or more of the ground surface, measured cumulatively from the effective date of this Article. Activities that disturb the ground surface include, but are not limited to, the construction, modification, conversion, or alteration of any building or structure and associated grading, filling,

excavation, change in the existing topography, and the addition or replacement of impervious surface. All sidewalks, parking, driveways, and landscaped and irrigated areas constructed in conjunction with the Development Project are included in the project area. Development Projects do not include interior remodeling projects, maintenance activities such as top-layer grinding, repaving, and re-roofing, or modifications, conversions or alterations of buildings or structures that does not increase the ground surface footprint of the building or structure.

(d) Development runoff requirements. The performance standards set forth in the Guidelines to address both the construction and post-construction phase impacts of new Development Projects on stormwater quality.

(e) General Manager. The General Manager of the Public Utilities Commission of the City, or a designated representative of the General Manager. With regard to stormwater management in areas of the City under the jurisdiction of the Port Commission, the Executive Director of the San Francisco Port Commission or a designated representative of the Executive Director shall have the same authority under this Article as the General Manager until the Port Commission adopts it own standards and procedures regarding stormwater management in all areas under Port Commission jurisdiction.

(f) Guidelines. The Stormwater Design Guidelines adopted by the San Francisco Public Utilities Commission or the San Francisco Port Commission. The Guidelines contain requirements pertaining to the type, design, sizing, and maintenance of post-construction stormwater BMPs.

(g) Low Impact Design (LID). A stormwater management approach that promotes the use of ecological and landscape-based systems that mimic pre-development drainage patterns and hydrologic processes by increasing retention, detention, infiltration, and treatment of stormwater at its source.

(h) Non-Stormwater Discharge. Any discharge to the City's Stormwater Collection System that is not composed entirely of Stormwater.

(i) Pollutant. Any substance listed in sec. 119(aa) of Article 4.1 of the Public Works Code or any substance described as a pollutant in the Guidelines.

(j) Separate Stormwater/sewer System. Stormwater and sanitary sewage collection facilities that convey, treat and discharge stormwater and sewage in separated catchbasins, pipelines, treatment facilities, outfalls, and other facilities, and do not combine stormwater and sewage in the same facilities.

(k) Stormwater. Water that originates from atmospheric moisture (rainfall or snowfall) and that falls onto land, water or other surfaces.

(l) Stormwater Collection System. All City facilities operated by the San Francisco Public Utilities Commission or the Port of San Francisco for collecting, transporting, treating and disposing of stormwater. For purposes of this Article, the Stormwater Collection System includes facilities owned and operated by public entities other than the City, where such facilities direct stormwater into the Stormwater Collection System and are subject to the jurisdiction of the San Francisco Public Utilities Commission or the Port of San Francisco as defined by law, contract, or interjurisdictional agreement.

(m) Stormwater Control. A device designed to remove pollution in stormwater runoff through detention, retention, filtration, direct plant uptake, or infiltration.

(n) Stormwater Control Plan. A plan that meets all applicable criteria, performance standards and other requirements contained in this Article and the Guidelines.

Section 147.2. Stormwater Control Plan

(a) Development Projects. Every application for a Development Project , including, but not limited to, a building or encroachment permit conditional use permit, variance, site permit,

or design review, shall be accompanied by a Stormwater Control Plan that meets the stormwater control criteria provided by the Guidelines. No City department shall approve or issue a conditional use permit, variance, site permit, design review approval, building or encroachment permit unless and until a Stormwater Control Plan developed in accordance with this Article and the Guidelines has been approved by the General Manager. All projects subject to the stormwater management requirements of Chapter 13C of the San Francisco Building Code shall comply with the requirements of the Guidelines.

(b) Subdivision Approvals.

(1) Parcel Map or Tentative Subdivision Map Conditions. The Director of Public Works shall not approve a tentative subdivision map or a parcel map for any property unless a condition is imposed requiring compliance with all applicable Stormwater Control Plans to serve the potential uses of the property covered by the parcel map or tentative subdivision map, as may be further specified in the provisions of this Article or the Guidelines.

(2) Subdivision Regulations. The Director of Public Works shall adopt regulations as necessary, consistent with and in furtherance of this Article, to ensure that all subdividers of property subject to the provisions of this ordinance provide a Stormwater Control Plan in compliance with this Article and the Guidelines.

(3) Final Maps. The Director of Public Works shall not endorse and file a final map for property within the boundaries of the City and County of San Francisco without first determining whether:

(A) The subdivider has complied with the conditions imposed on the tentative subdivision map or parcel map, pursuant to this Article and the Guidelines; and

(B) For any such conditions not fully satisfied prior to the recordation of the final map, the subdivider has signed a certificate of agreement and/or improvement agreement, to ensure compliance with such conditions.

(4) This Subsection (b) shall not apply to tentative subdivision maps or parcel maps submitted solely for the purposes of condominium conversion, as defined in San Francisco Subdivision Code Section 1308(d).

Sec. 147.3. Limitations and Prohibited Discharges.

(a) The establishment, use, maintenance or continuation of any unauthorized drainage connections to the Stormwater Collection System is prohibited.

(b) The discharge of Pollutants and Non-stormwater Discharges into the stormwater collection facilities located in the Separate Stormwater/sewer System portions of the Stormwater Collection System is prohibited, except as provided in this section.

(c) The following discharges are exempt from the prohibitions set forth subsection (b) above if the Regional Water Quality Control Board approves the exempted category under section C. 11. of the City's NPDES permit: uncontaminated pumped groundwater, foundation drains, water from crawl space pumps, footing drains, air conditioning condensate, irrigation water, landscape irrigation, lawn or garden watering, planned and unplanned discharges from potable water sources, water line and hydrant flushing, individual residential car washing, discharges or flows from emergency fire fighting activities, dechlorinated swimming pool discharges.

Section 147.4. Compliance with Maintenance and Inspection Requirements.

(a) All Stormwater Controls shall be maintained according to the Guidelines and the operation and maintenance plan included in the approved Stormwater Control Plan. The person(s) or organization(s) responsible for maintenance shall be designated in the plan.

Those persons responsible for maintenance shall inspect the Stormwater Controls at least annually and shall maintain the Stormwater Controls as required by the Guidelines and described in the Stormwater Control Plan.

(b) Operation and Maintenance Inspection and Certificates. Every person who owns, leases or operates any Stormwater Control or Controls must provide annual self-certification for inspection and maintenance, as set forth in the Guidelines.

(c) The General Manager may perform routine or scheduled inspections, as may be deemed necessary in the General Manager's sole discretion to carry out the intent of this Article and the Guidelines, including, but not limited to, random sampling or sampling in areas with evidence of Stormwater contamination, evidence of the discharge of Non-stormwater to the Stormwater Collection System, or similar activities.

(d) Authority to Sample and Establish Sampling Devices. The General Manager may require any person discharging Stormwater to the Stormwater Collection System to provide devices or locations necessary to conduct sampling or metering operations.

(e) Notification of Spills. All persons in charge of the Stormwater Controls shall provide immediate notification to the General Manager of any suspected, confirmed or unconfirmed release of pollutants creating a risk of non-stormwater discharge into the Stormwater Collection System. Such persons shall take all necessary steps to ensure the detection and containment and clean up of such release. This notification requirement is in addition to and not in lieu of other required notifications.

(f) Requirement to Test or Monitor. The General Manager may require that any person responsible for Stormwater Controls undertake such monitoring activities or analysis and furnish such reports as the General Manager may specify.

Section 147.5 Enforcement and Cost Reimbursement.

Any violation of this Article may be enforced by the General Manager pursuant to section 132 of Article 4.1 of the Public Works Code. Persons violating any provision of this Article, the Guidelines, or department regulations may be subject to penalties and abatement in accordance with the Guidelines and sections 133 and 134 of Article 4.1 of the Public Works Code.

Section 147.6 Severability

If any section, subsection, subdivision, paragraph, sentence, clause, or phrase of this Article, is for any reason held to be unconstitutional, invalid or ineffective by any court of competent jurisdiction, such decision shall not affect the validity or effectiveness of the remaining portions of this Article. The Board of Supervisors declares that it would have passed each section, subsection, subdivision, paragraph, sentence, clause, or phrase of this Article irrespective of the fact that any one or more sections, subsections, subdivisions, paragraphs, sentences, clauses, or phrases could be declared unconstitutional, invalid or ineffective.

APPROVED AS TO FORM:
DENNIS J. HERRERA, City Attorney

By: _____
JOHN RODDY
Deputy City Attorney

FILE NO. 100102

[Requiring the Development and Maintenance of Stormwater Management Controls]

LEGISLATIVE DIGEST

Ordinance amending the San Francisco Public Works Code by repealing Article 4.2, sections 140 – 149.4, and adding Article 4.2, sections 147 – 147.6, requiring the development and maintenance of stormwater management controls for specified activities that disturb 5,000 square feet or more of the ground surface, and are subject to building, planning and subdivision approvals.

Existing Law

The ordinance adopts new provisions. San Francisco codes currently do not require installation and maintenance of stormwater controls for new development and redevelopment projects in San Francisco. Existing provisions of the Public Works Code contain obsolete provisions regarding sewer service charges that have been superseded by Charter provisions.

Amendments to Current Law

The proposed ordinance will ensure San Francisco's compliance with the Federal Clean Water Act and Statewide General Permit by codifying requirements of the San Francisco Stormwater Design Guidelines, a policy document developed to comply with Federal Clean Water Act requirements and a State of California National Pollutant Discharge Elimination Permit ("Statewide General Permit").

The ordinance includes the following provisions:

1) A regulatory framework to ensure that project proponents subject to the stormwater management activities comply with required stormwater controls;

2) Definition of the development projects that are required to comply with stormwater management controls;

3) Requirements relating to the submittal of a Stormwater Control Plan for projects that must comply with the stormwater management controls;

4) Prohibited discharges to the SFPUC and Port stormwater collection systems;

5) Maintenance and inspection requirements for completed projects; and

6) Enforcement and cost reimbursement provisions for those projects that violate stormwater management controls.

The current sections 140 – 149.4 of the Public Works Code are obsolete provisions relating to the authority to levy sewer service charges. These provisions have been superseded by the Charter amendments adopted in November, 2002, that added Article 8B to the Charter. Section 8B.125 of the Charter now provides the authority and process for the adoption of sewer service charges.

Background Information

Like most California municipal agencies, the Port of San Francisco ("Port") and the San Francisco Public Utilities Commission ("SFPUC") administer Stormwater Management Programs developed in accordance with the Federal Clean Water Act and a State of California National Pollution Discharge Elimination Permit ("Statewide General Permit"). Among the specific obligations set forth in this NPDES Permit, the Port and SFPUC are required to develop, implement and enforce a program to reduce pollutants in storm water runoff from new development and redevelopment projects. This effort is commonly referred to as a *post-construction stormwater control program*[1].

The Statewide General Permit includes provisions requiring permittees to demonstrate oversight for post-construction stormwater control programs. To meet this requirement, SFPUC and Port staffs have developed a stormwater management ordinance and departmental regulations. The proposed ordinance:

- Establishes thresholds for compliance with the departmental regulations;
- Requires project applicants to adhere to all requirements in the ordinance and regulations and to submit a Stormwater Control Plan for review;
- Lists prohibited discharges to the SFPUC and Port stormwater collection systems,
- Establishes ongoing maintenance and inspection requirements for completed projects, and

[1] California State Water Resources Control Board General Permit for Stormwater Discharges from Small Municipal Storm Sewer Systems, Water Quality Order 2003-0005-DWQ: *"The Permittee must use an ordinance or other regulatory mechanism to address post-construction runoff from new development and redevelopment projects to the extent allowable under State or local law".*

- Establishes an administrative framework for enforcement and cost reimbursement.

The SFPUC and the Port have partnered to develop the San Francisco Stormwater Design Guidelines ("Guidelines"), departmental regulations that fulfill state and federal requirements for post-construction stormwater runoff control. In keeping with Mayor Gavin Newsom's policy goals for promoting sustainable development in San Francisco, the Guidelines require Low Impact Design ("LID") approaches for the stormwater management. LID strategies integrate green space, native landscaping, natural hydrologic functions and various other techniques to reduce pollution in runoff from developed land. The stormwater management ordinance will function as the regulatory mechanism through which the Guidelines regulations are implemented.

Projects complying with the ordinance will protect the water quality of the San Francisco Bay and the Pacific Ocean, help to restore hydrologic function and wildlife habitat to San Francisco's urban watersheds, reduce the burden on the city's combined sewer system, and contribute to the creation of a green city.

BOARD of SUPERVISORS

City Hall
Dr. Carlton B. Goodlett Place, Room 244
San Francisco 94102-4689
Tel. No. 554-5184
Fax No. 554-5163
TDD/TTY No. 554-5227

February 1, 2010

File No. 100102

Bill Wycko
Environmental Review Officer
Planning Department
1650 Mission Street, 4th Floor
San Francisco, CA 94103

Dear Mr. Wycko:

On January 26, 2010, Mayor Newsom introduced the following proposed legislation:

File: 100102

Ordinance amending the San Francisco Public Works Code by repealing Article 4.2, sections 140 – 149.4, and adding Article 4.2, sections 147 – 147.6, requiring the development and maintenance of storm water management controls for specified activities that disturb 5,000 square feet or more of the ground surface, and are subject to building, planning and subdivision approvals.

The legislation is being transmitted to you for environmental review, pursuant to Planning Code Section 306.7(c).

Angela Calvillo, Clerk of the Board

Alisa Somera

By: Alisa Somera, Committee Clerk
Land Use & Economic Development Committee

Attachment

cc: Nannie Turrell, Major Environmental Analysis
Brett Bollinger, Major Environmental Analysis

Exempt from CEQA Guidelines per Sections 15060(c)(3) and 15378. Not a project.
Nannie L. Turrell
February 26, 2010

Office of the Mayor
City & County of San Francisco

Gavin Newsom

December 7, 2009

San Francisco Public Utilities Commission
1155 Market Street
San Francisco, CA 94103

San Francisco Port Commission
Pier 1
San Francisco, CA 94111

RE: The San Francisco Stormwater Design Guidelines

Dear Commisioners:

I am very pleased to support approval of the San *Francisco Stormwater Design Guidelines* and promulgation of the San Francisco Stormwater Ordinance. This is a major milestone towards my vision for sustainable development in San Francisco and an important element for the implementation of other environmental and planning policy initiatives, including the Better Streets Plan and the San Francisco Green Building Ordinance.

The *Guidelines* provide innovative and multi-purpose solutions for managing stormwater in San Francisco's urban setting. In addition to protecting water quality, the Guidelines will contribute to attractive civic spaces, open spaces and streetscapes, and will protect and enhance wildlife habitat.

I applaud the Port and the SFPUC's ongoing commitment to stormwater management and urge your support of this important policy effort.

Sincerely,

Gavin Newsom
Mayor

1 Dr. Carlton B. Goodlett Place, Room 200, San Francisco, California 94102-4641
gavin.newsom@sfgov.org • (415) 554-6141

PUBLIC UTILITIES COMMISSION

City and County of San Francisco

RESOLUTION NO. **10-0008**

WHEREAS, urban stormwater runoff is a significant contributor of pollution to the San Francisco Bay and Pacific Ocean; and

WHEREAS, the Federal Clean Water Act and a State of California National Pollution Discharge Elimination System (NPDES) Permit require the City and County of San Francisco to administer a Stormwater Management Program to reduce pollution in stormwater runoff in San Francisco's municipal separate storm sewer systems; and

WHEREAS, developing and administering a Stormwater Management Program to reduce the volume and rate of stormwater runoff delivered to the combined sewer areas of San Francisco will enhance compliance with NPDES permits issued by the State of California and USEPA for combined sewer discharges; and

WHEREAS, the San Francisco Public Utilities Commission (SFPUC) Wastewater Enterprise and the Port of San Francisco (Port) have been charged with developing and implementing a stormwater management program that fulfills state and federal requirements for regulation of post-construction stormwater runoff control and provides the means to enforce the requirements of the program; and

WHEREAS, Port and SFPUC staff have developed the San Francisco Stormwater Design Guidelines (Guidelines), which define regulatory thresholds and requirements for development projects and offer San Francisco-specific approaches for stormwater management, including Low Impact Design (LID) solutions; and

WHEREAS, the SFPUC and the Port conducted an extensive community planning and public outreach effort in support of Guidelines development and incorporated input from community and technical stakeholders into the final Guidelines document; and

WHEREAS, the Guidelines require the use of LID wherever feasible and are therefore consistent with Mayor Gavin Newsom's policy and San Francisco Public Utilities Commission policy goals to promote greening and sustainable development in San Francisco; and

WHEREAS, the Guidelines are designed to work within the context of existing San Francisco regulations and policies, and are consistent with the City's Building Code and Planning Code requirements;

WHEREAS, the proposed Stormwater Ordinance establishes an administrative framework to ensure compliance with requirements established in the Guidelines; and

WHEREAS, the Commission is authorized to adopt regulations for matters under its jurisdiction, in accordance with Charter sections 4.104(a)(1) and 8B.121(a); and

WHEREAS, as required by San Francisco Charter Section 4.104(a)(1), on November 25, 2009, the SFPUC provided public notice of the SFPUC public hearing on the proposed Guidelines; and

WHEREAS, on December 2, 2009 the Planning Department determined that the actions contemplated in this resolution were exempt from the California Environmental Quality Act ("CEQA") as a Class 8 categorical exemption under CEQA Guidelines Section 15308 as described in the determination contained in the SFPUC files for this matter, now, therefore, be it

RESOLVED, That the Commission, pursuant to its Charter authority to adopt rules and regulations, hereby adopts the San Francisco Stormwater Design Guidelines; and be it

FURTHER RESOLVED, That the Commission authorizes and directs the General Manager of the SFPUC to submit the Stormwater Management Ordinance to the San Francisco Board of Supervisors for consideration and adoption, as an amendment of the San Francisco Public Works Code.

I hereby certify that the foregoing resolution was adopted by the Public Utilities Commission at its meeting of January 12, 2010

Michael Hoerth

Secretary, Public Utilities Commission

AGENDA ITEM
Public Utilities Commission
City and County of San Francisco

DEPARTMENT Wastewater Enterprise AGENDA NO. **#18**

MEETING DATE January 12, 2010

Adopt Guidelines: Regular Calendar
Project Manager: Sarah Minick

Adopt the San Francisco Stormwater Design Guidelines and Recommend the Stormwater Management Ordinance to the Board to Supervisors

Summary of Proposed Commission Action:	**Adopt** the San Francisco Stormwater Design Guidelines and **recommend** the San Francisco Stormwater Management Ordinance to the Board of Supervisors for approval.
Background:	Stormwater management is a critical municipal responsibility required by the Federal Clean Water Act that has a direct impact on public health and safety, surface water quality, and watershed function. The San Francisco Public Utilities Commission (SFPUC) and the Port of San Francisco (Port) administer Stormwater Management Programs developed in accordance with the State of California National Pollution Discharge Elimination System (NPDES) Statewide General Permit for Stormwater Discharges (Permit) in their respective areas of jurisdiction. The SFPUC Wastewater Enterprise (WWE) is responsible for maintaining compliance with the SFPUC's Permit, which covers non-Port municipal separate storm sewer systems. The Port is responsible for maintaining compliance under its own Permit, which covers Port-owned properties. Because the requirements are the same for both agencies, SFPUC and Port staffs are working collaboratively to achieve Permit compliance. The Permit specifies a suite of activities that municipalities must undertake to achieve compliance. One of these is the development, implementation, and enforcement of a program to reduce pollutants in stormwater runoff from new development and redevelopment projects. This effort is commonly referred to as a post-construction stormwater control program. San Francisco's strategy for implementing post-construction stormwater controls is to pursue Low Impact Design (LID), also known as green infrastructure. LID applies decentralized, site-based

APPROVAL:

DEPARTMENT / BUREAU		FINANCE	Todd L. Rydstrom
COMMISSION SECRETARY	Mike Housh	GENERAL MANAGER	Ed Harrington

strategies to manage the quantity and quality of stormwater runoff. LID Strategies include rain gardens, vegetated roofs, permeable pavement, swales, treatment wetlands, and rainwater harvesting. These strategies can be integrated into all development types, from public open spaces to high-density housing.

The program must be paired with an administrative framework to allow the SFPUC and the Port to monitor and enforce the program requirements. Staff proposes to achieve this via an ordinance and is therefore presenting two items to the Commission as a package:

- the San Francisco Stormwater Design Guidelines (Guidelines), which describe the new requirements to developers and provide the tools to help them achieve compliance; and
- the San Francisco Stormwater Management Ordinance (Stormwater Ordinance), which provides the administrative framework to enforce compliance.

Although the Permit only applies to separate storm sewer areas, implementing the Stormwater Ordinance and Guidelines city-wide will yield multiple benefits to the collection system and will compliment the city-wide stormwater requirements already in place under the Green Building Ordinance (effective since November, 2008). With this in mind, staff proposes that the Guidelines and Stormwater Ordinance be effective city-wide, covering both combined and separate sewer areas.

Approximately 90% of San Francisco is served by a **combined sewer**. In combined sewer areas, stormwater runoff contributes to localized flooding and combined sewer discharges and can reduce the efficiency and efficacy of the treatment system. In these areas, reducing the rate and volume of stormwater discharged to the sewer during large rain events provides the following benefits: it reduces the burden of wet weather flows on the city's combined sewer, allows existing infrastructure to perform more efficiently, increases upstream storage capacity, decreases the amount of energy and chemicals used to pump and treat stormwater, enhances compliance with NPDES additional Permits associated with combined sewer areas, and creates a more resilient infrastructure in the face of climate change.

San Francisco's **separate storm sewer areas** make up approximately 10% of the city. This includes Port lands, areas already under SFPUC jurisdiction (such as Lake Merced), and areas that will soon be under City jurisdiction, such as Mission Bay, Hunters Point Shipyard/Candlestick and Treasure Island. In separate storm sewer areas, stormwater flows directly to receiving waters without treatment and transports pollutants to receiving waters such as San Francisco Bay. Because of this, in separate sewer areas the goal of stormwater management is water quality protection, achieved by capturing and treating runoff before it reaches receiving waters.

To achieve the stormwater management goals of flow and volume reduction in combined areas and capture and treatment in the separate areas, the Guidelines require on-site stormwater management for all new and redevelopment projects of 5,000 square feet or more. Every gallon of stormwater managed on-site represents essential benefits to the SFPUC:

1) The addition of distributed, upstream storage that increases the capacity of the entire combined sewer system; and
2) The protection of downstream receiving waters, as required under the Federal Clean Water Act.

The San Francisco Stormwater Design Guidelines

In February 2007, SFPUC and Port staff initiated a joint effort to develop a regulatory document that fulfills state and federal requirements for post-construction stormwater runoff control. The Guidelines represent the culmination of this effort, which included extensive public outreach and opportunity for public comment (see Attachment 5 for a complete list of public outreach efforts).

In keeping with the Charter's policy goals for promoting sustainable development, the Guidelines require the use of LID wherever feasible to comply with stormwater management requirements. The Guidelines are designed to work within the context of existing San Francisco regulations and policies, including the Green Building Ordinance, the Better Streets Plan, the Sewer System Master Plan, and the Green Landscaping Ordinance, and are consistent with existing Building Code and Planning Code requirements for the City and the Port. The full text of the Guidelines is provided as Attachment 2.

Thresholds for Compliance

Projects that disturb 5,000 square feet or more of ground surface will be required to comply with the Guidelines. Activities that disturb the ground surface include, but are not limited to, the construction, modification, conversion, or alteration of any building or structure and associated grading, filling, excavation, change in the existing topography, and the addition or replacement of impervious surface. See the Stormwater Ordinance for definitions (Attachment 3).

Performance Measures

Projects located in separate storm sewer areas that are subject to the Guidelines are required to capture and treat 90% of the average annual rainfall using acceptable best management practices and using a design storm of .75 inches. This performance measure is equivalent to LEED Sustainable Sites Credit 6.2 titled "Stormwater Design: Quality Control."

Projects located in combined sewer areas that are subject to the Guidelines are required to reduce the rate and quantity of stormwater entering the combined sewer by implementing one of two options under LEED Credit Sustainable Sites 6.1 titled "Stormwater Design: Quantity

Control."

Methods of Compliance
Project applicants have a broad suite of design solutions that will enable them to achieve compliance with stormwater management requirements. Examples include rainwater harvesting, rain gardens, green roofs, and permeable paving. The Guidelines offer five tools to help project applicants achieve compliance:

- A step-by-step guide describing how to manage stormwater on site;
- A set of stormwater Best Management Practices (BMP) Fact Sheets;
- A vegetation palette to assist in BMP-appropriate plant selection;
- Sizing calculators to determine the required size of each BMP; and
- Maintenance checklists explaining the types and frequencies of the maintenance activities associated with each BMP.

Project Review Processes
SFPUC staff has established new procedures for project review to ensure compliance with the Guidelines. These processes have been coordinated with the Department of Building Inspection, the Planning Department, and WWE's Collection Systems Division.

Inspection and Enforcement
Property owners are responsible for the maintenance of stormwater BMPs on their property. Under the Permit, the SFPUC is responsible for ensuring that owners properly maintain BMP(s). In addition, property owners will be required to self-certify their stormwater BMPs by submitting annual maintenance checklists. Every three years, SFPUC inspectors will inspect the BMPs to ensure that they remain functional. Inspection procedures are detailed in the Guidelines.

San Francisco Stormwater Ordinance
To ensure that the Guidelines are successfully implemented, the Permit includes provisions requiring permittees to demonstrate oversight for post-construction stormwater control programs. To meet this requirement, SFPUC and Port staffs have drafted a Stormwater Ordinance which would reside in the San Francisco Public Works Code. The proposed Stormwater Ordinance achieves the following:

- Establishes thresholds for compliance with the Guidelines;
- Requires project applicants to adhere to all requirements in the Guidelines and submit a Stormwater Control Plan for review;
- Lists prohibited discharges to the SFPUC and Port stormwater collection systems,
- Establishes ongoing maintenance and inspection requirements for completed projects; and
- Establishes an administrative framework for enforcement and cost reimbursement.

The Stormwater Ordinance and the Stormwater Control Plan are provided as Attachments 3 and 4, respectively.

	Environmental Review A Class 8 Categorical Exemption was issued for the Guidelines by the Major Environmental Analysis Division of the San Francisco Planning Department on December 2, 2009.
Result of Inaction:	A delay in approving this agenda item will: o Render the SFPUC and Port in violation of the Statewide General Stormwater Permit administered by the Regional Water Quality Control Board. o Prevent the dissemination of technical and regulatory guidance to applicants seeking to comply with proposed and already existing stormwater management requirements for approval of new development and redevelopment projects.
Description of Action:	**Adopt** the San Francisco Stormwater Design Guidelines and **recommend** the San Francisco Stormwater Management Ordinance to the Board of Supervisors and Mayor Gavin Newsom for approval. If the Guidelines are adopted and the Stormwater Ordinance is approved, the requirements set forth in the Guidelines will be effective city-wide.
Recommendation:	SFPUC staff recommends that the Commission adopt the attached resolution.
Attachment(s):	1. SFPUC Resolution 2. San Francisco Stormwater Design Guidelines 3. Stormwater Ordinance 4. Stormwater Control Plan 5. Public Outreach 6. State Water Resources Control Board Order Number 2003-0005-DWQ, Attachment 4

PUBLIC UTILITIES COMMISSION

City and County of San Francisco

RESOLUTION NO. _____

WHEREAS, urban stormwater runoff is a significant contributor of pollution to the San Francisco Bay and Pacific Ocean; and

WHEREAS, the Federal Clean Water Act and a State of California National Pollution Discharge Elimination System (NPDES) Permit require the City and County of San Francisco to administer a Stormwater Management Program to reduce pollution in stormwater runoff in San Francisco's municipal separate storm sewer systems; and

WHEREAS, developing and administering a Stormwater Management Program to reduce the volume and rate of stormwater runoff delivered to the combined sewer areas of San Francisco will enhance compliance with NPDES permits issued by the State of California and USEPA for combined sewer discharges; and

WHEREAS, the San Francisco Public Utilities Commission (SFPUC) Wastewater Enterprise and the Port of San Francisco (Port) have been charged with developing and implementing a stormwater management program that fulfills state and federal requirements for regulation of post-construction stormwater runoff control and provides the means to enforce the requirements of the program; and

WHEREAS, Port and SFPUC staff have developed the San Francisco Stormwater Design Guidelines (Guidelines), which define regulatory thresholds and requirements for development projects and offer San Francisco-specific approaches for stormwater management, including Low Impact Design (LID) solutions; and

WHEREAS, the SFPUC and the Port conducted an extensive community planning and public outreach effort in support of Guidelines development and incorporated input from community and technical stakeholders into the final Guidelines document; and

WHEREAS, the Guidelines require the use of LID wherever feasible and are therefore consistent with Mayor Gavin Newsom's policy goals to promote greening and sustainable development in San Francisco; and

WHEREAS, the Guidelines are designed to work within the context of existing San Francisco regulations and policies, and are consistent with the City's Building Code and Planning Code requirements;

WHEREAS, the proposed Stormwater Ordinance establishes an administrative framework to ensure compliance with requirements established in the Guidelines; and

WHEREAS, the Commission is authorized to adopt regulations for matters under its jurisdiction, in accordance with Charter sections 4.104(a)(1) and 8B.121(a); and

WHEREAS, as required by San Francisco Charter Section 4.104(a)(1), on November 25, 2009, the SFPUC provided public notice of the SFPUC public hearing on the proposed Guidelines; and

WHEREAS, on December 2, 2009 the Planning Department determined that the actions contemplated in this resolution were exempt from the California Environmental Quality Act ("CEQA") as a Class 8 categorical exemption under CEQA Guidelines Section 15308 as described in the determination contained in the SFPUC files for this matter, now, therefore, be it

RESOLVED, That the Commission, pursuant to its Charter authority to adopt rules and regulations, hereby adopts the San Francisco Stormwater Design Guidelines; and be it

FURTHER RESOLVED, That the Commission authorizes and directs the General Manager of the SFPUC to submit the Stormwater Management Ordinance to the San Francisco Board of Supervisors for consideration and adoption, as an amendment of the San Francisco Public Works Code.

I hereby certify that the foregoing resolution was adopted by the Public Utilities Commission at its meeting of January 12, 2010

Secretary, Public Utilities Commission

PORT OF SAN FRANCISCO

MEMORANDUM

December 2, 2009

TO: MEMBERS, PORT COMMISSION
Hon. Rodney Fong, President
Hon. Stephanie Shakofsky, Vice President
Hon. Kimberly Brandon
Hon. Michael Hardeman
Hon. Ann Lazarus

FROM: Monique Moyer
Executive Director

SUBJECT: Adoption of San Francisco Stormwater Design Guidelines and Recommendation of Stormwater Ordinance to the Board of Supervisors

DIRECTOR'S RECOMMENDATION: Approve Attached Resolution

INTRODUCTION

Stormwater management is a critical municipal responsibility which has a direct impact on public health and safety, surface water quality, and wildlife habitat. Like many California municipal agencies, the Port of San Francisco administers a Stormwater Management Program developed in accordance with the Federal Clean Water Act and a State of California National Pollution Discharge Elimination Permit ("Statewide General Permit"). Among the specific obligations set forth in this NPDES Permit, the Port is required to develop, implement and enforce a program to reduce pollutants in storm water runoff from new development and redevelopment projects. This effort is commonly referred to as a *post-construction stormwater control program.*

In February 2007 Port staff introduced a community planning effort to the Port Commission wherein the Port would partner with the San Francisco Public Utilities Commission (SFPUC) to develop a regulatory guidance document that fulfills state and federal requirements for post-construction stormwater runoff control. This document, the *Stormwater Design Guidelines ("Guidelines")*, integrates and provides synergy with other current planning efforts in San Francisco, including the Better Streets Plan, Sewer System Master Plan, and the Urban Forest Master Plan. It is designed to fulfill regulatory policy mandates of the federal Clean Water Act while at the same time functioning within the context of existing regulations and policies administered in San

This Print Covers Calendar Item No. 11A

Francisco. After extensive public outreach and comment, Port and SFPUC staffs have completed a final draft of the *Guidelines* and a Stormwater Ordinance that establishes an administrative framework to ensure compliance with requirements set forth in the *Guidelines*. Port staff requests that the Port Commission adopt the *Guidelines* and urge that the San Francisco Board of Supervisors and Mayor Gavin Newsom for approve the Stormwater Ordinance.

BACKGROUND

The *Guidelines* are driven by state and federal clean water regulatory requirements that apply to the City's separate storm sewer areas, which include the Port, Hunters Point Shipyard, Mission Bay, Treasure Island and various parcels that discharge to inland receiving waters (e.g., Lake Merced). Stormwater runoff in these areas accumulates pollutants such as petroleum, metals and sediment as it flows to waterways. The *Guidelines* establish an engineering, planning and regulatory framework for designing new infrastructure in a manner that reduces or eliminates these pollutants.

Low Impact Design

In keeping with Mayor Gavin Newsom's policy goals for promoting sustainable development in San Francisco, the project team is pursuing a "Low Impact Design" or "LID" approach for the *Guidelines*. LID strategies integrate green space, native landscaping, natural hydrologic functions and various other techniques to reduce pollution in runoff from developed land. LID serves multiple functions within a facility design, and can be integrated into civic open spaces and recreational areas. LID also achieves consistency with the policy goals of regulatory bodies that have jurisdiction over Port development, including the San Francisco Bay Conservation and Development Commission ("BCDC") and the San Francisco Planning Department. The Stormwater Design Guidelines consider a broad range of LID stormwater controls, including the following which can be incorporated into development projects as landscape or open space features:

- Vegetated swales
- Rain gardens and above ground planters
- Permeable pavers
- Treatment wetlands

LID stormwater controls are an element of LEED ("Leadership in Energy and Environmental Design") certification. Port staff has discussed LID /LEED synergy with development teams working on Port projects and the feedback has been positive.

Community Outreach

Because stormwater regulations require local agencies to promote public participation in program development, public outreach is a key component to the *Guidelines* planning process. The project team developed a database of over 2,000 community stakeholders, including members of Port waterfront advisory groups and local civic and environmental organizations. Public meetings were held in March and October 2007 to

solicit public feedback on the *Guidelines* process. Additional meetings and presentations were held with Port advisory groups and local civic groups. A summary of the public outreach is provided as Attachment A.

The Stormwater Design Guidelines Document

The *Guidelines* document is comprised of two volumes. The first volume provides policy overview and a San Francisco specific context for post-construction stormwater control requirements, and explains how these requirements will be incorporated into the City's planning and permit review process. The second volume is comprised of appendices that provide detailed instructions on how to develop a *Stormwater Control Plan*. Every applicant seeking a building permit, encroachment permit and/or CEQA approval within Port jurisdiction for a new development or redevelopment project over 5,000 square feet must submit a Stormwater Control Plan to the Port Engineering Division showing that they have incorporated appropriate stormwater controls into their project. Port planning and engineering staff will review Stormwater Control Plan submittals for adequacy.

The *Guidelines* include compliance strategies, a decision tree to assist the selection of stormwater controls, and spreadsheets that assist in sizing stormwater controls. A hypothetical example project illustrates how to complete each step in the design process, and a template for the Stormwater Control Plan is included at the end of the document. Port and SFPUC staff included this level of detail in the document with the goal of streamlining the permitting and approval process for stormwater controls.

The San Francisco Stormwater Ordinance

The Statewide General Permit includes specific provisions that require local government stormwater programs to demonstrate adequate regulatory oversight for post-construction control programs. Specifically:

> *"The Permittee must use an ordinance or other regulatory mechanism to address post-construction runoff from new development and redevelopment projects to the extent allowable under State or local law."*[1]

Further, the San Francisco Bay Regional Water Quality Control Board (RWQCB) stated in a May 6, 2009 letter providing review and comments to the draft Guidelines:

> *"The Port must clarify its authority for enforcing implementation of the Guidelines for new development and redevelopment projects or provide a time schedule for adopting a storm water ordinance or other document to obtain this authority, prior to expiration of the General Permit. We stress the importance for SFPUC and the Port to develop a clear and enforceable stormwater ordinance to implement the Guidelines for both new and redevelopment projects."*

[1] California State Water Resources Control Board, "General Permit for Stormwater Discharges from Small Municipal Storm Sewer Systems, Water Quality Order 2003-0005-DWQ.

Port and SFPUC staffs have developed an ordinance that is responsive to requirements of the Statewide General Permit (Attachment B). The ordinance includes the following provisions:

1) Establishment of regulatory authority in the San Francisco Public Works Code for the Port Executive Director or his/her designee for specific activities related to stormwater management.[2]

2) Detail as to which types of projects are required to comply with the *Guidelines*.

3) Requirements relating to the submittal of a Stormwater Control Plan for projects that must comply with the *Guidelines*.

4) A summary of prohibited discharges to the SFPUC and Port stormwater collection systems,

5) Detail regarding ongoing maintenance and inspection requirements for completed projects.

6) Provisions for enforcement and cost reimbursement for those projects which violate the *Guidelines*.

Port and SFPUC staffs will continue to solicit public review and comment during the Board of Supervisor approval process. After adoption by the Board of Supervisors the Guidelines will be applied and enforced by means of the Stormwater Ordinance. In early 2010 the Port Building Code will be revised to adopt the *Guidelines* and the Stormwater Ordinance.

REGULATORY APPROVALS

Development, approval and implementation of the San Francisco Stormwater Design Guidelines was determined to be Categorically Exempt from environmental review by the San Francisco Planning Department subject to Section 15308 of the CEQA Guidelines ("Actions Taken by Regulatory Agencies for Protection of the Environment").

SCHEDULE

The following table shows the proposed implementation schedule for the Guidelines.

MILESTONE	DATE
Port and SFPUC Commission Approval of the Guidelines, Adoption of Port Building Code Amendments, and Referral to Board of Supervisors	December 8, 2009
Board of Supervisors Adoption of Stormwater Ordinance	February 2010
Port Building Code Amendments	February 2010

[2] Article 4.1 of the San Francisco Public Works Code already delegates authority to the SFPUC General Manager to regulate discharges to the City's sewer and stormwater collection systems.

SUMMARY

In response to federal and state mandates, Port and SFPUC staffs have developed formal design guidelines for the reduction of stormwater pollution associated with new development and redevelopment in separately sewered areas of San Francisco. Effective administration of these guidelines requires that the San Francisco Board of Supervisors adopt an implementing ordinance. Port staff request that the Port Commission adopt the *San Francisco Stormwater Design Guidelines* and recommend the Stormwater Ordinance to the San Francisco Board of Supervisors and Mayor Gavin Newsom for approval. *The Stormwater Design Guidelines* will apply to all new development and redevelopment projects greater than 5,000 square feet in size and will go into effect February 2010.

Prepared By: John Mundy, Utility Specialist

For: Edward Byrne, Chief Harbor Engineer

Attachment A: Stormwater Design Guidelines Public Outreach Summary
Attachment B: San Francisco Stormwater Ordinance

PORT COMMISSION
CITY AND COUNTY OF SAN FRANCISCO

RESOLUTION NO. 09-75

WHEREAS, Urban stormwater runoff is a significant contributor of pollution to the San Francisco Bay and Pacific Ocean; and

WHEREAS, The Federal Clean Water Act and a State of California National Pollution Discharge Elimination System (NPDES) Permit require the City and County of San Francisco to administer a Stormwater Management Program to reduce pollution in stormwater runoff in San Francisco's municipal separate storm sewer systems; and

WHEREAS, The San Francisco Public Utilities Commission (SFPUC) Wastewater Enterprise and the Port of San Francisco (Port) have been charged with developing and implementing said Stormwater Management Program in a manner that fulfills state and federal requirements for regulation of post-construction stormwater runoff control and provides the means to enforce the requirements of the program; and

WHEREAS, Port and SFPUC staff have developed the *San Francisco Stormwater Design Guidelines (Guidelines)*, which define regulatory thresholds and requirements for development projects, and offer San Francisco-specific approaches for stormwater management, including Low Impact Design (LID) solutions; and

WHEREAS, The SFPUC and the Port conducted an extensive community planning and public outreach effort in support of *Guidelines* development and incorporated input from community and technical stakeholders into the final *Guidelines* document; and

WHEREAS, The *Guidelines* require the use of (LID) wherever feasible and are thereby consistent with Mayor Gavin Newsom's policy goals to promote greening and sustainable development in San Francisco; and

WHEREAS, The *Guidelines* are designed to work within the context of existing San Francisco regulations and policies, and are consistent with the City's Building Code and Planning Code requirements; and

WHEREAS, The proposed Stormwater Ordinance establishes an administrative framework to ensure compliance with requirements set forth in the *Guidelines*; and

WHEREAS, The Port of San Francisco derives its authority to regulate and permit building construction or improvements within its jurisdiction from the Burton Act (Chapter 1333 of the Statutes of 1968) and from relevant sections of the Agreement Relating to Transfer of the Port of San Francisco from the State of California to the City and County of San Francisco; and

WHEREAS, The Port Commission has established its own building department with the responsibility for enforcement, administration, and interpretation of building standards on Port property; and

WHEREAS, The Planning Department has determined that the actions contemplated in this resolution are in compliance with the California Environmental Quality Act (California Public Resources Code sections 21000 et seq.). Said determination is on file with the Secretary of the Port Commission for Item No. 11A and is incorporated herein by reference, now, therefore, be it

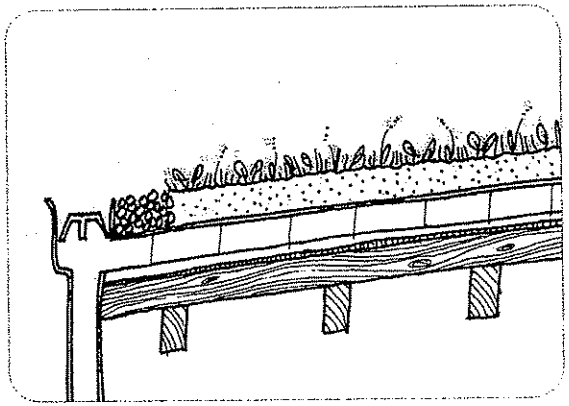
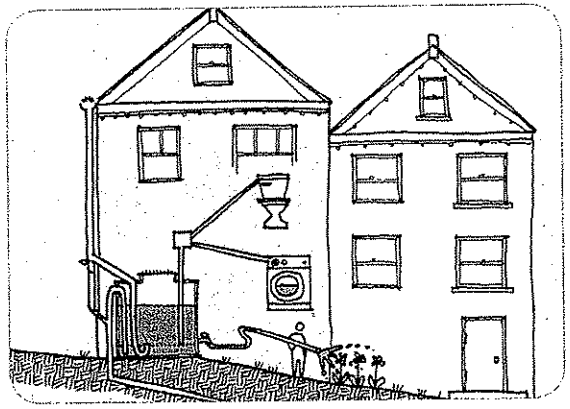
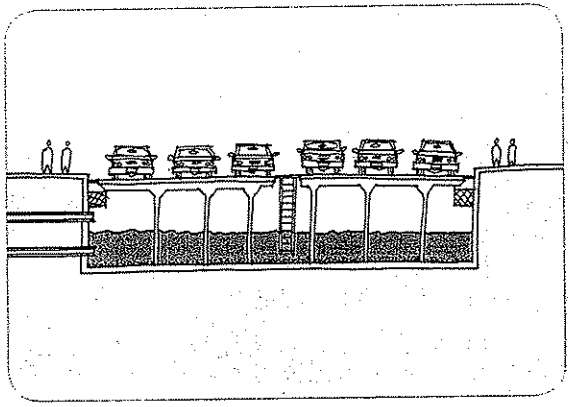
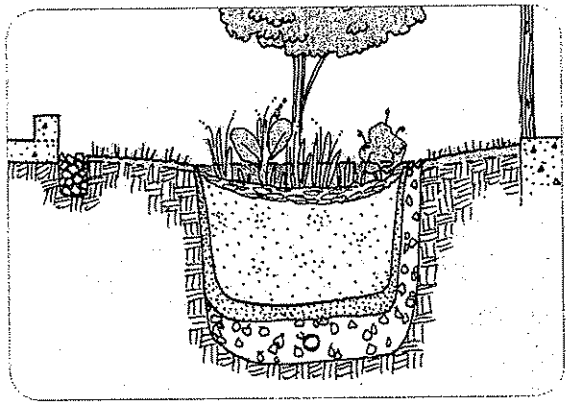
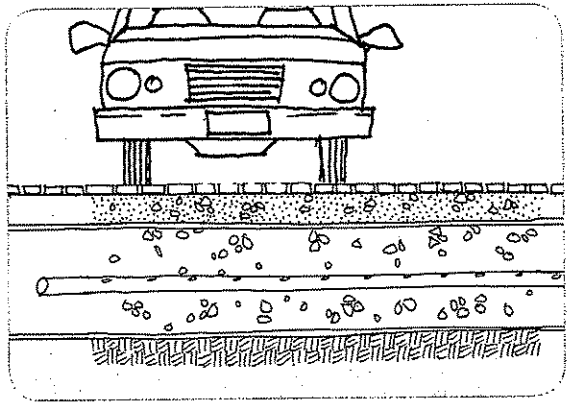
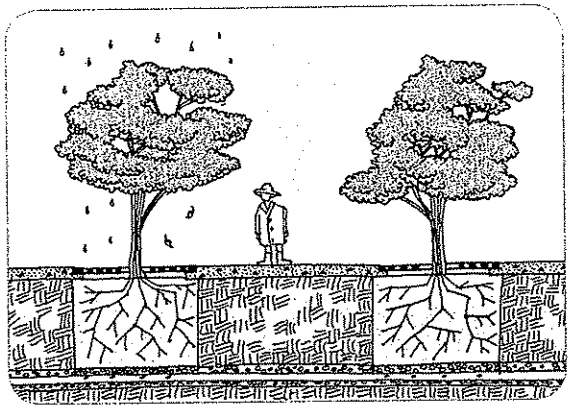
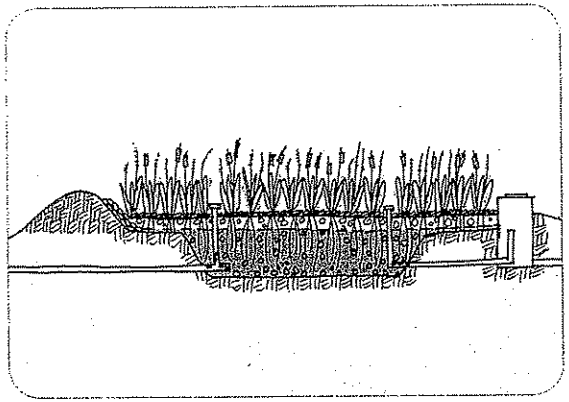
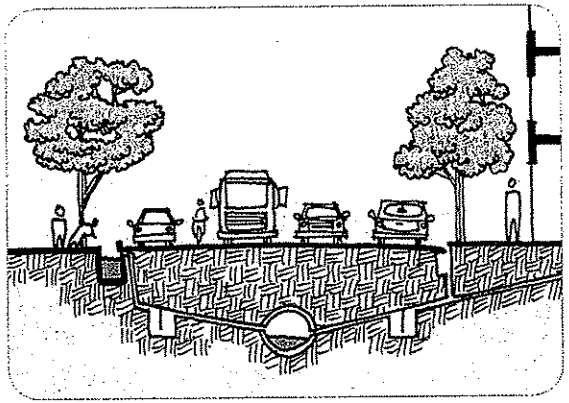
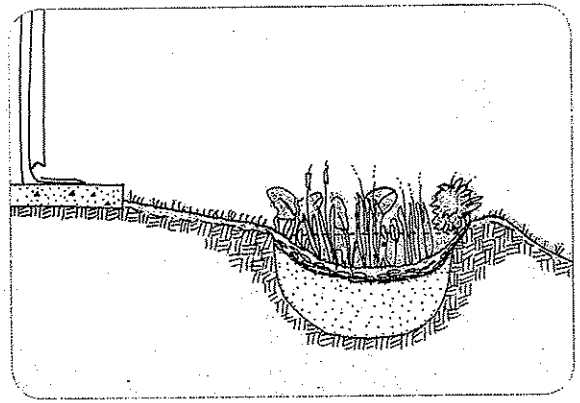
RESOLVED, That the Port Commission, pursuant to its Charter authority to adopt rules and regulations, hereby adopts the San Francisco Stormwater Design Guidelines; and be it further

RESOLVED, That the Port Commission urges the San Francisco Board or Supervisors and Mayor Gavin Newsom to adopt the Stormwater Ordinance for incorporation in the San Francisco Public Works Code; and be it further

RESOLVED, That Port staff incorporates the Stormwater Ordinance by reference into the Port Building Code after adoption by the Board or Supervisors.

I hereby certify that the foregoing resolution was adopted by the San Francisco Port Commission at its meeting of December 8, 2009.

Secretary

SAN FRANCISCO stormwaterdesignguidelines

Introduction

City of San Francisco

Gavin Newsom, Mayor
Astrid Haryati, Director of City Greening

San Francisco Public Utilities Commission

Ed Harrington, General Manager
Tommy T. Moala, Assistant General Manager
Jon Loiacano, Principal Engineer

Port of San Francisco

Monique Moyer, Executive Director
Ed Byrne, Chief Harbor Engineer
Byron Rhett, Deputy Director, Planning and Development

ACKNOWLEDGEMENTS

The *San Francisco Stormwater Design Guidelines* team would like to thank the Phase I cities that have gone before us and have graciously shared their wisdom, their support, and the many valuable lessons they have learned. We are particularly grateful for the examples set by the counties of Contra Costa and Santa Clara, California and the Cities of Emeryville, California; Portland, Oregon; and Seattle, Washington.

PROJECT TEAM

City of San Francisco

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Jonah Chiarenza

Sustainable Watershed Designs

Scott Durbin

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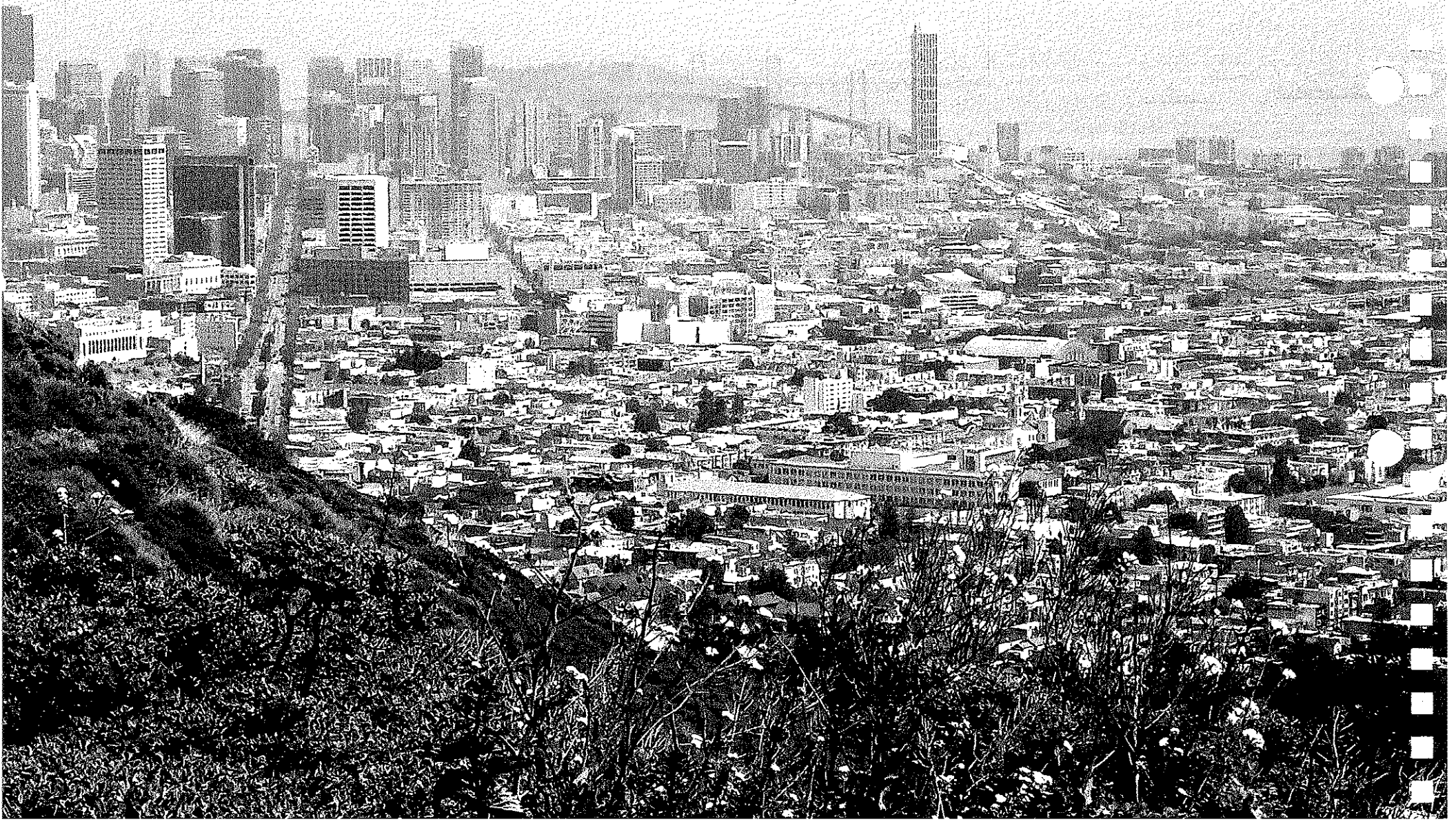
- Appendix A: Stormwater BMP Fact Sheets
- Appendix B: BMP Sizing Calculators
- Appendix C: Stormwater Control Plan Template
- Appendix D: Vegetation Palette

Executive Summary

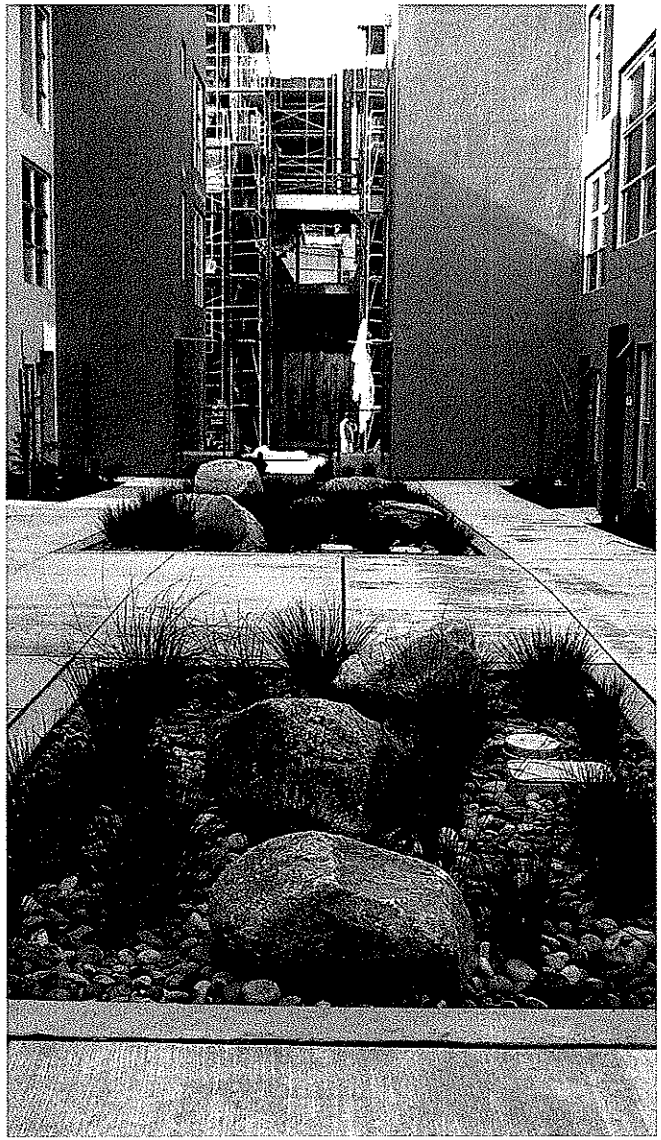


Stormwater management is a critical municipal responsibility that has a direct impact on public health and safety, surface water quality, and wildlife habitat.

Like many California municipal agencies, the San Francisco Public Utilities Commission (SFPUC) and the Port of San Francisco administer Stormwater Management Programs developed in accordance with the federal Clean Water Act and a State of California National Pollution Discharge Elimination System (NPDES) Permit.

NPDES permits for stormwater specify a suite of activities that municipalities must undertake to reduce pollution in stormwater runoff. One of these is the development, implementation, and enforcement of a program to reduce pollutants in stormwater runoff from new development and redevelopment projects. This effort is commonly referred to as a *post-construction stormwater control program.*

In February 2007, Port and SFPUC staff initiated a community planning effort to develop a regulatory guidance document that fulfills state and federal requirements for post-construction stormwater runoff control. The San Francisco Stormwater Design Guidelines (*Guidelines*) represent the culmination of this effort. The *Guidelines* describe an engineering, planning, and regulatory framework for designing new infrastructure in



Linked bioretention cells are a central part of the design for the Glashaus development in Emeryville, CA.

a manner that reduces or eliminates pollutants commonly found in urban runoff. The *Guidelines* are designed to work within the context of existing San Francisco regulations and policies, and are consistent with the City's and Port's Building Code and Planning Code requirements.

The *Guidelines* are currently directed primarily to San Francisco's **separate storm sewer areas**, which include the Port of San Francisco, Hunters Point Shipyard, Mission Bay, Treasure Island, Candlestick Point, and areas that discharge to inland receiving waters such as Lake Merced. However, the thresholds presented here and the general strategies described to achieve compliance also apply to **combined sewer areas**. While the thresholds and strategies are the same for both combined and separate sewers, the performance measures are different. For information about requirements in combined sewer areas, see page 62.

Low Impact Design

In keeping with San Francisco's policy goals for promoting sustainable development, the *Guidelines* encourage the use of Low Impact Design (LID) to comply with stormwater management requirements. LID applies decentralized, site strategies to manage the quantity and quality of stormwater runoff. LID integrates stormwater into the urban environment to achieve multiple goals. It reduces stormwater pollution, restores natural hydrologic function to San Francisco's watersheds, provides wildlife habitat, and contributes to the gradual creation of a greener city. LID can be integrated into all development types, from public open spaces and recreational areas to high-density housing and industrial areas.

Master-planned or Multi-Parcel Projects

Many future projects in San Francisco will be located in large redevelopment areas and will include construction of significant horizontal infrastructure and open space in addition to subdivided parcels and individual buildings. Master-planned projects, such as Treasure Island, Hunters Point Shipyard, and the Port's Sea Wall Lot 337, can make use of larger LID strategies that provide superior treatment, wildlife habitat, recreational amenities, and other benefits that may not be possible with smaller projects. Constructed wetlands and large-scale rainwater harvesting are just a few examples of LID strategies presented in these *Guidelines* that are ideally suited to large projects.

Using the Stormwater Design Guidelines

The *Guidelines* are intended to lead developers, engineers, and architects through a planning and design process that incorporates stormwater controls into site design. The *Guidelines* provide a policy overview, describe the regulatory context for post-construction stormwater control requirements, and explain how these requirements will be incorporated into San Francisco's planning and permit review process.

The *Guidelines* introduce the stormwater performance measures that must be achieved for project approval and provide detailed instructions for developing a Stormwater Control Plan (SCP), a document which will allow city staff to assess compliance. A worked example illustrates how to complete each step in the design process, and a template for the SCP is included at the end of the document. The *Guidelines* include compliance strategies, a decision tree to assist in the selection of stormwater controls, and spreadsheets for sizing stormwater controls. The requirements outlined in the *Guidelines* are of a technical nature and most project applicants will require the assistance of a qualified civil engineer, architect, or landscape architect in order to comply.

Every applicant seeking a building permit or every project that requires compliance with California Environmental Quality Act (CEQA) process on or after **January 1, 2010** for a new or redevelopment project over 5,000 square feet must complete a SCP showing that they have incorporated appropriate stormwater controls into their project and have met the stormwater performance measures described in these *Guidelines.* SFPUC and Port permit staffs will review SCP submittals for adequacy.

Native plants in bloom in the swales at the Sunset Circle parking lot, an LID feature that protects the water quality of Lake Merced.

Introduction

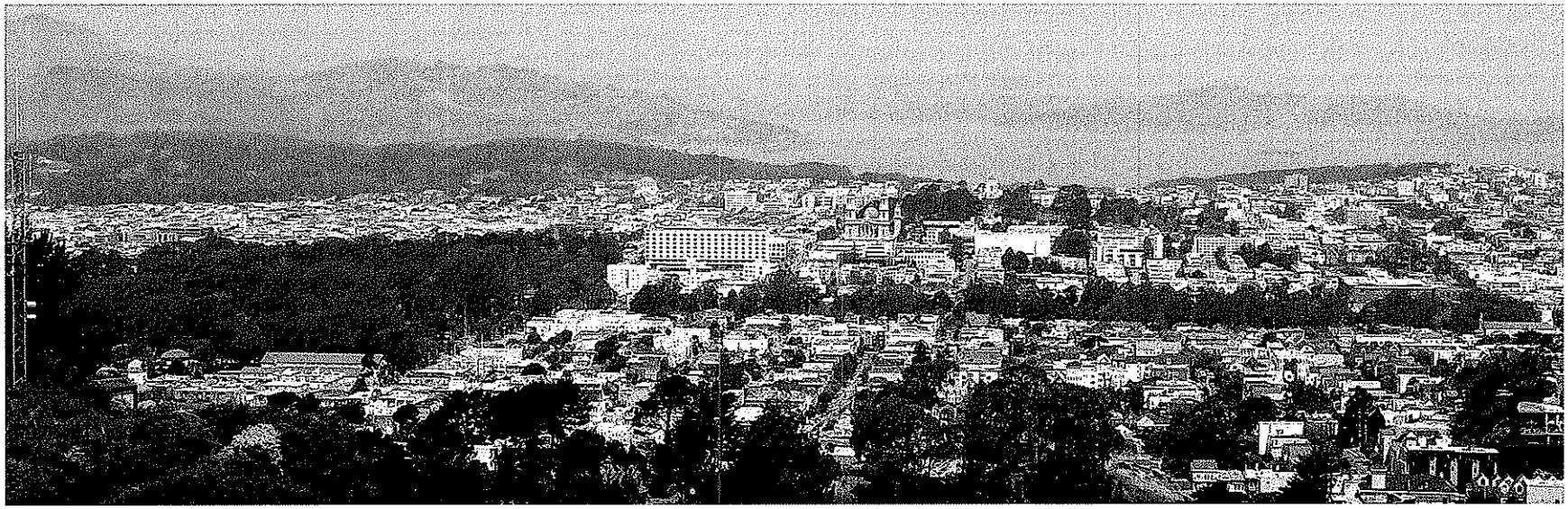
San Francisco's location adjacent to the Pacific Coast and San Francisco Bay, the largest estuary on the west coast of the United States, gives the City significant environmental, social, and economic advantages; it also confers unique responsibilities for water quality protection upon the City and its citizens.

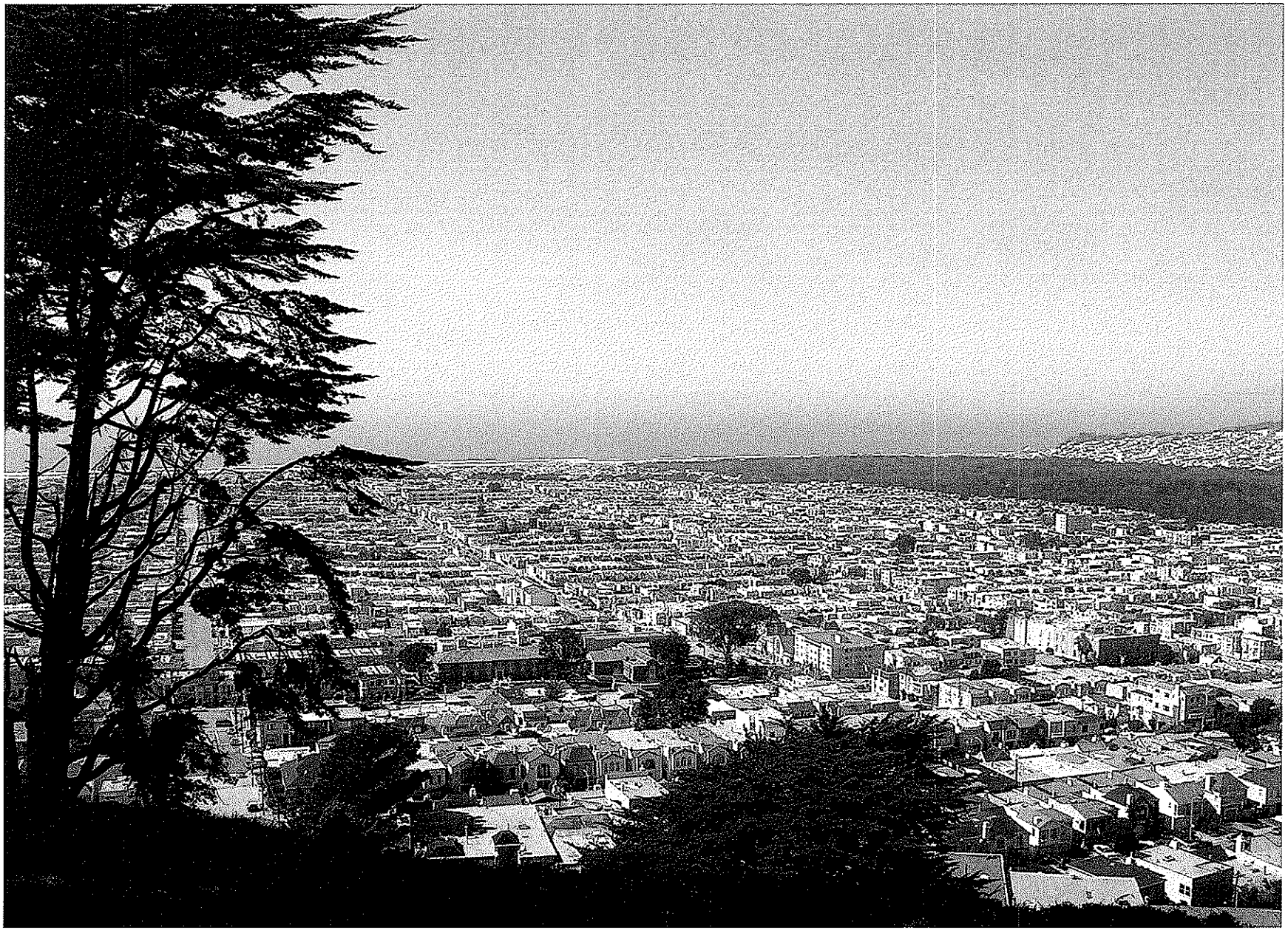
The San Francisco Public Utilities Commission (SFPUC) and the Port of San Francisco (Port) have partnered to create the *San Francisco Stormwater Design Guidelines* (*Guidelines*) for San Francisco's developers, designers, engineers, and the general public. The *Guidelines* are designed to help project applicants implement permanent post-construction stormwater controls. Water quality regulations under the federal Clean Water Act require such controls for new and redevelopment projects in areas served by municipal separate storm sewer systems (MS4s).

While water quality protection is the fundamental driver behind stormwater management, well-designed stormwater controls offer many ancillary benefits. These *Guidelines* encourage innovative and multi-purpose design solutions for meeting stormwater requirements in San Francisco's urban setting. In addition to protecting water quality, well-designed multi-purpose solutions will contribute to attractive civic spaces, open spaces, and streetscapes. They will also protect and enhance wildlife habitat and have the potential to effectively integrate stormwater management into the redevelopment of historic sites.

By implementing the stormwater management strategies articulated in this document, each project applicant will contribute to the incremental restoration of the health of the City's watersheds, protect the Bay and Ocean, and build a greener San Francisco. Patrick Condon, Chair in Landscape and Livable Environments at the University of British Columbia, underscores the contribution that each site can make to a region: "What the cell is to the body, the site is to the region. And just as the health of the body is dependent on the health of the individual cells that make it up, so too is the ecological and economic health of the region dependent on the sites that comprise it."

The *Guidelines* function as both policy document and design tool. They explain the environmental and regulatory drivers behind stormwater management, demonstrate the concepts that inform the design of stormwater controls, describe the benefits that green stormwater infrastructure bring to San Francisco, and take project applicants through the process of creating a Stormwater Control Plan (SCP) to comply with stormwater regulations. The *Guidelines* are specific to San Francisco's environment; they reflect the city's density, climate, diversity of land uses, and varying topography.





Regulatory Context

The federal Clean Water Act (CWA) establishes the foundation for stormwater regulation across the country. State, regional, and municipal laws and policies under the CWA help to ensure that San Francisco's stormwater requirements are appropriate to the city's geography, climate, and development patterns.

The Clean Water Act

In 1972, Congress passed the Clean Water Act (CWA) to regulate the discharge of pollutants to receiving waters such as oceans, bays, rivers and lakes. Under the CWA, waste discharges from industrial and municipal sources are regulated through the National Pollutant Discharge Elimination System (NPDES) Permit Program. Approximately 90% of San Francisco is served by a **combined sewer system** (see map on page 10) that conveys both sewage and stormwater for treatment to three sewage treatment plants before being discharged to receiving water. Discharges from the treatment plants are subject to the requirements of NPDES permits.

Stormwater runoff, now recognized by the United States Environmental Protection Agency (EPA) as a leading contributor to water quality degradation in the United States, was unregulated until 1987 when section 402(p) was added to the CWA. Section 402(p) established a two-phase plan to regulate polluted stormwater runoff under NPDES. The Phase I permits, finalized in 1990, regulate **municipal separate storm sewer systems (MS4s)** serving populations of 100,000 or more. Stormwater discharges associated with certain types of industrial facilities and construction sites greater than five acres are also

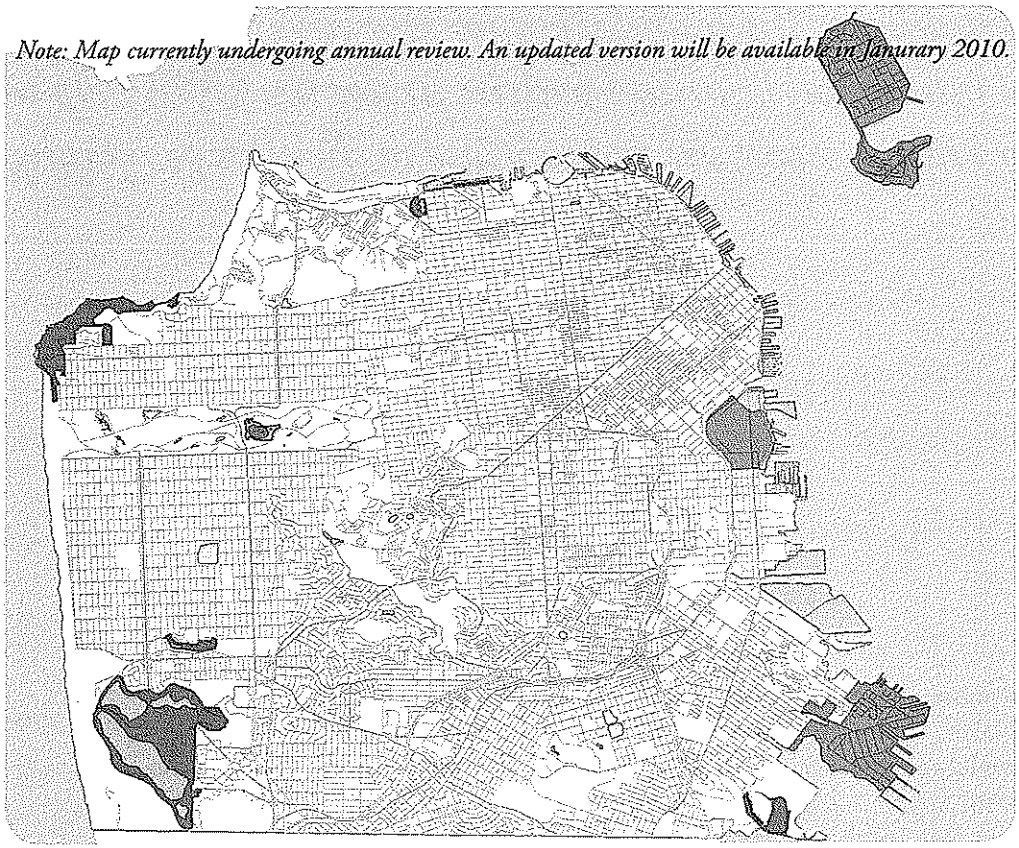


Figure 1. *Separate storm sewer areas and jurisdictions*

Best Management Practices

Stormwater Best Management Practices (BMPs) are measures or programs used to reduce pollution in stormwater runoff. The EPA defines a BMP as a "technique, measure or structural control that is used for a given set of conditions to manage the quantity and improve the quality of stormwater runoff in the most cost-effective manner."

regulated under Phase I. Phase II permits, finalized in 2000, regulate MS4s serving populations of 100,000 or less.

The California State Water Resources Control Board (SWRCB) serves as the implementing agency for NPDES regulations. In 2003, the SWRCB issued the *General Permit for Discharges of Stormwater from Small Municipal Storm Sewer Systems* (General Permit) to regulate small MS4s. San Francisco's MS4 areas cover approximately 10% of the City and serve fewer than 100,000 people. They are therefore subject to Phase II requirements in the General Permit.

The General Permit

To comply with NPDES Phase II regulations, the General Permit requires agencies holding the Phase II NPDES Permit (SFPUC and Port) to develop Stormwater Management Plans (SWMPs) describing the measures that will be implemented to reduce pollution in stormwater runoff in the MS4 areas.

The General Permit requires Permittees to implement four measures for post-construction stormwater management in new and redevelopment projects located in areas served by separate sewers:

1. Develop, implement, and enforce a program to address stormwater runoff from new and redevelopment projects to ensure that controls are in place to prevent or minimize water quality impacts;
2. Develop and implement stormwater management strategies, including a combination of structural and/or non-structural best management practices (BMPs) appropriate for the community;

3. Use an ordinance or other regulatory mechanism to control post-construction runoff from new and redevelopment projects to the extent allowable under the law; and,
4. Ensure the adequate long-term operation and maintenance of BMPs.

Under the General Permit, Permittees have two options for adopting the post-construction stormwater management requirements listed above. The first is to use the minimum design standards listed in Attachment 4 of the Phase II General Permit as a framework for administering post-construction control programs (http://www.waterboards.ca.gov/water_issues/programs/stormwater/docs/final_attachment4.pdf).

The second option for compliance is for Permittees to develop a functionally equivalent program that is acceptable to the San Francisco Bay Regional Water Quality Control Board (RWQCB). The Port and the SFPUC have chosen to pursue the latter option by implementing these *Guidelines*, which are largely based on the C.3 Provision of the San Francisco Bay Area Phase I stormwater permits. The C.3 requirements are similar to those in the General Permit, but require more effort on the part of the Permittee to develop a post-construction control program suitable for its climate, geography and development patterns.

Effective January 1, 2010, these *Guidelines* will apply to all projects greater than 5,000 square feet in the City of San Francisco. The *Guidelines* **do not** apply to those projects that have received 1) building permits and/or 2) discretionary approvals by the San Francisco Planning Department, the San Francisco Department of Building

Project Type	*Excluded Projects*
Commercial, industrial or residential development	*Projects with fewer than 5,000 square feet of developed area that are not part of a larger common plan of development.*
Single family residential development	*Construction of one single family home that is not part of a larger common plan of development and is fewer than 5,000 square feet, with the incorporation of appropriate source control measures, and using landscaping to appropriately treat runoff from impervious surfaces.*
Redevelopment and repair projects	*Interior remodels and routine maintenance and repair, such as roof replacement, exterior painting, utility trenching and repair, pier apron repair and pile replacement, pavement resurfacing, repaving and structural section rehabilitation within the existing footprint.*
Parking lots	*Parking lots of fewer than 5,000 square feet.*

Table 1. *Projects excluded from Stormwater Design Guidelines requirements*

Requirement

All project sites with an area greater than 5,000 square feet must incorporate post-construction stormwater controls that meet the performance measures set forth in these *Guidelines*, including minimizing the sources of stormwater pollutants (see Source Controls, beginning on page 75) and treating a specified flow or volume of stormwater (see Treatment BMPs, beginning on page).

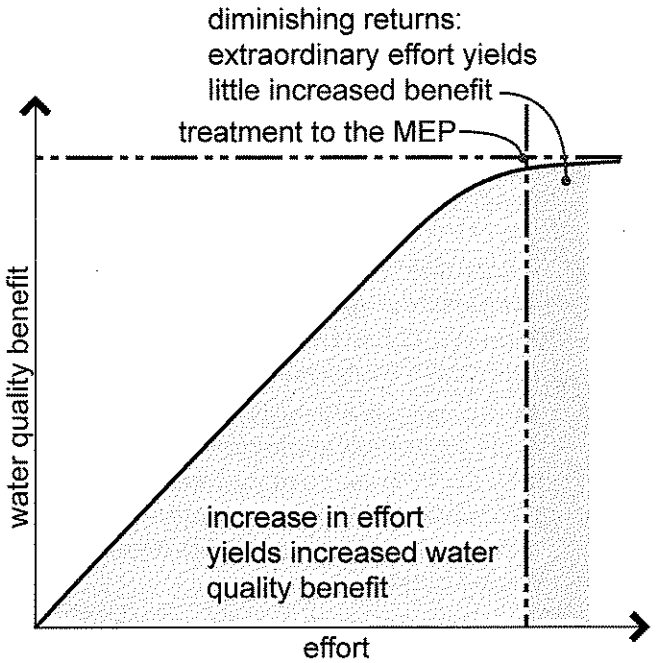


Figure 2. *As the maximum extent practicable (MEP) standard is approached, additional investment in BMPs yields reduced benefit.*

Inspection, the Port of San Francisco Planning Division, or the Port Building Department by January 1, 2010. All new project applications, incomplete project applications, and amendments received thereafter will be subject to these *Guidelines*. Table 1 lists the types of projects that are excluded from the *Guidelines*.

The RWQCB monitors San Francisco's implementation of General Permit requirements. The Port and the SFPUC must submit ongoing reports on their respective development review efforts, the number and type of projects reviewed, and the stormwater control measures included in the projects. To assess the effectiveness of stormwater control measures, the Port and SFPUC must define criteria for compliance. The RWQCB and the EPA require that stormwater control measures be designed to reduce pollution in stormwater runoff to the Maximum Extent Practicable (MEP).

The Maximum Extent Practicable Treatment Standard

MS4 permits require stormwater management strategies to "reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques and system, design and engineering methods."

Treatment to the maximum extent practicable (MEP) can be achieved by applying the BMPs that are most effective at treating pollutants in stormwater runoff. The SWRCB has said of the MEP standard that there "must be a serious attempt to comply, and practical solutions may not be lightly rejected." The SWRCB also states that if project applicants implement only a few of the least expensive stormwater BMPs, it is likely that the MEP standard has not been met. If, on the other hand, a project applicant implements all applicable and effective BMPs except those shown to be technically infeasible, or those whose cost would exceed any benefit to be derived, then the project applicant would have achieved treatment to the MEP. As technology and design innovation improve, stormwater BMPs become more effective. The definition of MEP continually evolves with the field to encourage innovation and improved water quality protection. Because of this, some end-of-pipe strategies such as vortex separators, which were considered to meet the MEP standard ten years ago, are no longer accepted as such. Similarly, in cases where just one BMP may have gained project approval in the past, today there are many cases where multiple BMPs will be required in order to achieve treatment to the MEP.

Pollutants of Concern

Because stormwater runs off of diverse sites, it mobilizes many kinds of pollutants. The following list summarizes the main categories of pollutants found in stormwater, their sources, and their environmental consequences.

Gross pollutants mobilized by stormwater include litter, plant debris and floatable materials. Gross pollutants often harbor other pollutants such as heavy metals, pesticides, and bacteria. They also pose their own environmental impacts; they degrade wildlife habitat, water quality, the aesthetic quality of waterways, and are a strangling and choking hazard to wildlife.

Sediment is a common component of stormwater runoff that degrades aquatic habitat and can be detrimental to aquatic life by interfering with photosynthesis, respiration, growth, reproduction, and oxygen exchange. Construction sites, roadways, rooftops, and areas with loose topsoil are major sources of sediment. Sediment is a vehicle for many other pollutants such as trace metals and hydrocarbons. Over half the trace metal load carried in stormwater is associated with sediment. Because of this, sediment removal is a good indicator for reduction of a broader range of pollutants. For the purpose of developing stormwater controls, engineers and designers must consider both coarse and fine ("suspended") sediments.

Oil and grease include a wide range of organic compounds, some of which are derived from animal and vegetable products, others from petroleum products. Sources of oil and grease include leaks and breaks in mechanical systems, spills, restaurant waste, waste oil disposal, and the cleaning and maintenance of vehicles and mechanical equipment.

Nutrients like nitrogen and phosphorous are typically used as fertilizers for parks and golf courses and are often found in stormwater runoff. They can promote excessive and accelerated growth of aquatic vegetation, such as algae, resulting in low dissolved oxygen. Un-ionized ammonia, a form of nitrogen, can be toxic to fish. In San Francisco, nutrients carried in runoff are a significant concern for enclosed freshwater bodies such as Lake Merced, more so than they are for the San Francisco Bay and Pacific Ocean.

Oils and gross pollutants pose a significant threat not only to water quality but also to bay area wildlife.

Stormwater runoff transports trash to local water bodies, where it creates an aesthetic nuisance, harms wildlife, and pollutes receiving waters.

Pesticides (herbicides, fungicides, rodenticides, and insecticides) are often detected in stormwater at toxic levels, even when they have been applied in accordance with label instructions. As pesticide use has increased, so have concerns about their adverse effects on the environment and human health. Accumulation of these compounds in simple aquatic organisms, such as plankton, provides an avenue for biomagnification through the food web, potentially resulting in elevated levels of toxins in organisms that feed on them, such as fish and birds.

Organics can be found in stormwater in low concentrations. They include synthetic compounds associated with adhesives, cleaners, sealants, and solvents that are widely used and are often stored and disposed of improperly.

Bacteria can enter stormwater via sources such as animal excrement, decay of organic materials, and combined sewer discharges. High levels of bacteria in stormwater runoff can lead to beach closures and fishing advisories.

Dissolved metals including lead, zinc, cadmium, copper, chromium, and nickel are mobilized by stormwater when it runs off of surfaces such as galvanized metal, paint, automobiles, and preserved wood, whose surfaces corrode, flake, dissolve, decay, or leach. Metals are toxic to aquatic organisms, can bioaccumulate in fish and other animals, and have the potential to contaminate drinking water supplies.

PCBs and Mercury are legacy contaminants that are found in low concentrations in soils associated with historically industrialized areas. San Francisco Bay is listed by the USEPA as an "impaired water body" for these contaminants. Control of PCBs and mercury will be implemented through design measures that limit the mobilization of these pollutants in contaminated soils.

Synergy with other Regulations and Initiatives

The *Guidelines* are designed to work with San Francisco's existing and emerging regulatory programs and policies. For example, development along the San Francisco waterfront is subject to policies adopted by the Port of San Francisco and the San Francisco Bay Conservation and Development Commission (BCDC); the *Guidelines* are consistent with these policies. Federal, state, and local regulations most relevant to the *Guidelines* are shown in Table 2 at the end of this section.

There are three initiatives underway in San Francisco that directly affect stormwater management in the City and that propose policies parallel to those presented in these *Guidelines*: the *Sewer System Master Plan*, the *Better Streets Plan,* and the Green Building Ordinance. These mutually-supportive efforts are consistent with the stormwater management goals and requirements put forward here.

The SFPUC's *Sewer System Master Plan* (Master Plan) is a comprehensive plan that charts a long-term vision and strategy for the management of the City's wastewater and stormwater. The Master Plan is intended to maximize system reliability and flexibility and to lay a path for capital investment and management of the City's infrastructure for the next 30 years. The Master Plan presents Low Impact Design (LID) as a major tool for addressing the City's drainage management needs. LID is an innovative stormwater management approach that is modeled after nature: it advocates managing runoff at its source using decentralized micro-scale facilities. The Master Plan contains protocols for using LID in ongoing repair and replacement projects as a part of its overhaul of drainage infrastructure.

The *Better Streets Plan* is a collaborative effort between the SFPUC, the Planning Department, the Public Works Department, the City's transit agencies, and other relevant agencies, to create a unified set of standards, guidelines, and implementation strategies that will govern how the City designs, builds, and maintains the public rights-of-way. The goal of the *Better Streets Plan* is to update applicable standards to improve pedestrian safety, enhance landscaping, and identify innovative methods for reducing stormwater runoff from the streets and sidewalks to create a more attractive and sustainable public realm in San Francisco.

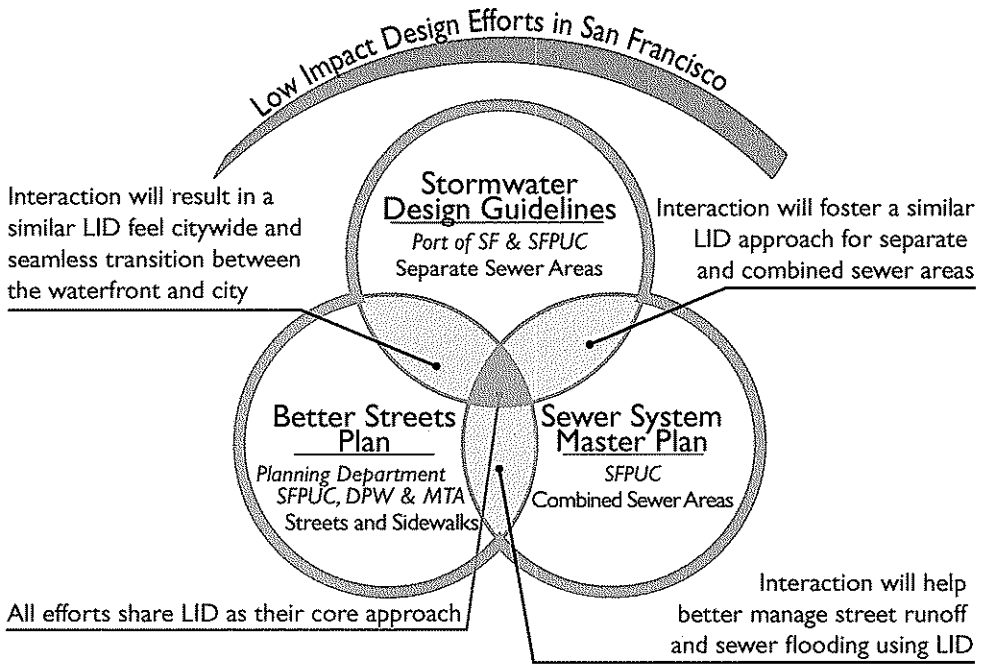
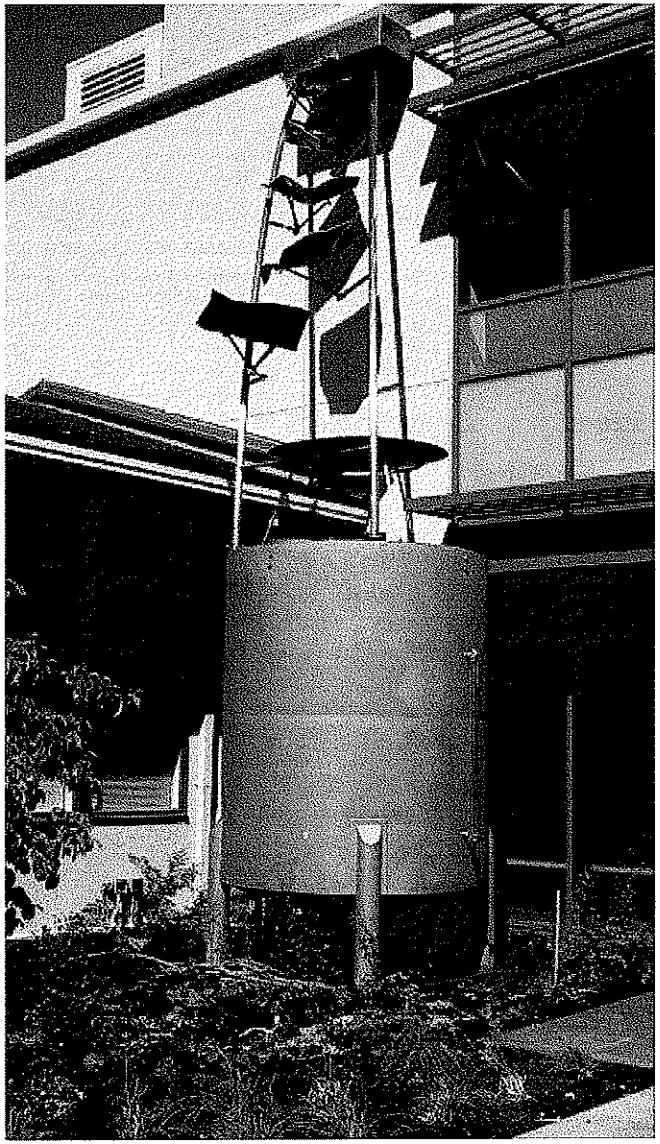


Figure 3. *LID is the common thread linking a number of major planning efforts currently underway in San Francisco.*



A cistern at Mills College in Oakland, CA is a stormwater BMP and a design element. Photo: Ingrid Severson

The Green Building Ordinance is a third initiative that will work in tandem with the *Guidelines*. The ordinance expands the scope of green building standards to apply not only to public buildings but also to private development and redevelopment projects in San Francisco. The task force was charged with creating building requirements that would foster environmentally sensitive design and sustainability in new development projects. As a part of this effort, SFPUC and Port staff developed stormwater management performance standards for new and redevelopment projects over 5,000 square feet. The Ordinance references the *Guidelines* and provides the regulatory authority to implement stormwater management requirements in combined sewer areas.

San Francisco Building Code Requirements

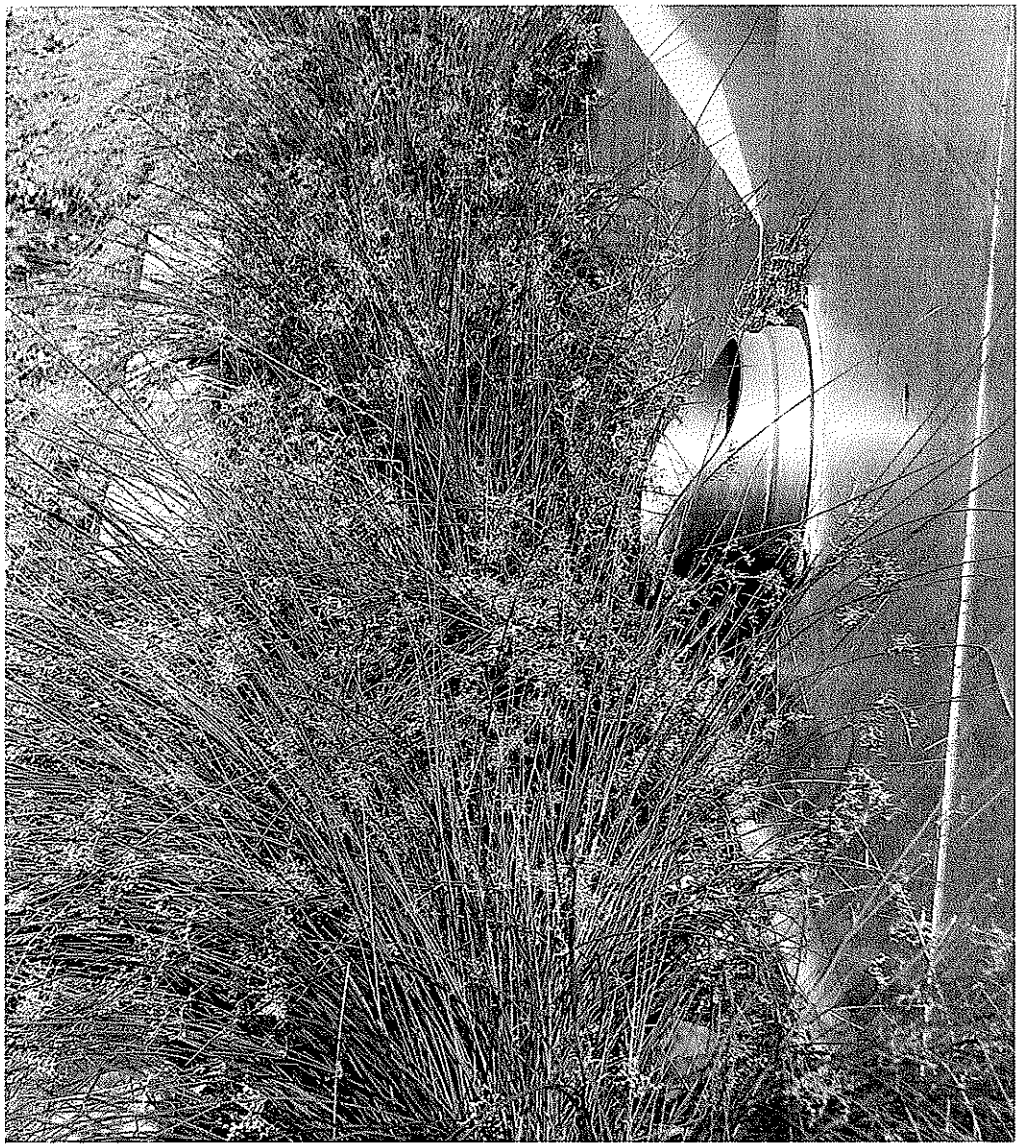
Projects that are implementing the *Guidelines* will also be subject to review by the San Francisco Department of Building Inspection (DBI) or the Port Building Department. Both DBI and the Port administer building codes that include provisions for managing drainage for new construction. Section 306.2 of the San Francisco Plumbing Code and Section 1506.1 of the San Francisco Building Code were amended on June 28, 2005 to allow roofs and other building areas to drain to locations other than the combined sewer. The 2005 amendments anticipated LID strategies such as downspout disconnection and rainwater harvesting, which are described in the *Guidelines*.

They now read as follows:

- **Plumbing Code, Section 306.2:** Roofs, inner courts, vent shafts, light well, or similar areas having rainwater drains shall discharge directly into a building drain or sewer, or to an approved alternate location based on approved geotechnical and engineering designs.
- **Building Code, Section 1506.1:** All storm or casual water from roof areas which total more than 200 square feet shall drain or be conveyed directly to the building drain or storm drain or to an approved alternate location based on approved geotechnical and engineering design. Such drainage shall not be directed to flow onto adjacent property or over public sidewalks. Building projections not exceeding 12 inches in width are exempt from drainage requirements without area limitations.

In the amended codes listed above, "approved alternate location" is the key phrase that allows for downspout disconnection and encompasses all properly designed stormwater management facilities, including rain barrels or cisterns.

In 2008, the SFPUC, DBI, and the Department of Public Health (DPH) signed a Memorandum of Understanding (MOU) for Rainwater Harvesting Systems. The MOU records a technology-based agreement between the three agencies, which concludes that project applicants can safely harvest rainwater and use it for non-potable applications such as toilet flushing, irrigation, and vehicle washing without treating it to potable standards. More detailed specifications and permitting requirements for rainwater harvesting can be found on the "Rainwater Harvesting" fact sheet in Appendix A.



An interior roof drain discharges to a vegetated swale in Emeryville, CA. This properly designed and permitted stormwater facility is an example of an "approved alternate location" for stormwater discharge.

Regulatory Context

Name/Title	Administered By	Summary
FEDERAL REQUIREMENTS		
National Pollutant Discharge Elimination System (NPDES) Phase II General Permit	California Regional Water Quality Control Board (RWQCB)	Requires municipalities to develop programs to control runoff pollution from both new and redevelopment projects. The *Guidelines* provide standards and guidance to implement the requirements of the Phase II Municipal General Permit.
NPDES Industrial Permits	RWQCB	Requires facilities subject to the requirements of the Industrial Permit to implement BMPs to prevent or reduce pollution in stormwater runoff. Newly constructed industrial facilities over 5,000 square feet must implement post-construction controls per requirements of the *Guidelines*.
Federal Clean Water Act 401 Certification	RWQCB	The RWQCB must certify that construction projects taking place in or over federal and state water bodies do not negatively impact water quality. The *Guidelines* will help project proponents comply with post-construction stormwater control requirements often included as conditions of 401 certification.
303(d) Impaired Water Bodies - Clean Water Act - Total Maximum Daily Load (TMDL) Program	RWQCB	San Francisco Bay and other water bodies are impaired by pollutants such as mercury and PCBs. TMDLs require pollutant sources to reduce levels of pollutant loading associated with water quality impairment. Stormwater treatment control selection should consider TMDL pollutant removal.
Secretary of the Interior's Standards for the Treatment of Historic Properties	National Park Service/California State Office of Historic Preservation	In order to qualify for Federal Rehabilitation Tax Credits, construction within designated Historic Districts must avoid or minimize changes that would adversely affect an historic resource's character defining features. Stormwater management measures selected for a given project must comply with these standards as applicable.
Americans with Disabilities Act (ADA) California Code of Regulations Title 24	San Francisco Department of Building Inspection (DBI) San Francisco Department of Public Works (SFDPW)	The ADA establishes requirements for accessibility to places of public accommodation and commercial facilities by individuals with disabilities. Stormwater management measures described in the *Guidelines* must accommodate ADA requirements, including curb ramp standards promulgated through SFDPW Order No. 175,387. Treatment controls located in the public right-of-way must comply with ADA architectural guidelines.
STATE REQUIREMENTS		
California Environmental Quality Act (CEQA)	San Francisco Planning Department	A process to review new and redevelopment projects for potential impacts to the environment and, as necessary, propose mitigation measures to substantially lessen the project's significant environmental effects. The *Guidelines* include measures that will substantially reduce water quality and hydrological impacts associated with new and redevelopment projects.
REGIONAL REQUIREMENTS		
San Francisco Bay Basin Plan	RWQCB	Designates the beneficial uses and water quality objectives designed to protect those beneficial uses for state waters in the San Francisco Bay Region. Stormwater management measures described in the Guidelines promote restoration and maintenance of beneficial uses for waters in and around San Francisco.
San Francisco Bay Sea Port Plan and San Francisco Special Area Plan Maritime Commerce, Land Use and Public Access	San Francisco Bay Conservation and Development Commission (BCDC)	Policies that guide BCDC regulation within 100 feet of the shoreline edge, including most of the Port's piers. Policies are geared to limiting Bay fill, protecting water quality, and encouraging maximum feasible public access that does not impact commercial maritime activities. Wherever practical projects should retain or restore native vegetation buffer zones, rather than hardscape shoreline development. Applicable to waterfront development within 100' of the shoreline. Stormwater management measures described in the *Guidelines* are consistent with BCDC policy goals.

Table 2. *Relevant jurisdictions, codes, and ordinances*

Name/Title	Administered By	Summary
SAN FRANCISCO REQUIREMENTS		
San Francisco Public Works Code	San Francisco Department of Public Works - Bureau of Streets and Mapping (SFDPW-BSM)	SFDPW-BSM permits and approves all work in the public right-of-way, streets and sidewalks (including paper streets). Permits tree-lawns and planting strips. Permits sidewalk, curb and gutter, pavement, or any other facilities in the public right-of-way improvements. Stormwater management measures described in the *Guidelines* must satisfy Public Works Code requirements for design and construction within the public right-of-way.
San Francisco Public Works Code	San Francisco Department of Public Works - Bureau of Hydraulics	San Francisco Department of Public Works - Bureau of Engineering provides technical review on behalf on the San Francisco Public Utilities Commission (SFPUC), and designs and contracts sewer improvements. Stormwater management measures described in the Guidelines must comply with engineering standards administered by San Francisco Department of Public Works - Bureau of Hydraulics.
San Francisco Better Streets Master Plan	Mayor's Office of Greening, San Francisco Planning Department, DPW, Municipal Transportation Agency, and the SFPUC	Guides design and construction within the public right-of -way and streets. Stormwater management measures proposed in the *Guidelines* are consistent with those considered in the *Better Streets Plan* . For design standards applicable to stormwater, the *Guidelines* will take precedence.
Waterfront Land Use Plan - Waterfront Design and Access Element	Port of San Francisco	Guides the physical form of the waterfront revitalization envisioned in the *Port Waterfront Land Use Plan;* provides guidance on public access and waterfront accessibility, planting (both the presence and type of vegetation), protection and preservation of historic resources; and defines distinct geographic areas wherein specific design criteria apply.
Recycled Water Policy	San Francisco Department of Public Health (DPH)	Recycled water must be treated to Title 22 standards, which differ according to the proposed use of the water.
Rainwater Harvesting Policy	Department of Building Inspection (DBI), SFPUC, and the DPH	Rain barrels less than 100 gallons may be installed without a permit if they are used for irrigation and not connected to indoor or outdoor plumbing. Permits must be obtained from DBI for rainwater harvesting systems over 100 gallons that are connected to indoor or outdoor plumbing and are used for irrigation or toilet flushing. Rainwater harvesting systems for indoor uses other than toilet flushing must obtain permits from DBI and DPH.
Greywater Policy	DBI and the DPH	Untreated greywater may be used for subsurface irrigation. For all other uses, greywater must be treated to Title 22 standards, which differ according to the proposed use of the water.
Plumbing and Connections	DBI	The Plumbing Inspection Division (PID) of DBI is responsible for assuring, through permitting and inspection, the proper functioning for installations of drainage, water, gas, and other mechanical systems covered in the Plumbing and Mechanical Codes. These inspections are carried out in buildings that are newly constructed, remodeled, or repaired. Stormwater management measures must be implemented in a manner that satisfies DBI requirements.
San Francisco Planning Code, Article 10	San Francisco Planning Department, Landmarks Preservation Advisory Board and the City Planning Commission	Exterior alterations to San Francisco properties that are designated local landmarks will be reviewed for consistency with requirements set forth in the Secretary of the Interior's Standards for the Treatment of Historic Properties. Stormwater management measures described in the *Guidelines* must comply with Article 10 and the Secretary Standards.
San Francisco Health Code, Article 22A	DPH	The Maher Ordinance regulates construction and post-construction activities for properties constructed on fill materials adjacent to the historic Bay shoreline. Much of the waterfront and other areas in San Francisco are subject to the Maher Ordinance. Soil and groundwater in areas of the San Francisco Waterfront subject to the Maher Ordinance may contain pollutants that preclude the use of stormwater treatment controls using infiltration.

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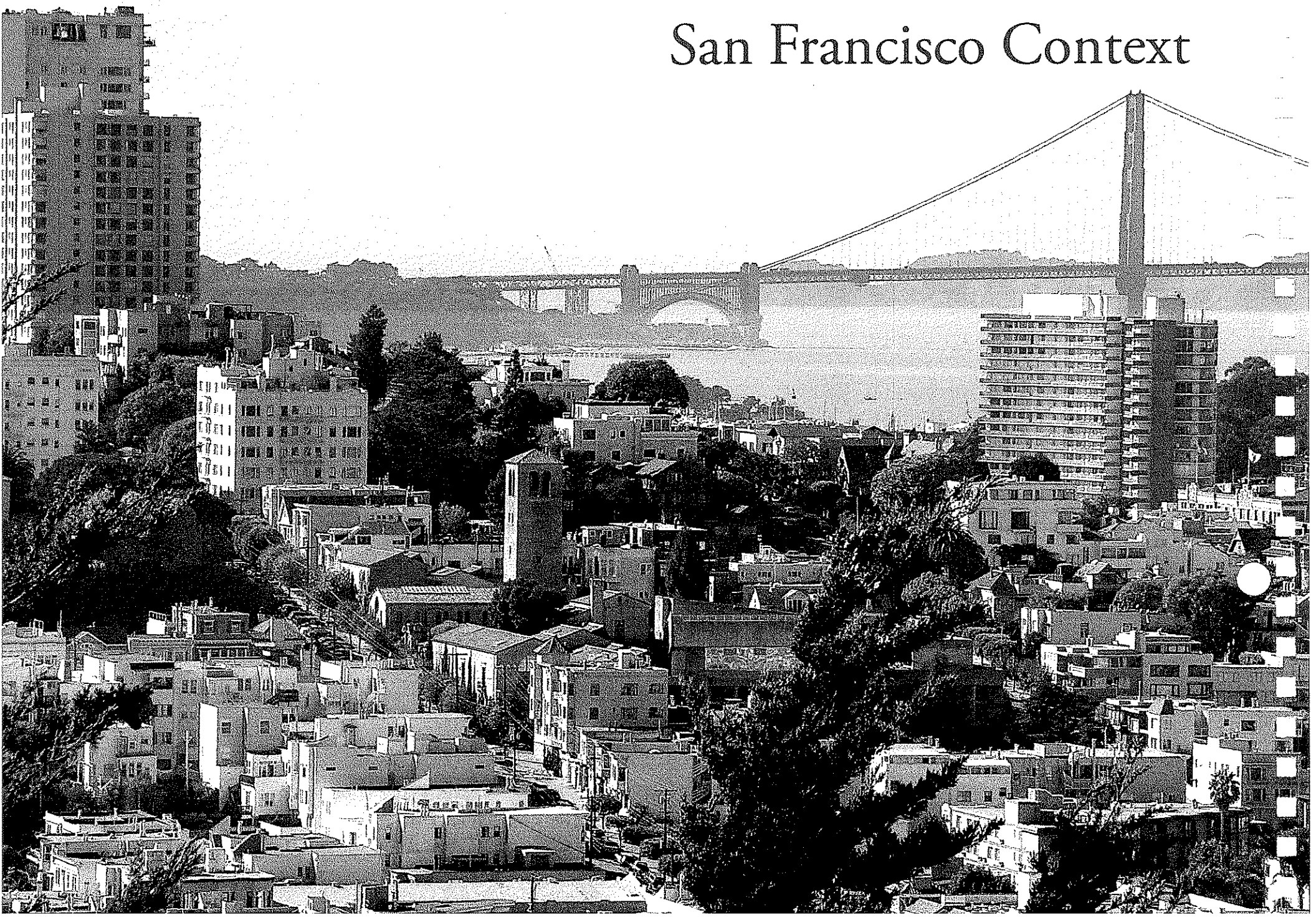
Boardwalks provide access across waterfront bioretention facilities in Seattle, WA.

San Francisco Context



Before San Francisco developed into the thriving city it is today, it consisted of a diverse range of habitats including oak woodlands, native grasslands, riparian areas, wetlands, and sand dunes. Streams and lakes conveyed and captured rainwater. Wetlands lined the Bay and functioned as natural filtering systems and as buffers from major storms. Rainwater infiltrated into the soil, replenishing groundwater supplies and contributing to stream base flow.

The Urban Watershed

Watershed function

Today, impervious surfaces such as buildings, streets, and parking lots have covered most of the City, preventing rainfall infiltration. Over time, creeks were buried and connected to the sewers, and wetlands were filled. Instead of percolating into soils, runoff now travels over impervious surfaces, mobilizes pollutants like oil and debris, and washes them into the sewer system or receiving water bodies—creeks, lakes, San Francisco Bay, and the Pacific Ocean. During heavy rain events, stormwater runoff can contribute to localized flooding, combined sewer discharges, and the degradation of surface water quality. Moreover, the decrease in infiltration resulting from paved surfaces contributes to groundwater depletion. LID can help to mitigate these adverse effects. With every project contributing incremental improvements, San Francisco can work toward restoring natural hydrologic function in its urban watersheds.

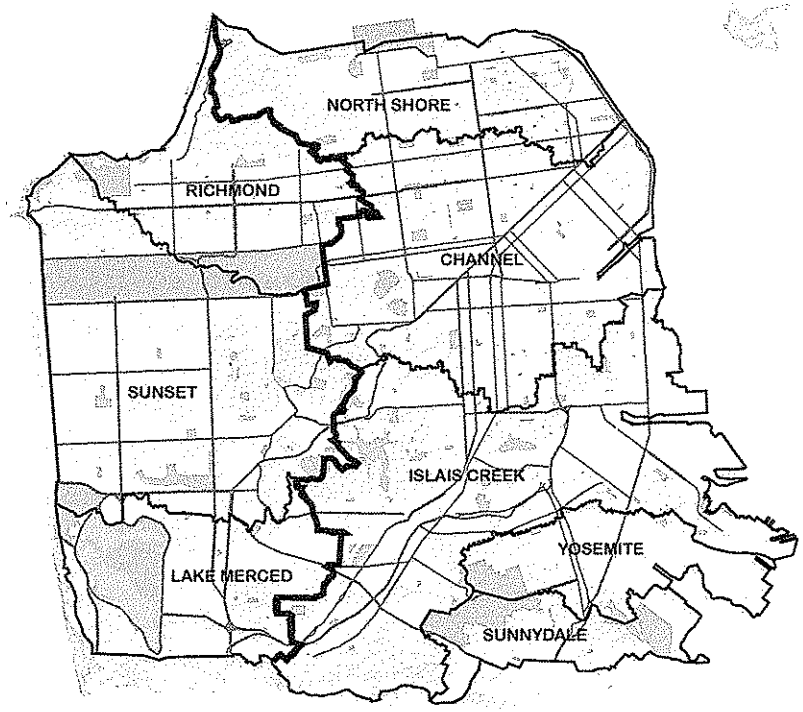


Figure 4. *San Francisco's topography divides the Westside Basins from the Eastside Basins.*

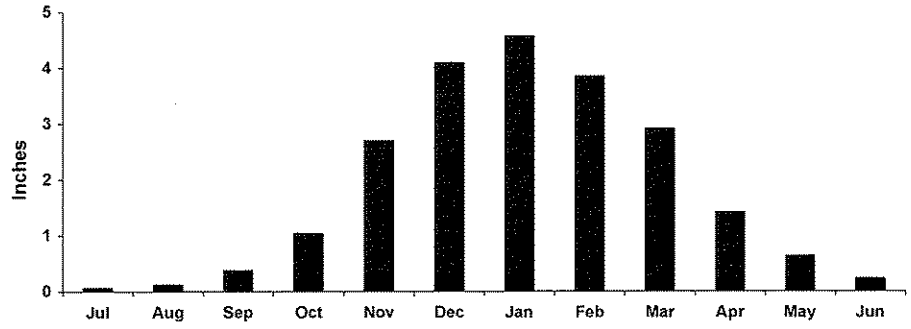


Figure 5. *Average monthly rainfall for San Francisco.*
Source: National Weather Service Gage, Federal Office Building, July 1907 to June 1978

Environment

San Francisco is roughly divided into two major drainages: the eastern and western basins (see Figure 4). These are comprised of eight major sub-basins containing diverse urban neighborhoods with a range of residential, commercial, and industrial land uses, open spaces, and natural areas. Each sub-basin is underlain with unique topography, hydrology, soils, vegetation and water resources that create opportunities and challenges for drainage and stormwater management.

San Francisco has a temperate Mediterranean climate, with dry summers and rainy winters (see Figure 5). In a typical year, San Francisco receives less than an inch total of rain from May through September and an average of 20 inches of rain between November and March. Rainfall is not distributed evenly across the City. It ranges from approximately 22 inches in the south, to 20 inches along the western edge and northeastern quadrant, to 18 inches in the extreme northeast. Like all Mediterranean climates, San Francisco experiences periods of drought punctuated by intense winter rains, often resulting in water scarcity in the summer and flooding in the winters.

The potential for stormwater to infiltrate varies dramatically by location. Infiltration may be limited in areas that have steep slopes, shallow depth to bedrock or to the water table, clay soils, contaminated soils, or are built on bay mud and fill over former creeks and wetlands. However, in many areas of the City, particularly in the western basins, soils are generally sandy and have the potential to provide excellent infiltration rates and pollution removal. Where infiltration is limited, a wide array of stormwater management strategies that do not depend upon infiltration can be implemented.

San Francisco's Stormwater Infrastructure

While the creation of these *Guidelines* is driven primarily by regulatory requirements for the City's separate sewer areas, the majority of San Francisco (90%) is served by a combined sewer system (see Figure 6). The stormwater management goals for areas served by separate storm sewers are different from those for areas served by the combined sewer system. Despite this, many of the fundamental design concepts for stormwater management apply to both areas, and as such, the *Guidelines* can be used as a tool in both the separate and combined sewer areas of San Francisco. Using landscape-based stormwater infrastructure will enhance and diversify the functions of both the separate and combined systems.

Approximately 10% of the City is served by a **separate storm sewer system** or is lacking stormwater infrastructure; in most of these areas stormwater flows directly to receiving waters without treatment. In the separate storm sewer areas, the primary reason for implementing post-construction controls is to improve stormwater quality before it reaches a receiving water body. These controls are aimed at removing specific pollutants of concern and treating what is known as the "first flush". The first flush is the dirtiest runoff, usually generated during the beginning of a rain event; it mobilizes the majority of the pollutants and debris that have accumulated on impervious surfaces since the last rain.

A **combined sewer system** conveys wastewater and stormwater in the same set of pipes. The combined flows receive treatment at wastewater treatment plants before being discharged to the Bay and Ocean. Conventional separate storm sewer systems provide no stormwater treatment, while combined sewer systems treat most urban runoff to secondary standards, including the first flush and most additional stormwater runoff. However, when the capacity of the system is exceeded by large storm events, localized flooding and combined sewer discharges (CSDs) can occur. In the event of a CSD, the system discharges a mixture of partially treated sanitary effluent and stormwater to receiving water bodies. While these discharges are dilute (typically consisting of roughly six percent sewage and 94 percent stormwater), they can cause public health concerns and lead to beach or Bay access closures.

The primary reason for implementing LID measures in a combined sewer system is to reduce and delay the volumes and peak flows of stormwater reaching the sewer system. Volume reductions and peak flow desynchronization can help reduce the number of CSDs, reduce flooding, and protect water quality. Post-construction controls in the combined system can also improve the capacity and efficiency of the City's treatment facilities.

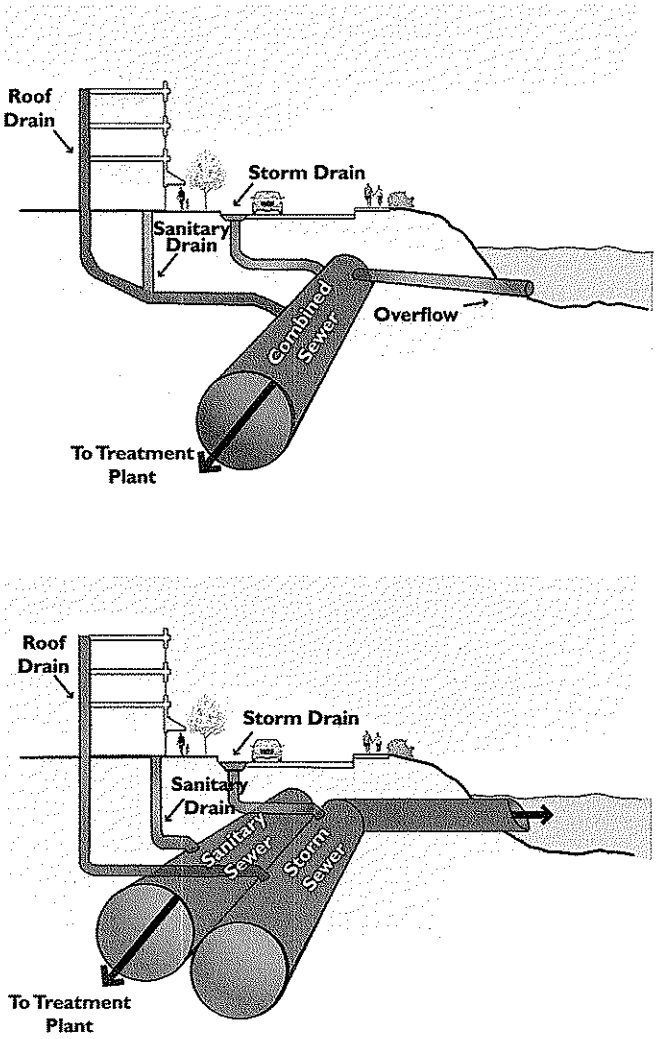


Figure 6. *Combined sewer systems (top) serve 90% of San Francisco. Separate sewer systems (bottom) serve 10%. Image: modified from King County Wastewater Management Division*

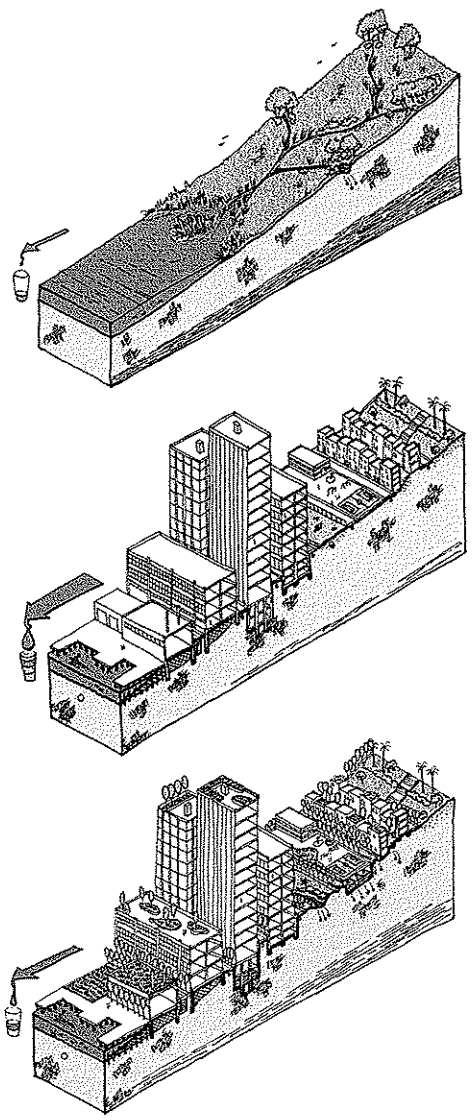


Figure 7. *Low Impact Design seeks to reduce runoff and restore hydrologic function through effective site planning, increased permeability, and landscape-based BMPs.*

Managing Stormwater in San Francisco

Low Impact Design

To lessen the impacts of urbanization on stormwater quality and peak flows, cities around the world are taking advantage of Low Impact Design (LID), which promotes the use of ecological and landscaped-based systems to manage stormwater. LID aims to mimic pre-development drainage patterns and hydrologic processes by increasing retention, detention, infiltration, and treatment of stormwater runoff at its source. This decentralized approach not only treats stormwater at its source and facilitates the best and highest use of stormwater; it also allows greater adaptability to changing environmental conditions than do centralized conveyance systems.

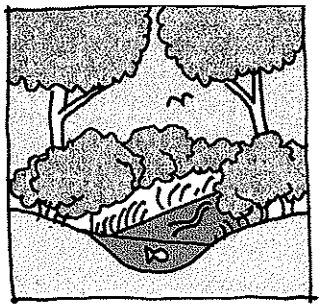
LID strategies direct runoff to BMPs such as flow-through planters, swales and rain gardens. These BMPs capture, filter, and slow stormwater runoff, thereby improving stormwater quality and reducing the quantity of runoff. Strategic placement of BMPs helps to ameliorate the negative water quality and ecosystem impacts of impervious surfaces. LID also emphasizes the integration of stormwater management with urban planning and design and promotes a comprehensive, watershed-based approach to stormwater management.

Figure 7 shows how LID can be incorporated into an urban setting like San Francisco without compromising its character and livability. Vegetated roofs and landscaped areas minimize the amount of stormwater runoff. BMPs are incorporated into the fabric of the city, doubling as recreational areas, wildlife habitat, and landscaping. These measures may increase initial capital costs (approximately 3%), but they bring multiple benefits to the site and the city: not only do they protect water quality and provide open space, they may also decrease downstream stormwater infrastructure costs because they lessen stormwater flows and volumes.

The most effective application of LID is a comprehensive approach that includes *site design*, *source controls*, and *treatment controls*. Careful site design can minimize the impacts of stormwater runoff from the outset. The more that stormwater management is integrated into the design process, the easier it is to create a successful and multi-purpose stormwater management strategy for a given site. The following pages list a set of goals to guide site design.

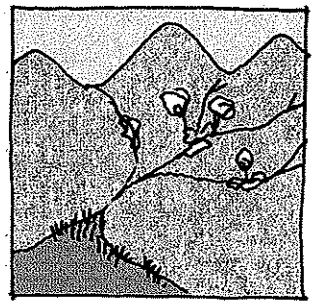
Mint Plaza, San Francisco, CA is an example of how LID can be integrated into an ultra-urban setting. The design includes rain gardens, permeable paving, and a subsurface infiltration gallery.

Figure 8. Site Design Goals



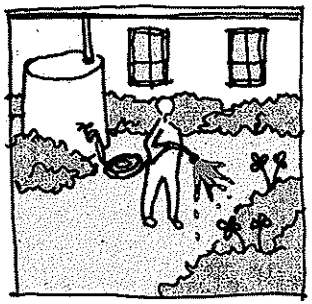
1. Do no harm: preserve and protect existing waterways, wetlands, and vegetation.

Creeks and wetlands are natural drainage features that can define the character and aesthetic value of a site. Moreover, they are already designed to convey and treat stormwater. Trees and ground cover act as natural stormwater management measures. They capture rainwater in their foliage, slow its progress through the landscape, and facilitate its infiltration into the soil.



2. Preserve natural drainage patterns and topography and use them to inform design.

Existing topography and drainage networks can be used as a framework around which to organize development. Changing the topography of a site through grading significantly increases the chances of diminishing water quality by delivering sediment to receiving waters; it also increases project costs.

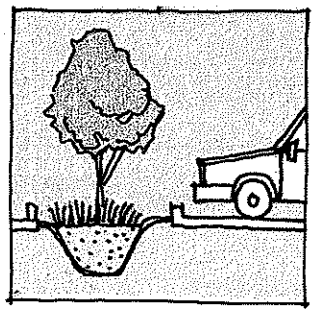


3. Think of stormwater as a resource, not a waste product.

Stormwater has traditionally been viewed as a nuisance to be eliminated. It is actually an untapped resource that can offset potable water use for irrigation, toilet flushing, cooling towers, and many other applications. It also offers opportunities to create interesting and site-specific designs using water features, rain-irrigated landscapes, and educational elements.

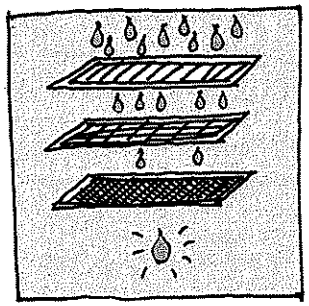
4. Minimize and disconnect impervious surfaces.

Minimizing and disconnecting impervious surfaces allows designers to treat relatively small volumes of runoff from multiple surfaces on a site, rather than treating relatively large volumes of stormwater that have mobilized diverse pollutants from impervious surfaces across an entire site. Disconnecting impervious surfaces and directing runoff to BMPs can be thought of as creating an obstacle course for stormwater; it increases the time needed for runoff to travel from its source to its discharge point, thereby increasing opportunities for treatment, flow reduction, and volume reduction.



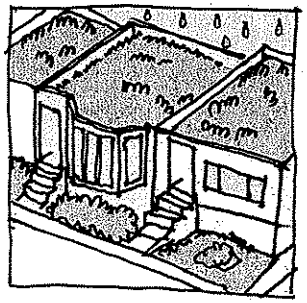
5. Treat stormwater at its source.

Treating stormwater pollutants at their source can reduce the need to treat multiple pollutants or higher pollutant loads further downstream in the drainage area. Treating at the source can result in smaller, less costly and more effective stormwater treatment facilities.



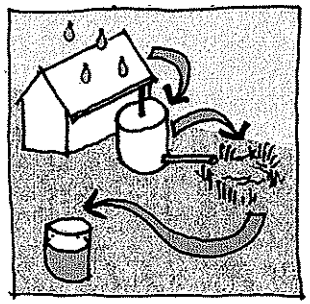
6. Use treatment trains to maximize pollutant removal.

In most scenarios, treatment to the MEP cannot always be achieved with a single BMP. In most cases, a series of linked BMPs called a treatment train must be used to maximize pollutant removal. Like a series of ever-finer sieves, treatment trains clean stormwater by running it through a series of BMPs, each designed to remove specific pollutants, from large pieces of trash, to suspended solids, to dissolved pollutants.



7. Design the flow path of stormwater on a site all the way from first contact to discharge point.

It is important to delineate the path of travel of stormwater from its first surface contact (where it changes from rain to stormwater runoff) to its final discharge point after treatment. All BMPs must have an approved overflow discharge location for storm flows that exceed the design criteria and in case of clogging.



The Ekostaden residential development in Malmo, Sweden, channels all stormwater runoff through BMP treatment features such as bioswales, ponds, and wetlands as shown here. Photo: Brooke Ray Smith

During the site design process, designers should identify potential sources of stormwater pollution and select appropriate source controls to minimize their impacts. Source controls are stormwater management measures that prevent pollutants from entering stormwater runoff. Source controls can be design measures, such as enclosing trash areas to prevent trash from contacting stormwater; materials choices, such as using non-toxic roofing materials to prevent runoff from entraining pollutants from roof contact; and operational procedures, such as sweeping streets. See page 81 of the *Guidelines* for a description of how to select and locate source controls.

Site design strategies and source control measures minimize the quantity and improve the quality of stormwater runoff from a site. However, it is impossible to eliminate all surfaces that will contribute runoff. Treatment controls must therefore be implemented to accommodate the remaining runoff from the site. Treatment controls are permanent stormwater facilities such as vegetated swales or flow-through planters that are designed to receive and treat runoff from the site. Treatment control BMPs are typically designed to accomplish one or more of the following five stormwater treatment strategies: infiltration, detention, biofiltration, harvesting or retention, or bioretention. Each of these treatment strategies is described in Appendix A. Infiltration is typically the easiest and most cost-effective strategy for managing stormwater but, in areas where this is not feasible, designers can use a combination of the other four strategies. See page 83 of the *Guidelines* for a description of how to select, locate, and size treatment controls.

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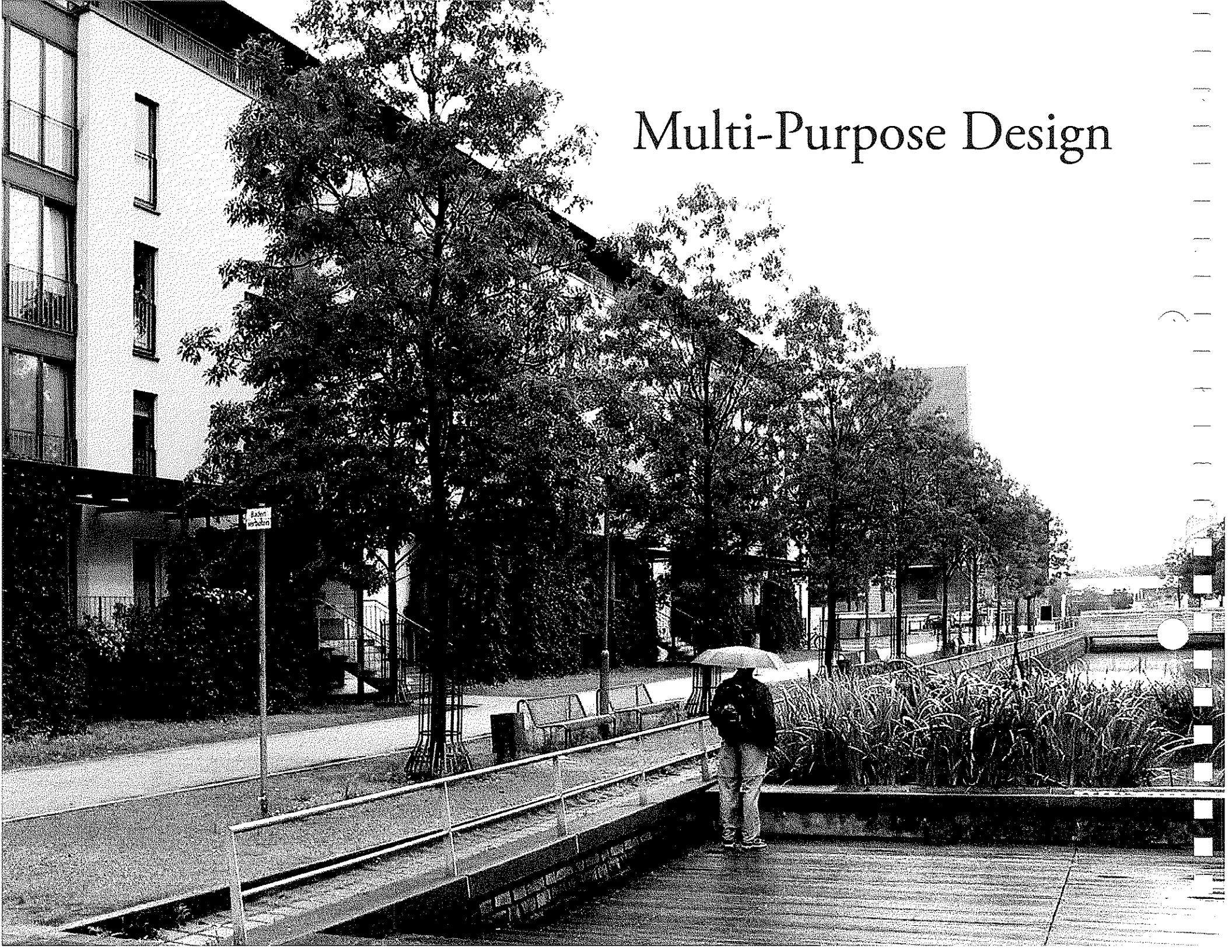


Multi-Purpose Design

Low Impact Design can be integrated into the site design process in a way that protects water quality, contributes to the quality of the site design, and meets the stormwater performance measures required by the Port and SFPUC.

LID is the multi-purpose integration of infrastructure, architecture, and landscape and can be a catalyst for design innovation in all three disciplines. LID can integrate water quality protection with improvements to the public realm, create and enhance urban wildlife habitat, promote responsible use of water, and advance environmental education and watershed stewardship.

Traditional urban design goals can also be achieved through the implementation of stormwater BMPs. Stormwater facilities can enhance the aesthetics of the built environment, increase pedestrian safety, calm traffic, make streets and public spaces greener, and provide structure, texture, and identity to the City's streets and other public spaces.

Stormwater BMPs bring designers a diverse palette of paving surfaces, vegetation, and drainage strategies, and also a new purpose that can inform design: to improve water quality and restore ecological function.

Open space is a valuable amenity in San Francisco, now the second densest city in the nation. LID measures can double as **civic spaces, open spaces and recreational areas**: a constructed wetland filters stormwater and could be the center of a neighborhood nature

Rain gardens and a creek daylighting project are the centerpieces of open space adjacent to the Headwaters development in Portland, OR.

A community in Germany integrates LID into the parking.

area; a vegetated roof that reduces stormwater discharge can also be a gathering area. At Potsdamer Platz, Berlin, Germany, stormwater management strategies include rainwater harvesting for non-potable uses such as toilet flushing and fire safety, vegetated treatment modules, and water features. Stormwater management forms the centerpiece of this major civic space.

LID can also contribute to San Francisco's **urban ecosystem** by enhancing existing wildlife habitats and creating new ones. San Francisco's trees are concentrated in its parks, not on its streets; the city has roughly 40% fewer street trees per mile than the national average and many of its tree lawns and tree wells have been paved over. Expanding the City's urban forest with careful attention to species selection would simultaneously address stormwater issues, increase wildlife habitat, improve air quality, and create a network of green corridors that would contribute to the aesthetics and health of the City's neighborhoods. Habitat can also be created by implementing stormwater BMPs on the roofs and walls of buildings. In London, England, and Basel, Switzerland, vegetated roofs are being used to provide patches of foraging, breeding, and nesting habitat for endangered wildlife. See Appendix D for a vegetation palette listing climate appropriate plants and their habitat value.

Integrating LID into the **streetscape** yields a more attractive pedestrian realm through the inclusion of vegetated curb extensions, sidewalk planters, street trees, pervious surfaces, and other stormwater BMPs that add attractive, pedestrian-scale details. These elements can simultaneously achieve stormwater management goals and improve streets for pedestrians and local residents by encouraging walking, reducing noise, and calming traffic. They can improve neighborhood aesthetics, safety, quality of life, and even property values. In Vancouver, B.C., Canada, a stormwater management project on Crown Street eliminated curbs, added clustered parking, and designed infiltration areas underneath the parking. The narrow street and clustered parking allows more space to be dedicated to biofiltration areas and plantings, which create a lush and pleasant streetscape.

Stormwater is also a valuable **water resource**. Using stormwater on-site rather than releasing it downstream decreases demand for potable water and can protect receiving waters by reducing runoff rates, volumes, and pollutant loads. Rain barrels and cisterns collect stormwater and store it for later use in irrigation and toilet flushing, uses that unnecessarily burden potable water supplies. Stormwater can even contribute to future potable water supplies, by recharging underground aquifers. In Cambria, California, a two-million gallon cistern beneath an athletic field harvests rainwater from the Cambria

Elementary School site. The water is sufficient for year-round irrigation of the multiple athletic fields.

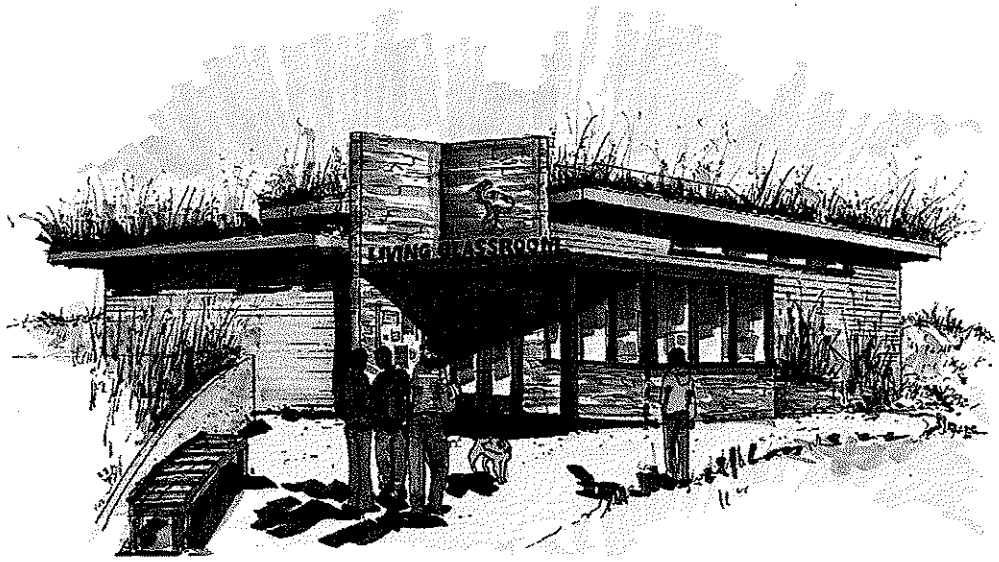
LID can also be a useful tool for **environmental education** when it is integrated into school curricula, public outreach, or interpretive signs. LID concepts can be presented at many different levels of complexity, from an introduction to watersheds to an explanation of the hydrologic cycle and environmental stewardship. LID concepts touch upon numerous disciplines, including biology, ecology, watershed planning, engineering, design, and resource management. The Eco-Center at Heron's Head Park in the Bayview-Hunters Point neighborhood is an environmental education center for local students of all ages. Educational programs at the Eco-Center focus on habitat conservation and community stewardship. A collaboration between Literacy for Environmental Justice, the Port of San Francisco, and the San Francisco Department of the Environment, the Eco-Center includes a vegetated roof, rainwater harvesting, photovoltaic panels, solar hot water generation, native planting, and other LID features. At the time of writing these *Guidelines*, this project was under construction.

Lastly, LID can help the design and development community achieve **environmental performance measures**, which aim to minimize the environmental impacts of development and provide high quality, healthy environments. In San Francisco, both Leadership in Energy and Environmental Design (LEED®), a green building rating system developed by the U.S. Green Building Council, and the GreenPoint Rated system, a rating system developed by the non-profit Build It Green, are being used to assess the environmental quality of site and building design. In both systems, stormwater management facilities can earn points toward certification.

Environmental Justice

Over the past decade, increased attention has been given to the disproportionate impact of environmental pollution on socio-economically disadvantaged communities. The USEPA defines environmental justice as "the fair treatment of people of all races, cultures and income, regarding the development of environmental laws, regulations and policies." This issue is of concern in many areas of San Francisco, and in particular the Bayview-Hunters Point neighborhood, former home to Hunters Point Shipyard, the only federal Superfund site in San Francisco.

The Bayview-Hunters Point neighborhood contains over 100 brownfield sites. The residents of the primarily African-American neighborhood have borne the environmental and health impacts of these brownfield sites. The *Guidelines* proposes LID measures that can effectively manage stormwater runoff at the Shipyard and other areas of Bayview-Hunters Point, while at the same time improving the quality and safety of neighborhoods by providing attractive landscape features, traffic calming measures, and a safer pedestrian realm.



A vegetated roof and other LID features at the Eco-Center at Heron's Head Park help illustrate sustainable design practices to students in San Francisco's Bayview-Hunters Point neighborhood.

LEED Category	Credits		Points
Sustainable Sites	SS6.1	Stormwater quantity control	1
	SS6.2	Stormwater quality control	1
	SS5.1	Protect or restore habitat	1
	SS5.2	Maximize open space	1
	SS7.1	Urban heat island effect - non-roof	1
	SS7.2	Urban heat island effect – roof	1
Water Efficiency	WE1.1	Water efficient landscaping - reduce by 50%	1
	WE1.2	Water efficient landscaping - no potable water use or no irrigation	1
	WE2	Innovative wastewater technologies	1
	WE3.1	Water use reduction - 20% reduction	1
	WE3.1	Water use reduction - 30% reduction	1
		Total stormwater-related credits	**11**

Table 3. *LEED® credits related to stormwater in LEED-NC® Version 2.2.*

In Southern California, Santa Monica's Main Library used an innovative stormwater management design to help achieve its water-saving goals and receive a LEED Gold rating: a 225,000-gallon cistern under the building stores stormwater for irrigation of both landscaping at the library and adjacent street plantings.

Many of the LEED certification systems include credits that explicitly address stormwater. In LEED for New Construction, these credits are in the Sustainable Sites category (see Table 3). Implementing LID measures such as habitat enhancement, reduction of impervious surfaces,

The Academy of Sciences in Golden Gate Park is targeting LEED Platinum certification and includes a 2.5 acre vegetated roof.
Photo: Rana Creek - Living Architecture

vegetated roofs, and rainwater harvesting can also help project applicants earn credits in other areas.

The GreenPoint Rated system includes many measures that are related to stormwater, although it does not propose any quantitative performance measures for stormwater management (Table 4). Stormwater-related points can be earned in the areas of site design, landscaping, exterior finishing, and innovation in the water category. To be considered GreenPoint Rated, a home must achieve 50 total points, with a minimum number of points in each of the five environmental categories (Community, Energy Efficiency, Indoor Air Quality, Water Conservation and Resource Conservation). Single family projects require at least eight points earned in the water category, while multifamily projects require at least three points earned in the water category. The GreenPoint Rating system specifically encourages rainwater harvesting and water efficient landscaping.

GreenPoint Checklist	Feature		Points (Category)
Multifamily	A.3.a.	Protect soil & existing plants & trees	1 (Community)
	A.7.c.	Specify drought-tolerant California natives, Mediterranean or other appropriate species	1 (Water)
	A.7.d.i.	Mulch all planting beds to a depth of 2 inches or greater as per local ordinance	1 (Water)
	A.7.d.ii.	Amend with 1 inch of compost or as per soil analysis to reach 3.5 % soil organic matter	1 (Water)
	A.7.e.i.	Specify smart (weather-based) irrigation controllers	1 (Water)
	A.7.e.ii.	Specify drip, bubblers, or low-flow sprinklers for all non-turf landscape areas	1 (Water)
	A.7.f.	Group plants by water needs (hydrozones)	1 (Water)
	A.9.	Cool site through permeable paving (minimum of 30% of site)	1 (Community)
	C.12.a.	A portion of the low-slope roof area is covered by a vegetated or "green" roof (25% or greater)	1(Community) 1(Water)
	D.14.b.	Use captured rainwater for landscape irrigation or to flush 5% of toilets and/or urinals	4 (Water)
	F.2.a.	Provide O & M manual to building maintenance staff	1 (Energy)
	F.2.b.	Provide O & M manual to occupants	1 (Energy) 1(Water)
		Total points:	**17**
Single Family	A.1.a.	Protect topsoil from erosion & reuse after construction	1 (Community) 1 (Water)
	A.1.b.	Limit & delineate construction footprint for maximum protection	1 (Water)
	C.1.a.	No invasive species listed by Cal-IPC are planted	1 (Water)
	C.1.c.	75% of plants are California natives or Mediterranean species or other appropriate species	3 (Water)
	C.4.	Plant shade trees	3 (Water)
	C.5.	Group plants by water needs (hydrozoning)	2 (Water)
	C.6.a.	System uses only low-flow drip, bubblers or low-flow sprinklers	2 (Water)
	C.6.b.	System has smart (weather-based) controllers	3 (Water)
	C.7.	Incorporate 2 inches of compost in the top 6-12 inches of soil	3 (Water)
	C.8.	Mulch all planting beds to the greater of 2 inches or local water ordinance requirement	2 (Water)
		Total points:	**22**

Table 4. *GreenPoint Rated credits related to stormwater*

If stormwater is clean enough, it can be used to fill swimming pools.
Photo: Bassin Takis in Paris, KMD Architects

Integrating LID into San Francisco's Urban Landscape

The illustrations on the following pages show how LID can be integrated into San Francisco's diverse land uses to both protect water quality and contribute to the character of a given location. The figures illustrate stormwater management strategies appropriate for each of the following land uses:

- High-density Residential
- Low-density Residential
- Mixed Use
- Industrial
- Open Space and Natural Areas
- Piers over Water
- Former Shipyards

The figures are not meant to provide a comprehensive list of stormwater design solutions that are possible in San Francisco. Rather, they offer ideas and examples of the benefits that result from the implementation of multi-purpose LID.

A creek daylighting project in Zurich, Switzerland protects and improves water quality, by keeping it out of the sewer, and transforms the streetscape.

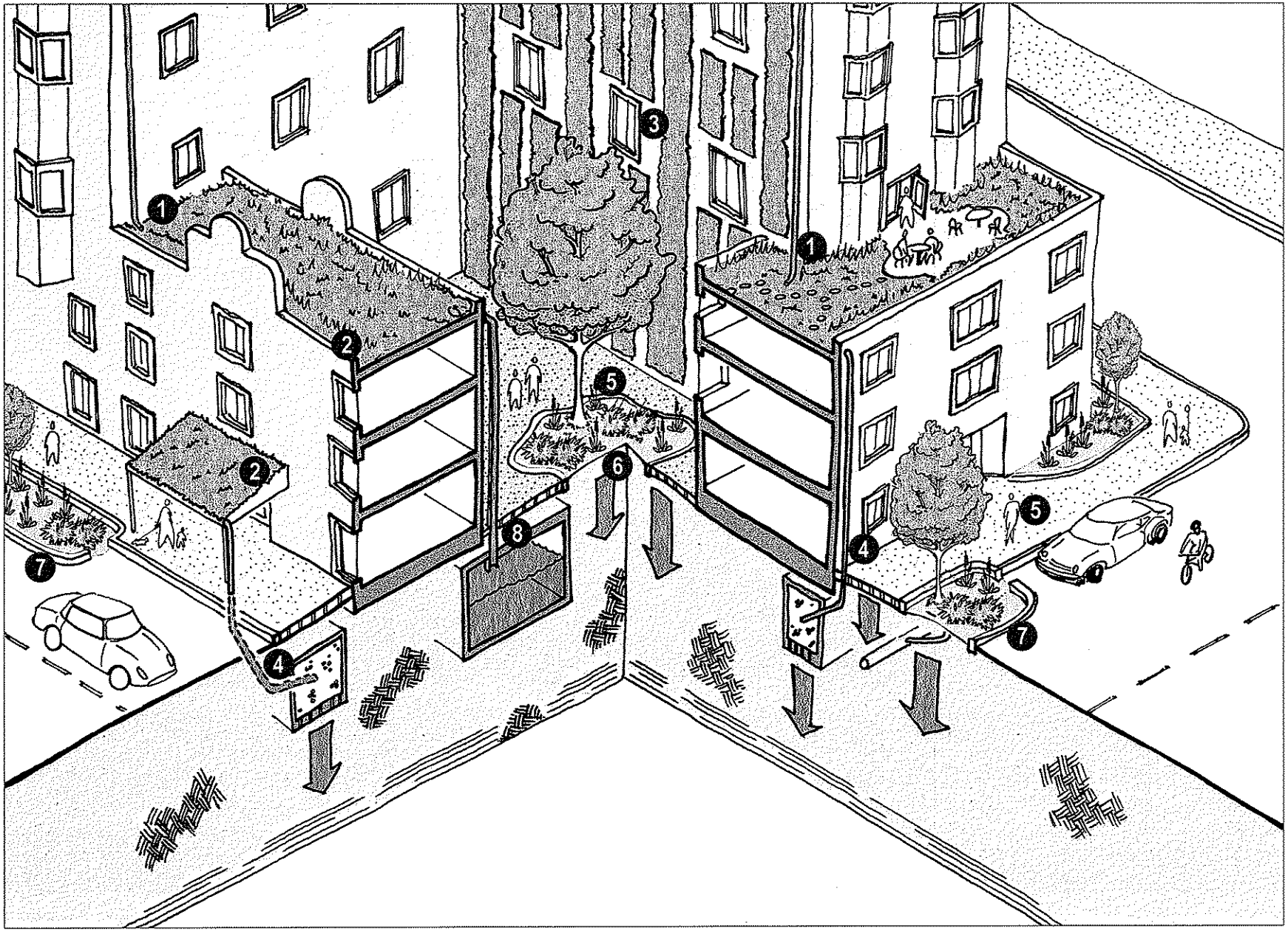

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Figure 9. High-density Residential

In San Francisco, high-density residential development is classified as 40 or more living units per acre. Some defining characteristics of high-density residential are zero-lot line development, reduced, public open space, and high levels of imperviousness. In this context, the greatest opportunities for stormwater management reside in replacing impervious surfaces with pervious surfaces and adding green space to roofs and interior courtyards. Ample roof space with relatively low pollutant loads provides opportunities for eco-roofs and rainwater harvesting. Interior courtyards can accommodate landscape-based BMPs, permeable paving, and subsurface treatment or capture systems. Sidewalks and streets adjacent to high-density residential development are often the nearest public open spaces available to residents. As such, they are ideal places to site stormwater management BMPs that also improve streetscape aesthetics and provide wildlife habitat, such as biofiltration areas, street trees, green walls, and bioretention bulbouts. All of these measures help to manage stormwater runoff; they also reduce the volumes of stormwater generated by the site in the first place.

1. Downspout Discharges to Vegetated Roof to Reduce Runoff
2. Vegetated Roof to Reduce Runoff
3. Green Wall to Slow Runoff
4. Downspout Connected to Dry Well
5. PermeablePaving in Pedestrian Areas
6. Rain Garden for Bio-Infiltration
7. Bio-Retention Planter with Curb Cuts
8. Downspout Connected to Large-Scale Cistern for Rainwater Harvesting

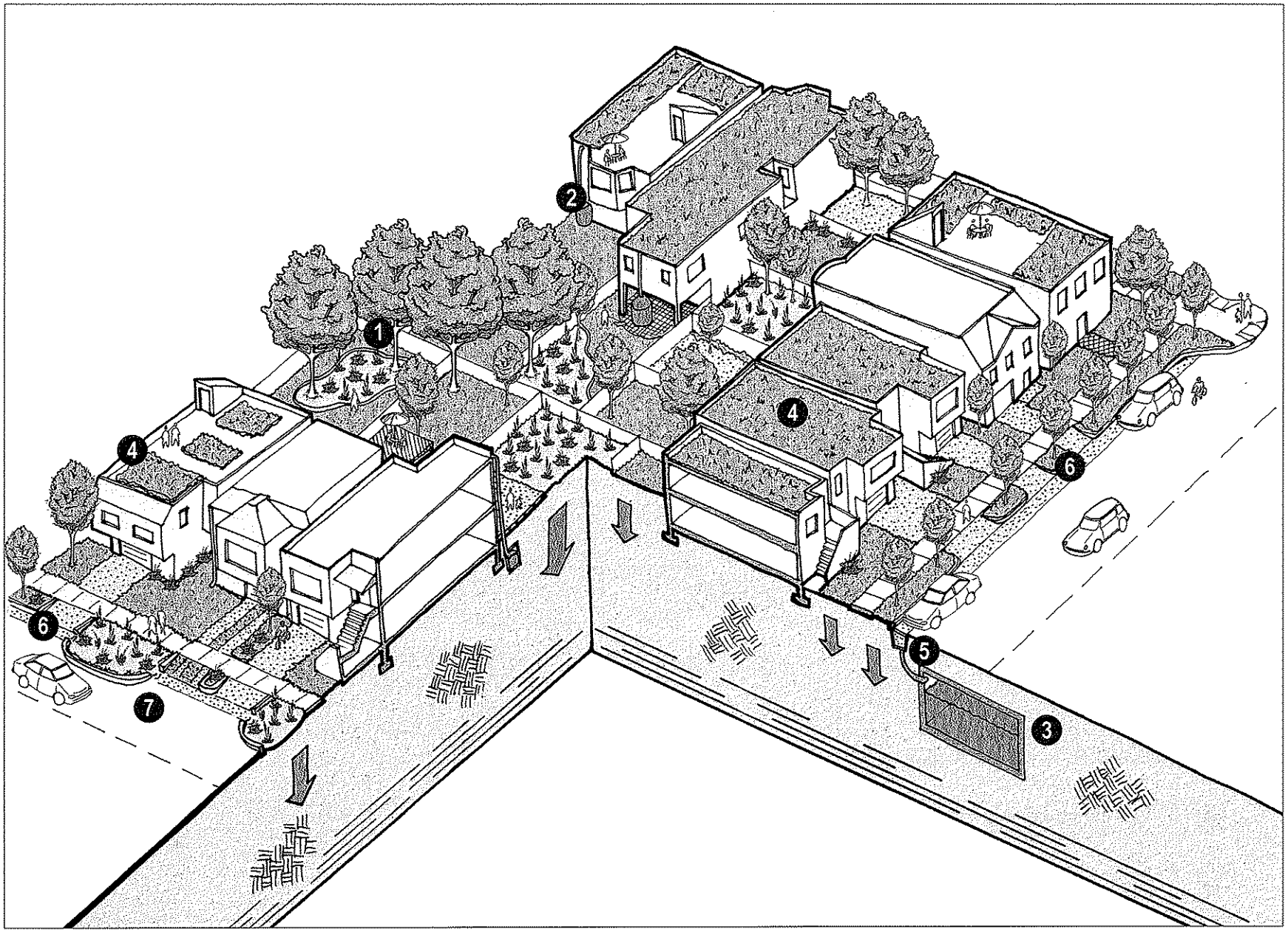
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Figure 10. Low-density Residential

In San Francisco, low-density residential development refers to 24 living units per acre or fewer. Low-density residential parcels typically include open space in the form of yards and setbacks, wider sidewalks than those found in high-density residential, and rooftops that are more likely to be under the control of a single owner. Low-density residential parcels therefore tend to both generate less stormwater and have more space in which to manage stormwater than high-density areas. Diverse parcel sizes and shapes, along with variability in building footprints, provide opportunities for site-specific stormwater management designs.

1. Rain Garden for Bio-Infiltration
2. Downspout Connected to a Rain Barrel
3. Cistern to Store Rainwater for Irrigation
4. Vegetated Roof to Reduce Runoff
5. Infiltration Trench
6. Permeable Paving
7. Bio-Retention Planter with Curb Cuts

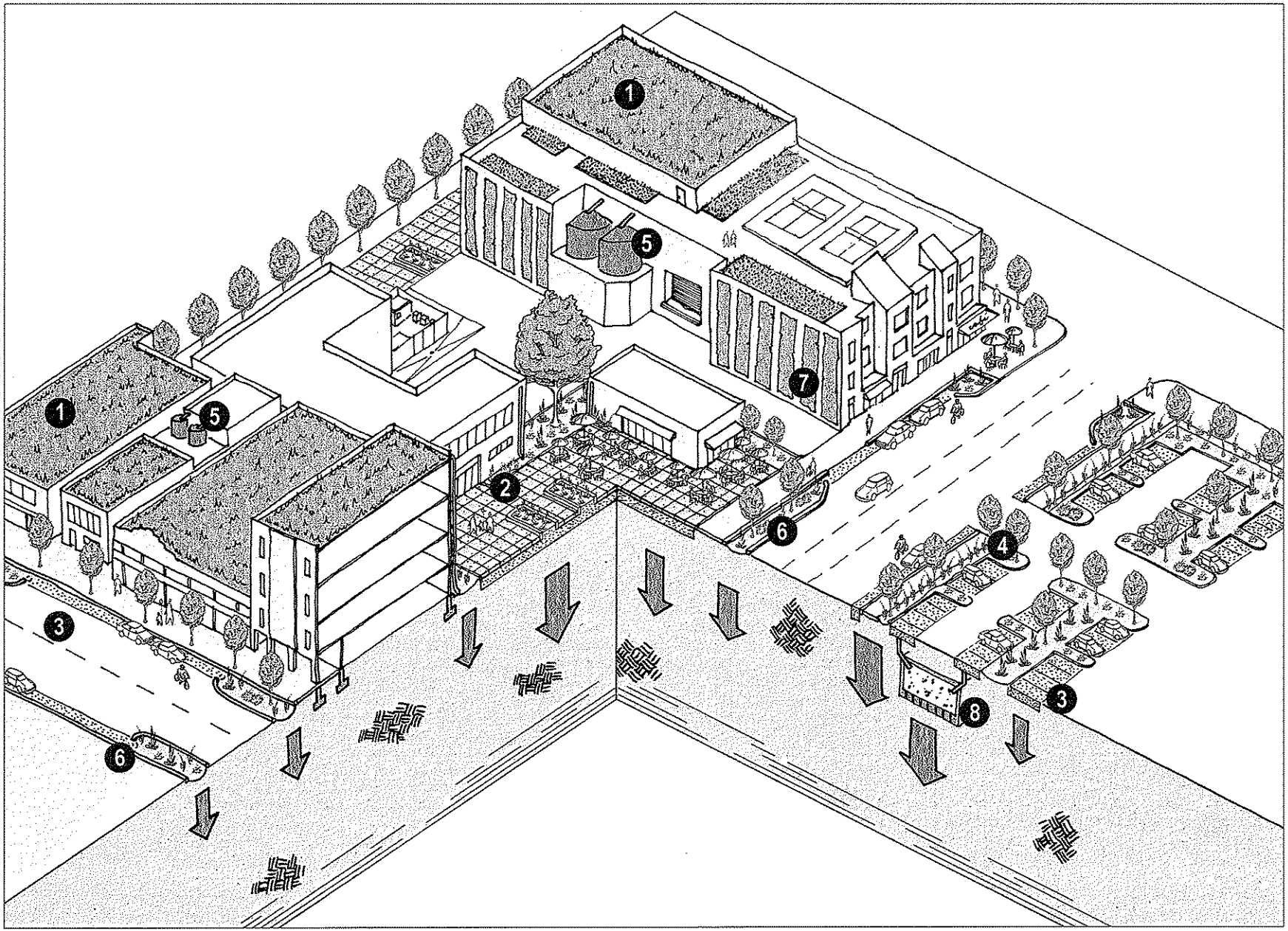
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Figure 11. Mixed Use

Many new, redevelopment, and infill projects in San Francisco include mixed-use areas. Mixed use development fosters a high level of activity throughout the day, resulting in an active public realm. Roofs, public plazas, setbacks, parking lots, and the public right-of-way are all spaces that can double as LID measures that improve the quality of the public realm and achieve stormwater management goals. Of these spaces, roofs generally have the lowest pollutant loads while streets have the highest. The commercial elements of mixed use development sometimes require special attention. For example, restaurants and light industrial activities will need to implement source controls targeting grease, litter, and other food wastes.

1. Vegetated Roofs to Reduce Runoff
2. Permeable Paving in Pedestrian Areas
3. Permeable Paving in Parking Areas
4. Swales in Parking Lots
5. Cistern to Store Rainwater for Toilet Flushing
6. Bio-Retention Planter with Curb Cuts
7. Green Wall to Slow Runoff
8. Dry Well

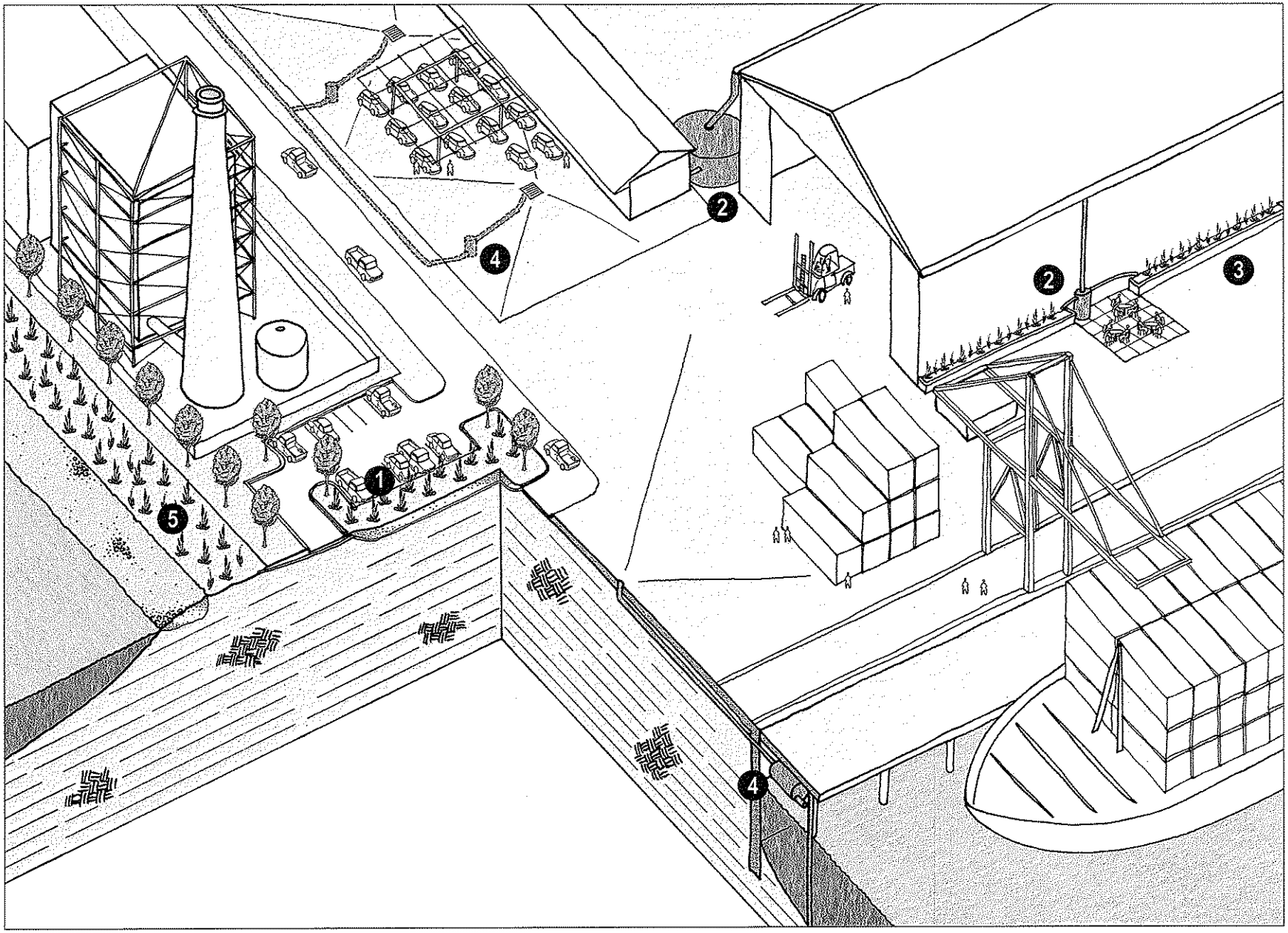
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Figure 12. Industrial

Industrial land uses in San Francisco are concentrated in the Bayside watersheds. Because industrial areas often contain potentially polluting activities coupled with large impervious areas, treating stormwater on-site in these areas is essential. Industrial land use is generally characterized by large, low-density structures that provide ample space for treatment measures. Stormwater management strategies in industrial areas can serve not only to protect water quality but also to provide high quality rest areas for workers, act as a buffer for adjacent land uses, and maintain public access to waterfront open space where appropriate. Pollutants associated with industrial activities – chemical waste storage, for example – require special source control strategies such as hydraulic isolation and treatment in areas where polluting activities occur.

1. Swales in Parking Lots
2. Cisterns to Store Rainwater for Vehicle Washing
3. Flow-through Planters to Improve Water Quality
4. Vortex/Swirl Separator or Media Filter
5. Vegetated Buffer Strip

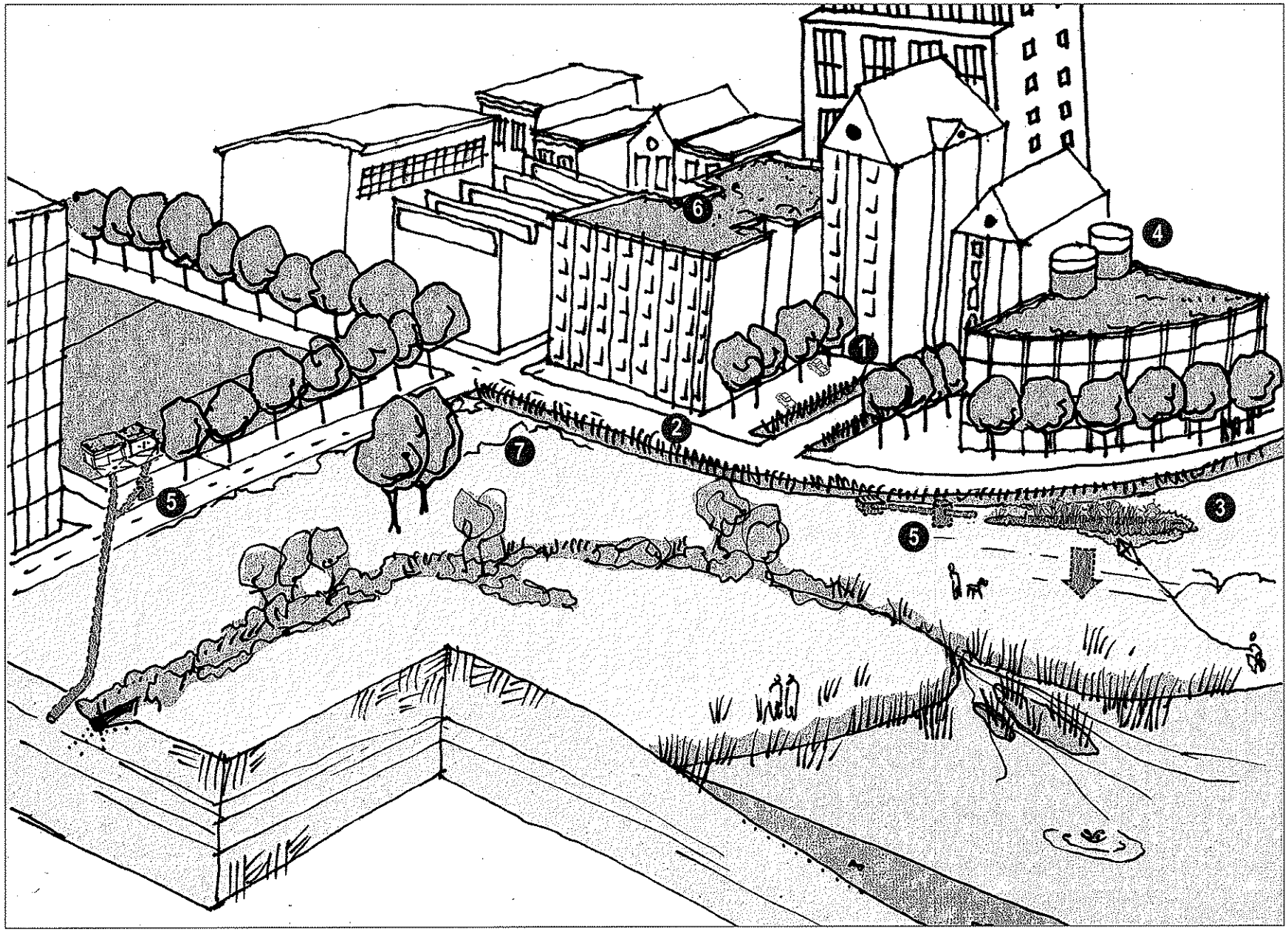
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Figure 13. Open Space

San Francisco's open spaces provide space for passive and active recreation, wildlife habitat, and environmental education. Open space areas also contribute to air and water quality protection. Some open space areas, most notably Lake Merced, include water bodies whose health and function depend upon protection from adjacent polluting activities. To that end, stormwater BMPs can be sited on less sensitive open spaces to protect the more sensitive core areas. Open spaces can often accommodate larger stormwater treatment trains that integrate stormwater management with other ecological functions. Because of this, stormwater management in open spaces can make significant contributions toward restoring natural hydrology and ecosystem health. Open spaces that are opportunity sites for LID include parks, recreational areas, school playfields, and natural areas.

1. Swales in Parking Lots and Roadways
2. Swales to Buffer Open Space from Development
3. Constructed Wetlands to Buffer Open Space from Development
4. Cistern to Store Rainwater for Irrigation
5. Street Drains to Wetland via Swirl Separator; Trash Area Drains to Sewer via Swirl Separator
6. Vegetated Roof to Reduce Runoff
7. Vegetated Slope to Reduce Erosion/Sedimentation

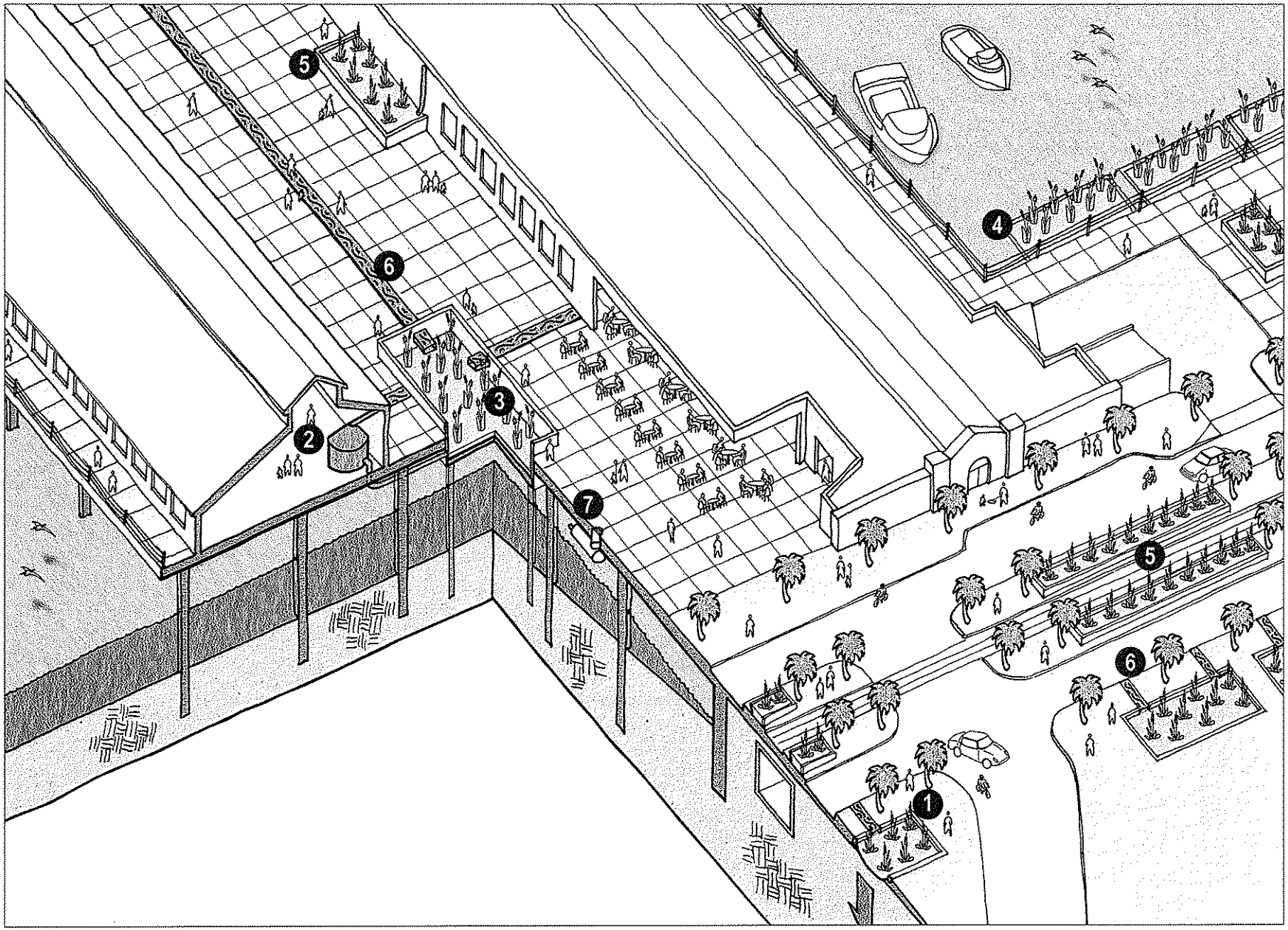
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Figure 14. Piers Over Water

Piers over water are common along San Francisco's waterfront. They are frequently the site of redevelopment projects seeking to adaptively reuse attractive and unique historic properties. Development on piers over water includes a wide variety of land uses, including commercial, recreational, industrial, and maritime uses. Because runoff from piers over water often flows directly to the Bay without the benefit of dedicated conveyance structures, stormwater management on piers over water requires creative infrastructure solutions. Limited space, cultural and historic preservation requirements, and public access goals all impose additional design constraints. The transition between piers and streetscape may provide opportunities for landscape-based stormwater management strategies that may not be feasible on the piers themselves. In some cases, media filtration devices may be the only feasible option for certain aspects of pier redevelopment.

1. Rain Gardens in the Streetscape
2. Cistern for Rainwater Harvesting
3. Detention Pond
4. Vegetated Pontoons for Biofiltration*
5. Above Ground Planter for Biofiltration
6. Trench Drains for Conveyance
7. Vortex/Swirl Separator or Media Filter

* See the Emerging Technologies factsheet in Appendix C for more about vegetated pontoons.

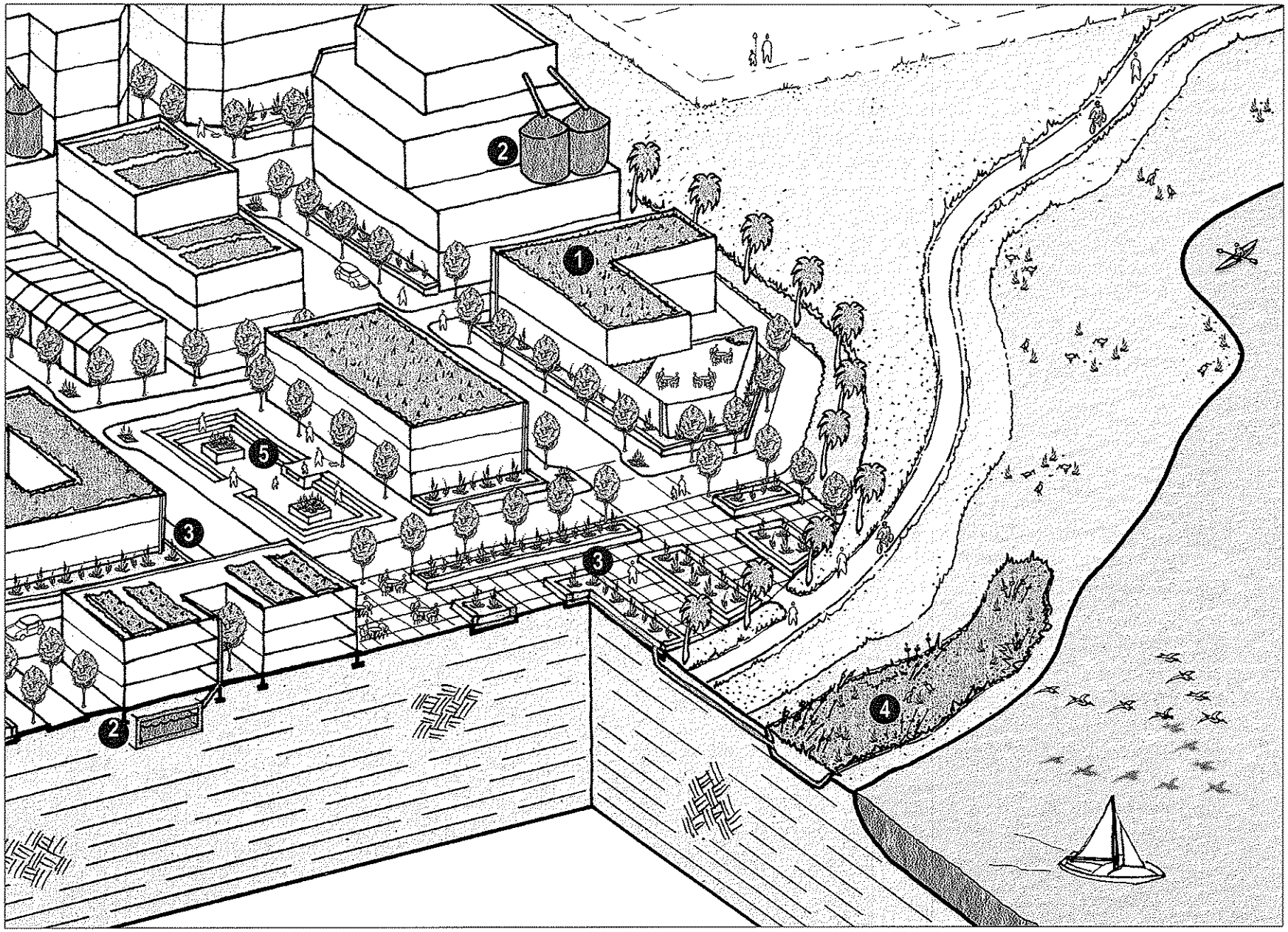
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Figure 15. Former Shipyards

A number of San Francisco's redevelopment areas are former shipyards. Former shipyards have a variety of challenging conditions associated with them, such as a high water table, uncompacted fill, and legacy pollutants from historic shipyard activities. Historic pollution can limit the feasibility of certain LID measures, and those LID measures that are implemented will often require engineered liners to prevent mobilization of subsurface contaminants. Despite these challenges, redevelopment of former shipyards offers significant opportunities for innovative and comprehensive stormwater management because it often requires building new infrastructure systems.

1. Vegetated Roofs to Reduce Runoff
2. Cisterns to Harvest Rainwater for Heating and Cooling
3. Rain Gardens for Biofiltration
4. Constructed Wetland to Buffer Water from Urban Development
5. Urban Stormwater Plaza/Detention Pond

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Port Plan Approval

To ensure consistent implementation of LID in new and redevelopment projects in San Francisco's separate sewer areas, the Port requires all projects disturbing 5,000 square feet or more to comply with stormwater performance measures in order to gain plan approval.

Project applicants subject to these *Guidelines* will be required to complete a Stormwater Control Plan (SCP) to demonstrate that they have met San Francisco's stormwater requirements. The requirements are performance-based and are very similar to those used in other Bay Area Cities. The stormwater performance measures for projects served by separate storm sewer systems under Port jurisdiction require the capture and treatment of:

- The flow of stormwater runoff resulting from a rain event equal to at least 0.2 inch per hour intensity; **or**
- Eighty percent or more of the annual stormwater runoff volume, determined from unit basin storage volume curves for San Francisco.

Project applicants developing or redeveloping properties subject to these performance measures must complete a SCP for project approval. The SCP will allow the Port, the SFPUC, and the Planning Department to certify compliance with these requirements. The contents of the SCP are described in the next section, and a SCP template is provided in Appendix C.

Project applicants must also ensure compliance with other stormwater regulations that may apply to their project. For instance, construction sites greater than 1 acre are generally required to seek coverage under the *California Statewide General Permit for Stormwater Discharges Associated with Construction Activities.* Specific types of commercial and industrial operations must seek coverage under the *California Statewide General Permit for Stormwater Discharges Associated with Industrial Activities.*

Port Requirement

All qualifying projects in the separate storm sewer area that disturb 5,000 square feet or more of the ground plane are required to capture and treat rainfall from a 0.2-inch per hour event **or** eighty percent or more of the annual stormwater runoff volume, determined from unit basin storage volume curves for San Francisco. Disturbed area includes any movement of earth, or a change in the existing soil cover or the existing topography. Land disturbing activities include, but are not limited to, clearing, grading, filling, excavation, or addition or replacement of impervious surface.

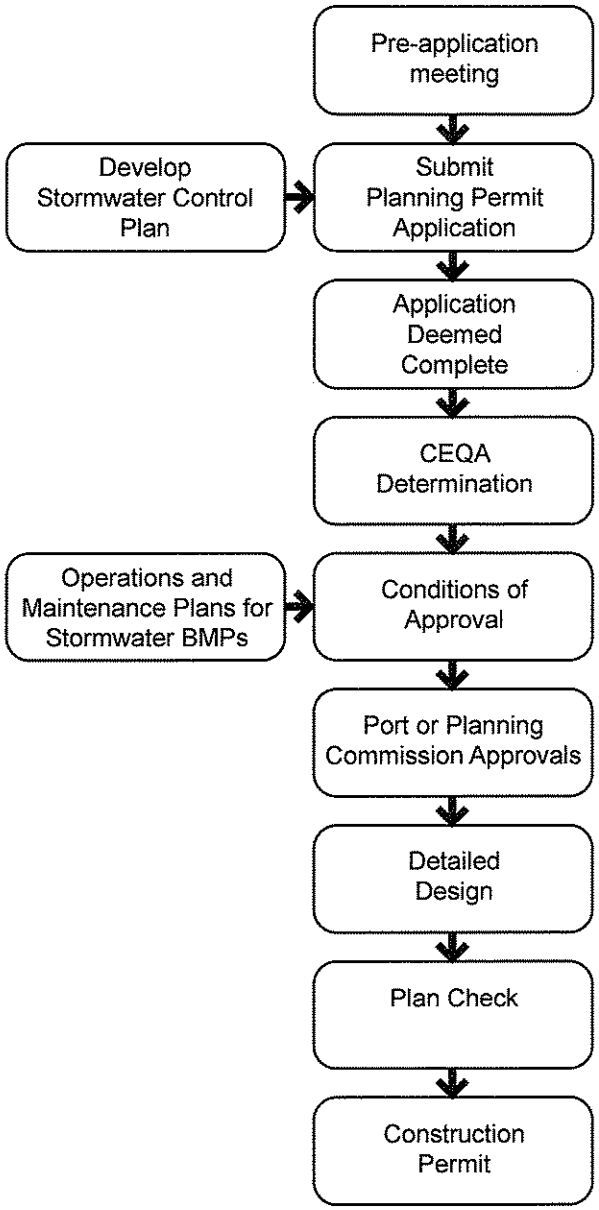

Figure 16. *The SCP submittal and plan approval process.*

The Development Review Process

The Port has integrated SCP review into its existing development review processes. A simplified diagram for a typical development review process is shown in Figure 16.

The SCP must be submitted along with the development application for Planning Review. Planning Department staff will often request that applicants provide a preliminary site layout, preliminary landscaping plan, elevation drawings, or other illustrations for review at a pre-submittal meeting. Project applicants will also discuss their preliminary SCP at the pre-submittal meeting. At this stage project applicants should bring a drainage plan with proposed locations for BMPs.

CEQA

Most projects subject to the requirements of these *Guidelines* will also require some level of CEQA review. The California Environmental Quality Act (CEQA) environmental review imposes both procedural and substantive requirements for environmental protection. CEQA requires local jurisdictions to identify and evaluate the environmental impacts of their actions, including zoning decisions and discretionary land-use approvals. The CEQA process provides decision-makers and members of the public with information about potentially adverse environmental impacts and requires implementation of feasible alternatives and mitigation measures in order to reduce those impacts.

CEQA is intended to minimize the environmental impacts of development activities, which is consistent with the objectives of these *Guidelines*. The basic purposes of CEQA are to:

- Inform decision-makers and the public about the potential significant environmental effects of proposed activities.
- Prevent significant, avoidable damage to the environment by requiring changes in projects through the use of alternatives or mitigation measures when the governmental agency finds the changes to be feasible.
- Disclose to the public the reasons why a governmental agency approved the project in the manner the agency chose if significant environmental effects are involved.

The CEQA Initial Study Checklist

The Phase II General Permit requires local municipalities to evaluate water quality effects and identify appropriate mitigation measures when conducting environmental review of proposed projects. This effort can be integrated into the completion of the CEQA Initial Study Checklist. The CEQA Initial Study Checklist is used to determine whether a given project will have significant impacts on the environment.

The San Francisco Planning Department's Initial Study Checklist contains questions that link potentially significant project impacts to requirements under the CWA and the California Water Code:

- Question 14.a: **"Would the project violate any water quality standards or waste discharge requirements?"** This question evaluates a project's compliance with water quality standards and considers the project's potential effect on water bodies on the Section 303(d) list.
- Question 14.d: **"Would the project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner that would result in substantial erosion or siltation on- or off-site?"** This question investigates the potential effects of increased runoff peak flows and durations.
- Question 14.e: **"Would the project create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial new sources of polluted runoff?"** This question evaluates the potential impacts of pollutants in runoff and increased stormwater flows to the collection system.
- Question 14.f: **"Would the project otherwise substantially degrade water quality?"** This question is the most tightly linked to the *Guidelines*. The intent of these *Guidelines* is to ensure that projects do not degrade water quality.

Port, SFPUC, and City Planning staff will work with project applicants to ensure that the CEQA Initial Study Checklist clearly articulates potential impacts that the project may have on the quantity and quality of stormwater runoff. BMPs required by the *Guidelines* will reduce stormwater impacts by controlling sources of pollution, reducing site imperviousness, and providing for treatment facilities that retain, detain, or treat runoff.

The CEQA process is generally administered in several steps:

1. Review of the CEQA checklist to determine the appropriate level of review.

2. Issuance of a Categorical Exemption for projects exempt from CEQA review.

3. Preparation of an Initial Study to characterize the environmental effects of the project.

4. Preparation of an Environmental Impact Report (EIR) or Negative Declaration.

In cases where a higher level of environmental review is required for project approval, such as a Mitigated Negative Declaration or an EIR, the CEQA process may require the consideration of project alternatives. Because the final project configuration is uncertain, it may not be possible to complete a SCP prior to CEQA approval. In such cases, a preliminary SCP would be required to be completed once the project configuration is finalized. The SCP must be completed and approved before the applicant begins final design drawings for the project.

If CEQA approval for a project includes mitigation measures, project applicants will be required to participate in a mitigation monitoring and reporting program (MMRP). CEQA requires the MMRP to ensure compliance with adopted mitigation measures during project implementation. The MMRP specifies the required actions and monitoring that are required for each mitigation measure recommended in the EIR. The requirements for the construction and maintenance of stormwater BMPs described in the SCP can be used in the MMRP for EIRs and Mitigated Negative Declarations.

The San Francisco Planning Department prepares CEQA documents for proposed City projects. If the CEQA analysis determines that a project would have a significant or potentially significant impact on hydrology and water quality, then the project would be required to administer mitigation measures that would reduce the impact to less than significant, or the City would need to make Findings of Overriding Considerations.

Project applicants must meet the stormwater performance measures described in these *Guidelines* to avoid negative impacts to water quality. By doing so, they may avoid triggering CEQA mitigation requirements. Projects receiving a Categorical Exemption or Negative Declaration under CEQA are still required to submit a complete SCP in order to gain project approval.

Multi-Parcel Projects

While compliance with the *Guidelines* is required for all new and redevelopment projects greater than 5,000 square feet, master-planned and multi-parcel projects offer the greatest opportunity for regional LID elements (i.e., stormwater facilities serving more than one parcel) such as treatment wetlands, water features, and wet ponds. The Port and SFPUC will work with project applicants who are proposing large projects to develop a comprehensive Stormwater Control Plan (SCP) that integrates stormwater management approaches across multiple parcels.

Requirements for a comprehensive SCP and associated Operations and Maintenance Plan will follow the methodology for preparation of an SCP, as discussed in later sections of the *Guidelines*. During CEQA review for large projects, greater emphasis will be placed on the relationship between overall stormwater infrastructure development and the development of specific parcels. Please contact Port staff to initiate this process.

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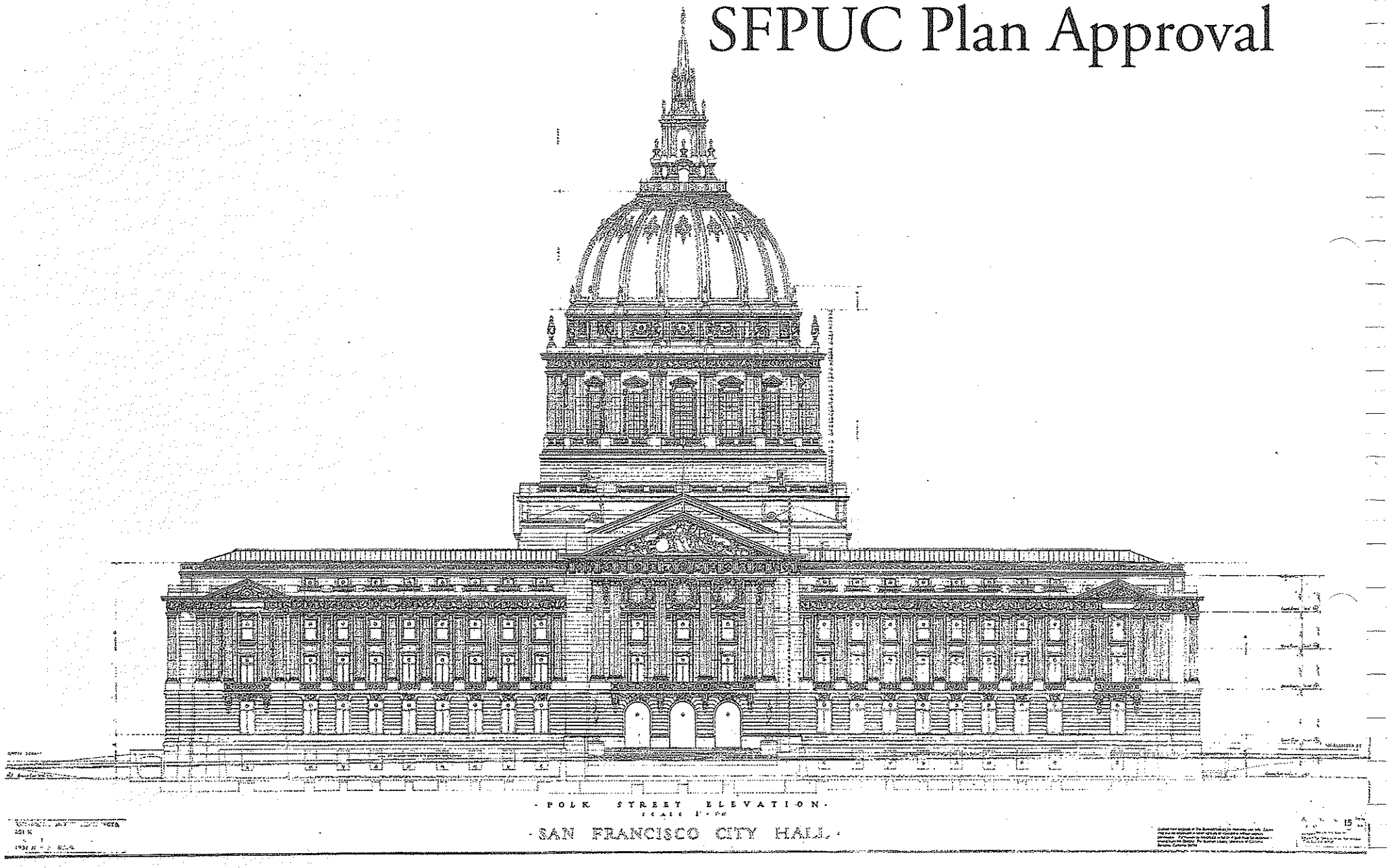
SFPUC Plan Approval



To ensure consistent implementation of LID in new and redevelopment projects in San Francisco, the SFPUC requires all projects disturbing 5,000 square feet or more to comply with stormwater performance measures in order to gain plan approval.

In separate sewer areas under SFPUC jurisdiction, applicants proposing new or redevelopment projects that either a) disturb 5,000 square feet or more of the ground plane, or b) are subject to San Francisco's Green Building Ordinance, are required to:

- Capture and treat the rainfall from a design storm of 0.75 inch using acceptable best management practices (BMPs); and
- Complete a Stormwater Control Plan (SCP) demonstrating how the project will capture and treat rainfall from the 0.75-inch design storm.

This performance measure is equivalent to LEED Sustainable Sites Credit 6.2 titled "Stormwater Design: Quality Control." The rainfall depth of 0.75 inch is the LEED-based performance measure for semi-arid watersheds.

In combined sewer areas under SFPUC jurisdiction, applicants will be required to reduce the flow rate and volume of stormwater going into the combined system by achieving LEED Sustainable Sites Credit 6.1 titled "Stormwater Design: Quantity Control."

The SCP requirement will allow the SFPUC, the Department of Building Inspection (DBI), and the Planning Department to verify compliance with stormwater requirements. The *Guidelines* chapter entitled, "The Stormwater Control Plan," describes the required contents of a SCP and also provides sizing instructions for stormwater treatment BMPs to comply with this requirement. A SCP template is provided in Appendix C.

SFPUC Requirement

Developments or redevelopments disturbing 5,000 square feet or more of the ground surface are required to manage stormwater on-site. Land disturbing activities include, but are not limited to, clearing, grading, filling, excavation, or addition or replacement of impervious surface.

In separate sewer areas, applicants must achieve LEED SS6.2 and demonstrate compliance in a SCP.

In combined sewer areas, applicants must achieve LEED SS6.1 and demonstrate compliance in a SCP.

How does LEED Credit SS6.2 compare to the General Permit requirements?

San Francisco's GBO adopts performance measures drawn from LEED, a nationally-recognized standard. Analysis indicates that the performance measure listed in LEED 6.2 is roughly equivalent to the performance measures listed in the General Permit, with LEED 6.2 being slightly more stringent (by about 2%). The proposal to use LEED-based performance measures was approved by the RWQCB on December 19, 2008.

GBO Project Thresholds

Midsize Residential
(5+ units and < 75 feet height to highest occupied floor)

High-Rise Residential
(5+ units and > or = 75 feet height to highest occupied floor)

Mid-Size Commercial Office Building of a B Occupancy
(>5,000 SF and <25,000 SF)

New Large Commercial Office Building of a B Occupancy
(>25,000 SF)

Table 5*. Projects required to achieve stormwater points under the Green Buliding Ordinance*

The Green Building Ordinance

On November 3, 2008, the City of San Francisco's Building Code was amended to include Chapter 13C, "Green Building Requirements," known as the Green Building Ordinance (GBO). The code requires certain types of new and redevelopment projects constructed in San Francisco to meet green building standards developed by San Francisco's Green Building Task Force. Many of the standards are based on LEED, a green building rating system developed by the United States Green Building Council (USGBC). Projects that fall into one of four building categories listed in Table 5 must comply with the GBO by obtaining specified levels of LEED certification. For the full text of the GBO, go to http://www.sfenvironment.org/downloads/library/sf_green_building_ordinance_2008.pdf.

The GBO requires projects to obtain LEED's Sustainable Sites credit entitled "Stormwater Design: Quantity Control" (SS6.1) or "Stormwater Design: Quality Control" (SS6.2), depending on whether the site is in a separate or combined sewer area.

For the full text of Credits SS6.1 and SS6.2, see pages 75-87 of the "LEED for New Construction and Major Renovation Reference Guide, Version 2.2."

The GBO refers to both LEED and these *Guidelines* in Section 1304C.0.3:

Stormwater management shall meet the "Best Management Practices" and "Stormwater Design Guidelines" of the San Francisco Public Utilities Commission, and shall meet or exceed the applicable LEED SS 6.1 and 6.2 guidelines.

The applicable LEED credit for separate sewer areas is SS6.2. while the applicable LEED credit for combined sewer areas is SS6.1. SFPUC staff is currently in the process of modeling the impacts of SS6.1 on the combined sewer area and developing calculators for SS6.1. Until this modeling is completed, applicants with questions about projects in the combined sewer should contact SFPUC staff for direction.

Projects subject to stormwater requirements under the GBO that do not disturb 5,000 square feet of the ground surface must achieve LEED Certification and achieve either LEED SS6.1 or LEED SS6.2, but need not submit a Stormwater Control Plan. Only projects disturbing 5,000 square feet or more need to submit a SCP.

The Development Review Process

The SFPUC has integrated the review of SCPs with the City's development review process. All projects disturbing 5,000 square feet or more must submit a SCP. A diagram showing how the SCP fits into a typical development review process is shown in Figure 17.

Project applicants must also ensure compliance with all stormwater regulations that may apply to their projects. For instance, construction sites greater than 1 acre are generally required to seek coverage under the California Statewide General Permit for Stormwater Discharges Associated with Construction Activities. Specific types of commercial and industrial operations must seek coverage under the California Statewide General Permit for Stormwater Discharges Associated with Industrial Activities.

Permit applicants that are also subject to the GBO will be required to receive third-party verification by the Green Building Certification Institute (GBCI), USGBC's official accreditation and certification body; or by the project's Green Building Compliance Professional of Record. The building permit application must include a complete LEED checklist, as stipulated in Administrative Bulletin for Chapter 13C (AB-093), which outlines administrative procedures for meeting green building requirements (see http://www.sfgov.org/site/dbi_index.asp?id=89703). The LEED Version 2.2 checklist includes Credits SS6.1 and SS6.2, and applicants must indicate their intent to comply in order to receive a building permit.

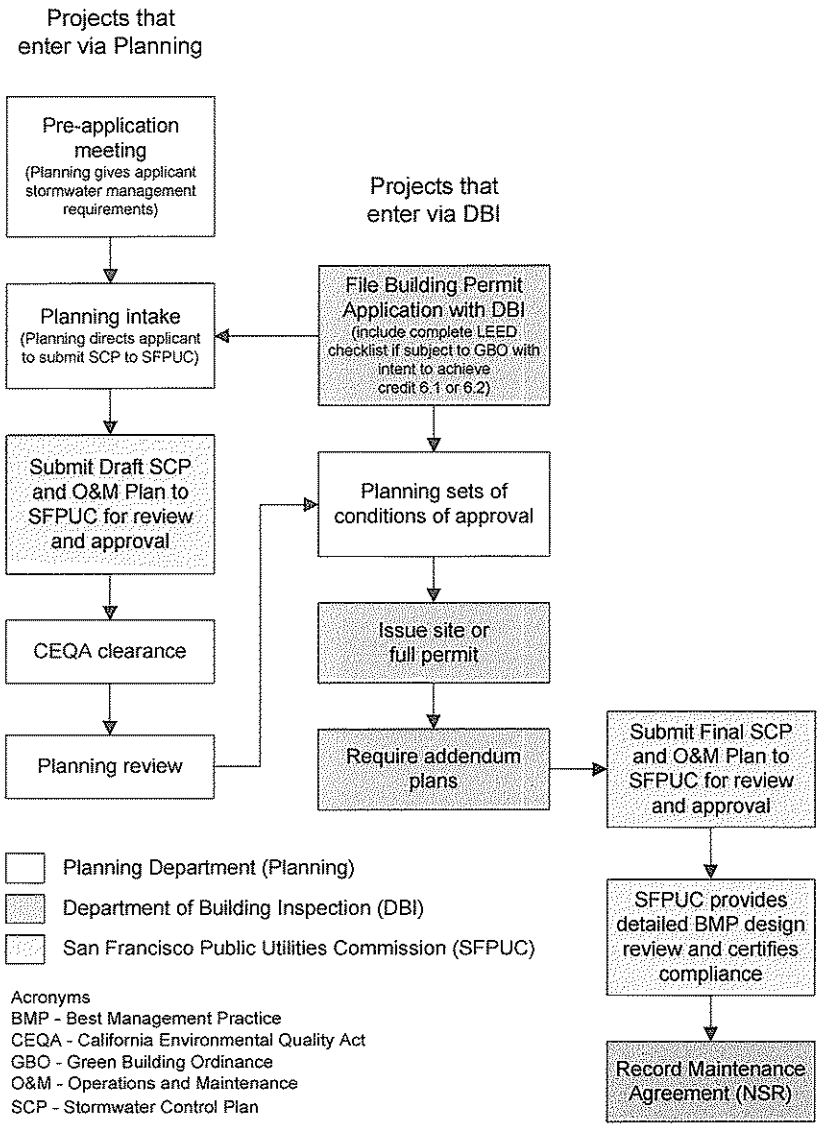
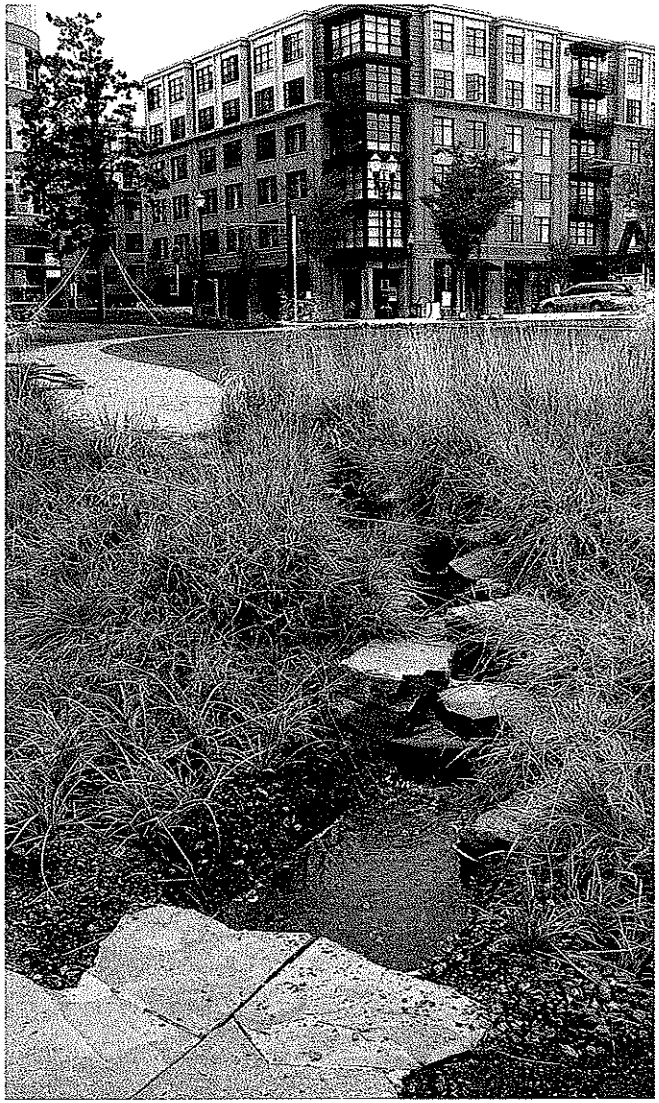


Figure 17. *The Stormwater Control Plan submittal and approval process*



LID measures like the stormwater wetland in Portland's Tanner Springs Park treat polluted street runoff, thereby minimizing negative impacts to water quality.

References and Resources

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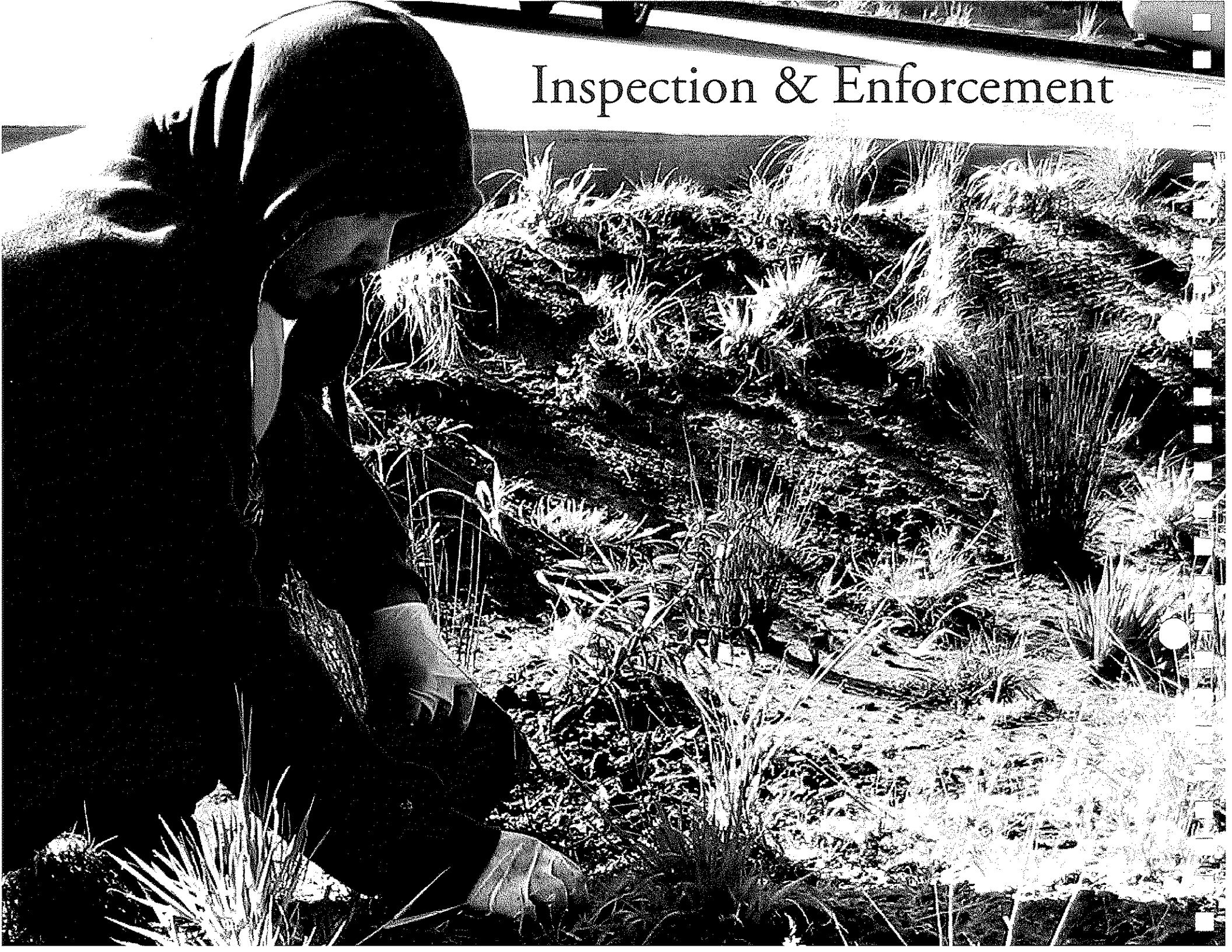
The Western Harbor, located in Malmo, Sweden, conveys and treats stormwater by implementing both parcel and block-scale surface systems that direct runoff to vegetation and ponds, which double as amenities throughout the neighborhood. Habitat value is enhanced through the use of various vegetation types. Photo: Andres Power

Inspection & Enforcement



The SFPUC and the Port require periodic inspections to ensure that BMPs are properly maintained and continue to provide effective stormwater treatment.

Once stormwater management facilities are incorporated into new development and redevelopment projects, the SFPUC and Port require periodic inspections to ensure that they are properly maintained and continue to provide effective stormwater treatment. There are three types of inspections under this operation and maintenance verification program: post-construction building permit inspections, annual self-certification inspections conducted by the property owner, and tri-annual inspections conducted by the Port or the SFPUC, depending on who has jurisdiction on the site. The Port and the SFPUC will also inspect BMPs in response to complaints or emergencies. If maintenance requirements identified through inspections are not completed in accordance with the protocols described in this chapter, the SFPUC or the Port will enact enforcement procedures.

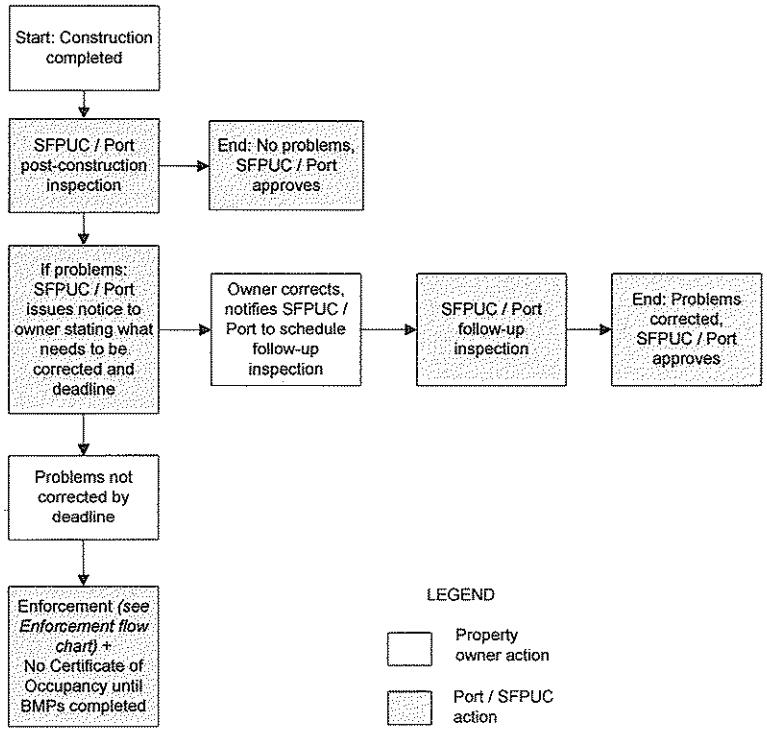


Figure 18. *Post-construction inspections.*

Inspections

Post-construction inspections

The Port or the SFPUC will inspect stormwater BMPs upon completion of construction. These inspections will be based on a standardized inspection checklist. Inspection staff will confirm that stormwater facilities are built in conformance with approved plans.

If there are issues that require follow-up, the Port or the SFPUC will send the property owner a notice stating what corrective action needs to be taken and the timeframe for corrective action. The deadline will be between 24 hours and 30 days from the date of the notice, depending on the severity of the problem. The property owner is responsible for correcting these issues and scheduling a follow-up inspection by the Port or the SFPUC. If the issues are rectified by the time of the follow-up inspection, the Certificate of Occupancy will be issued. A diagram showing the post-construction inspection process is shown in Figure 18.

Annual self-certification

Once BMPs are successfully built, the Port or the SFPUC will send self-certification inspection reminders to property owners at all sites with stormwater BMPs. The reminder will include a submittal deadline and a blank self-certification checklist. The property owner will perform the self-certification inspection and digitally submit the completed checklist and maintenance logs from that year to the SFPUC Collection System Division or to the Port. With this submittal, the property owner will propose either approval or maintenance they will perform if there are outstanding issues that have not been resolved by the submittal date. The Port or the SFPUC will either approve the submittal and renew the certificate of compliance or contact the property owner to schedule an inspection.

If a Port or SFPUC inspection is necessary, the property owner must be present and provide annual maintenance logs. If the issues are rectified by the time of the inspection, the certificate of compliance will be renewed.

For sites at which the property owner does not submit self-certification documents, the Port or the SFPUC will send a notice stating that the deadline has passed and will contact the property owner to schedule an inspection. The notice will include a fee to cover the cost of the inspection plus a penalty. If the inspection indicates that there no maintenance issues requiring follow-up action, the certificate of compliance will be renewed. A diagram showing the annual self-certification process is shown in Figure 19.

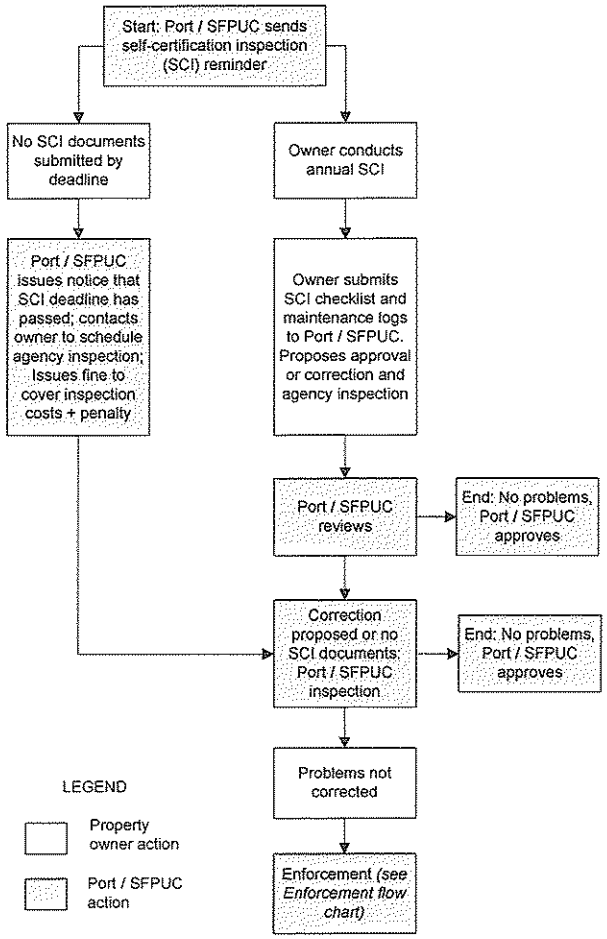


Figure 19. *Annual self-certification inspections.*

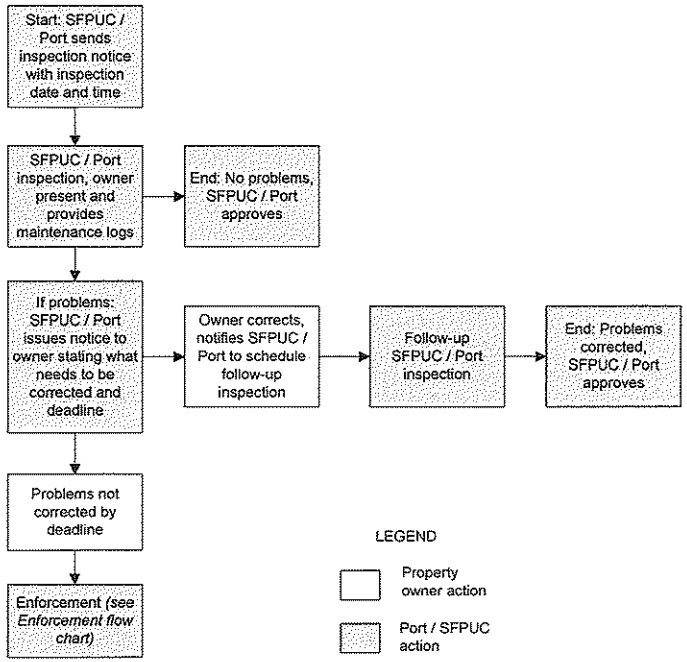


Figure 20. *Tri-annual Port / SFPUC inspections.*

Tri-annual Port / SFPUC inspections

Every third year, the Port or the SFPUC will inspect stormwater BMPs. The agency with jurisdiction on the project site will send inspection notices to property owners at sites due for inspection. The notice will include a proposed inspection date and time and a phone number to call should the proposed date not work for the property owner. The property owner must be present and provide annual maintenance logs. If the inspection indicates that there no maintenance issues requiring follow-up action, the certificate of compliance will be renewed.

If there are issues that require follow-up, the Port or the SFPUC will send the property owner a notice stating what corrective action needs to be taken and the deadline. The deadline will be between 24 hours and 30 days from the date of the notice, depending on the severity of the problem. The property owner is responsible for rectifying the issues and scheduling a follow-up inspection by the Port or the SFPUC within the time allotted. If the inspection indicates that the issues are rectified, the certificate of compliance will be renewed. A diagram showing the tri-annual Port or SFPUC inspection process is shown in Figure 20.

Enforcement

For all three types of inspections, if the property owner is unresponsive or if maintenance issues are not rectified by prescribed deadlines, the Port or the SFPUC will carry out an enforcement action. If an enforcement action becomes necessary, the Port or the SFPUC will issue a warning with a 15-day deadline for the property owner to take corrective action and schedule a follow-up inspection. The warning will include a fee to cover the cost of the inspection plus a penalty. If the inspection indicates that maintenance issues requiring follow-up action have been rectified, the annual certificate of compliance will be renewed. If there are outstanding issues requiring maintenance action or if the owner is unresponsive, the Port or the SFPUC will issue a notice of violation stating that the property owner will be fined. Fines will be levied based upon Article 4.1 of the San Francisco Public Works Code.

If the issues have not been rectified by the end of 25 days, the Port or the SFPUC will perform the required maintenance and will bill the owner for the fine plus the cost of the work. If the owner does not pay the fine and the bill within 30 days, the Port or the SFPUC have the option to initiate lien proceedings against the property. A diagram showing the enforcement process is shown in Figure 21.

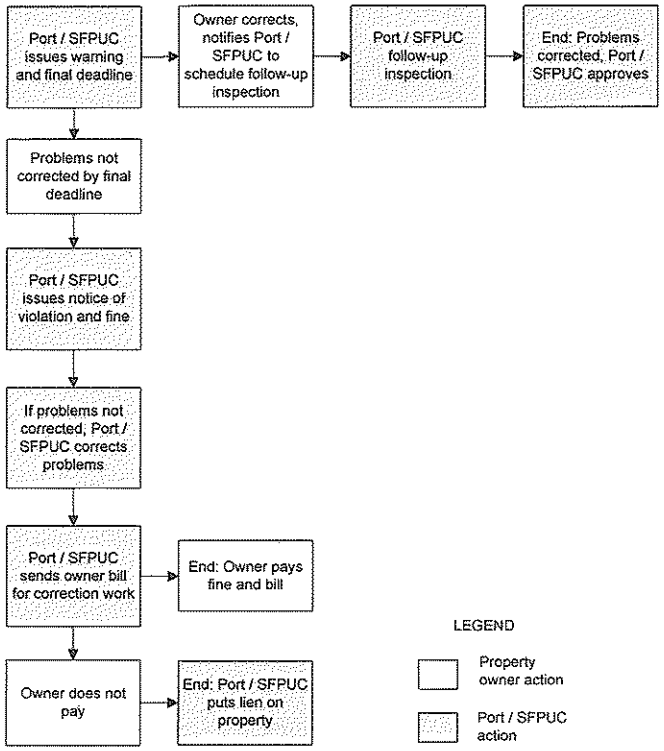
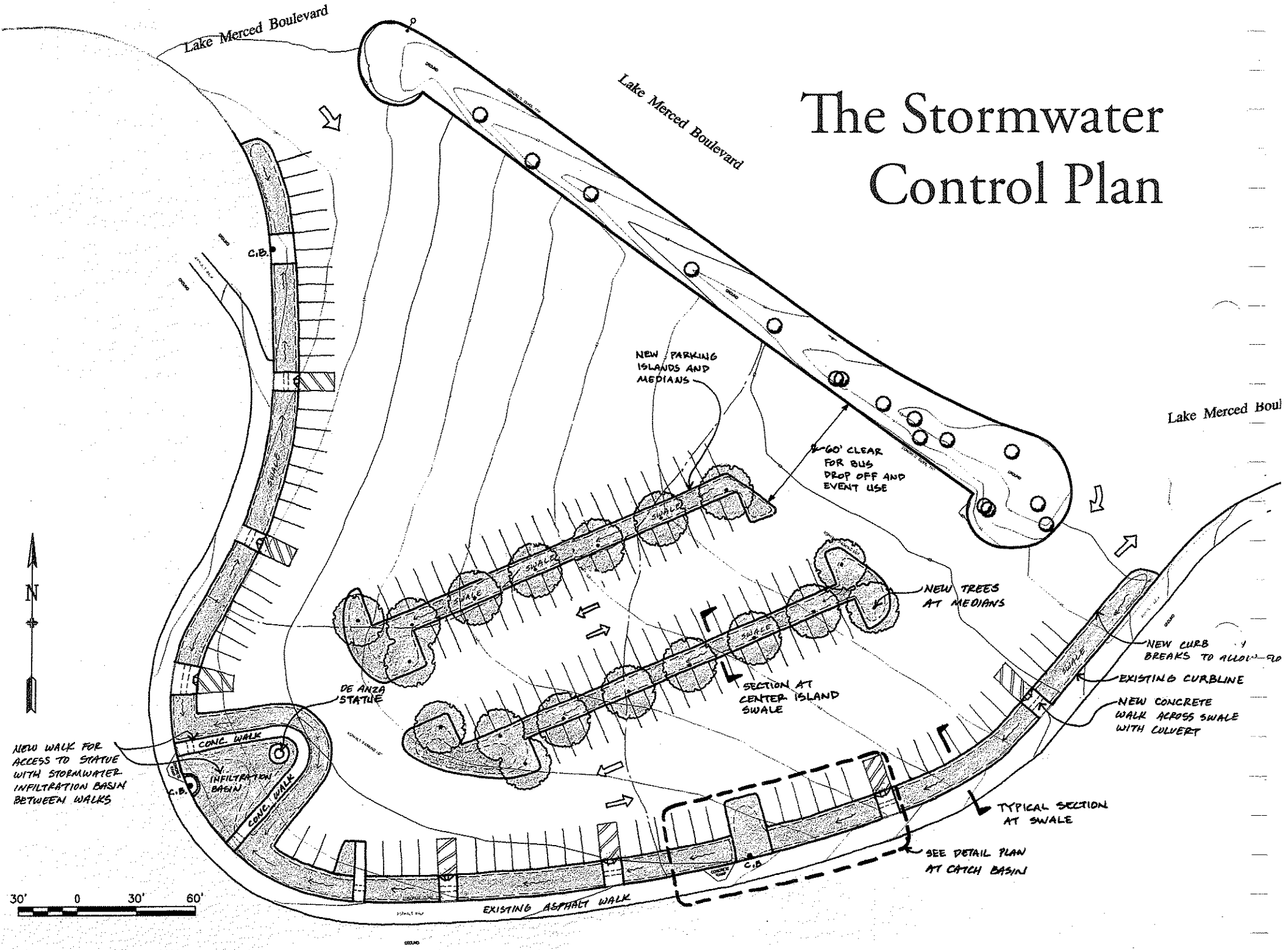


Figure 21. *Enforcement.*

The Stormwater Control Plan



The Port and SFPUC require submittal of a Stormwater Control Plan (SCP) with every development application for discretionary planning approval in San Francisco for all projects disturbing 5,000 square feet or more of the ground plane.

The Port and SFPUC require the submission of a Stormwater Control Plan (SCP). The SCP will allow the Port, the SFPUC, and the Planning Department to review projects that are subject to the *Guidelines* and ensure compliance with them. SCPs must be reviewed and stamped by a California licensed landscape architect, architect, or engineer.

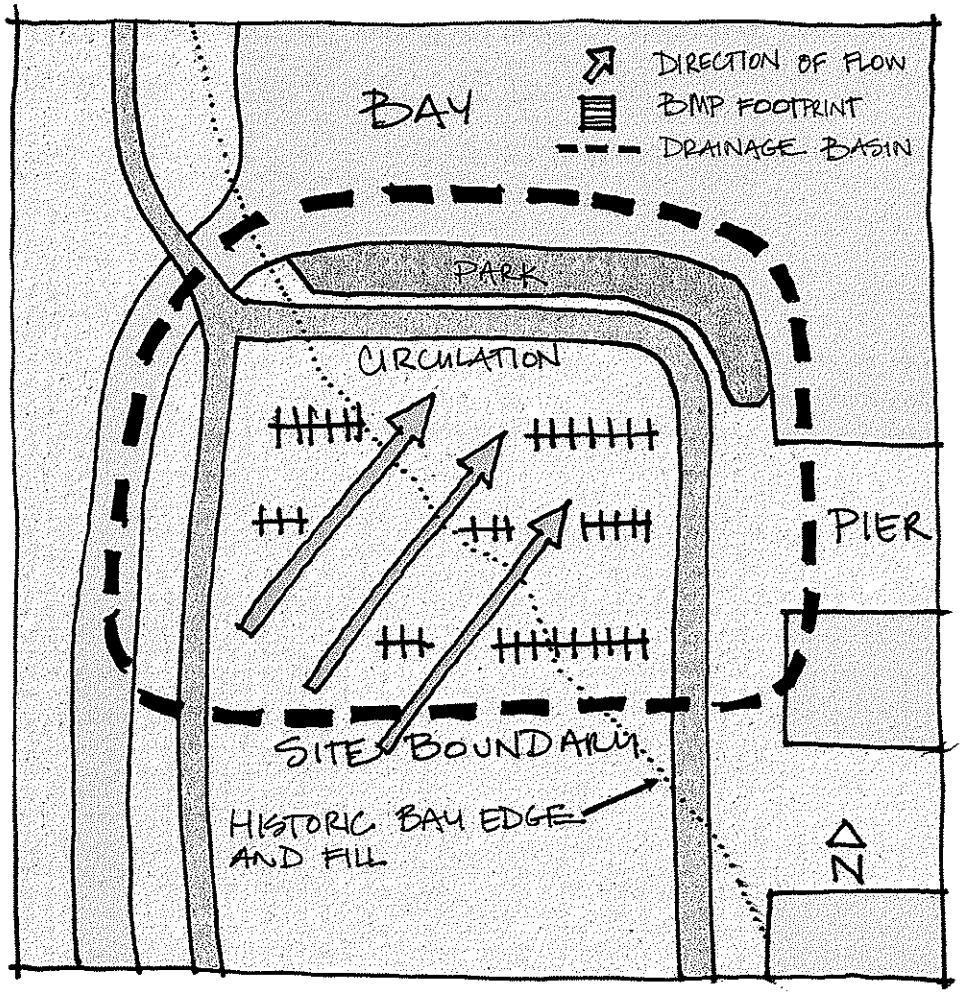
Project applicants must complete each of the following elements in their SCPs to be eligible for project approval:

1. Characterize existing site conditions
2. Identify design and development goals
3. Develop a site plan
4. Develop a site design
5. Select and locate source controls
6. Select and locate treatment BMPs
7. Size treatment BMPs
8. Check against design goals and modify as necessary
9. Develop an operations and maintenance plan
10. Compile the Stormwater Control Plan

Requirement

The Stormwater Control Plan (SCP) must be reviewed and stamped by a licensed landscape architect, architect, or engineer.

Although the elements of the SCP are presented as a series of steps, in practice they should be iterative. For example, although site design comes before BMP sizing in the SCP checklist, BMP sizing results may require designers to make changes to the original site design. The following section provides an overview of each element of the SCP, illustrated by a conceptual drawing. An example of a completed SCP is included in Appendix C.



Step 1

Characterize existing conditions

The stormwater management approach available to a given site is largely dictated by existing site conditions. Soil types, topography and drainage, vegetation types, wildlife habitat, proximity to receiving waters, existing structures, adjacent land uses, and historical and cultural features are all factors that project proponents should consider prior to initiating design of stormwater BMPs. A comprehensive checklist of site conditions that should be evaluated during the site analysis phase can be found in the SCP (Appendix C).

Jurisdictional concerns can influence a site as much as physical conditions. For example, parcels within 100 feet of the San Francisco Bay shoreline are subject to San Francisco Bay Conservation and Development Commission (BCDC) policies governing public access, circulation, and landscaping. Alterations to structures along most of the San Francisco Northern Waterfront are subject to the requirements of a National Historic Register District. Some properties may have deed restrictions establishing requirements for the management of residual soil and groundwater pollution. Port, SFPUC, and City Planning staff will work with project applicants to identify jurisdictional issues that are relevant to the site.

Characterizing existing conditions helps to define the opportunities and constraints that will shape the site design. Opportunities include existing drainage patterns and vegetation, oddly configured or otherwise unbuildable parcels, easements, and landscape amenities, including open spaces that can serve as locations for BMPs. Differences in elevation across the site

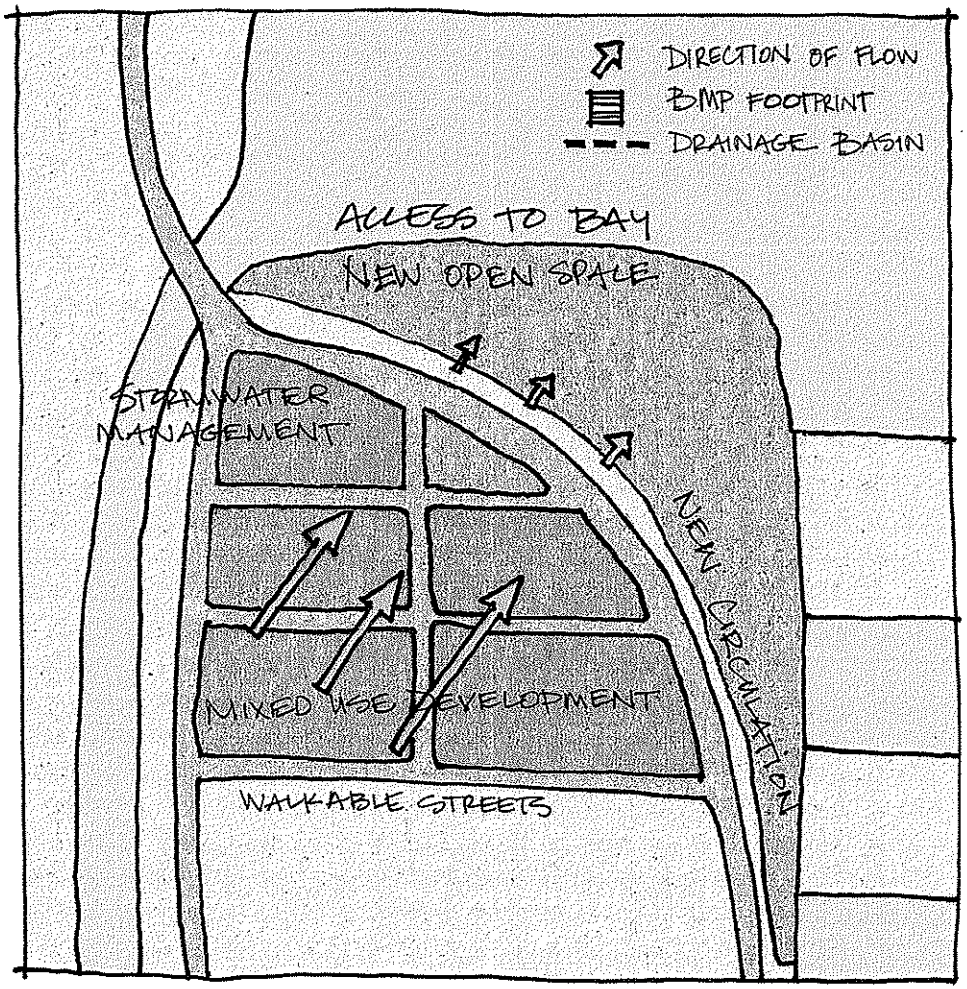
and existing low-lying areas present opportunities to implement BMPs that reduce or eliminate the need for pumping or other mechanical conveyance, a savings in both installation and long-term operation costs.

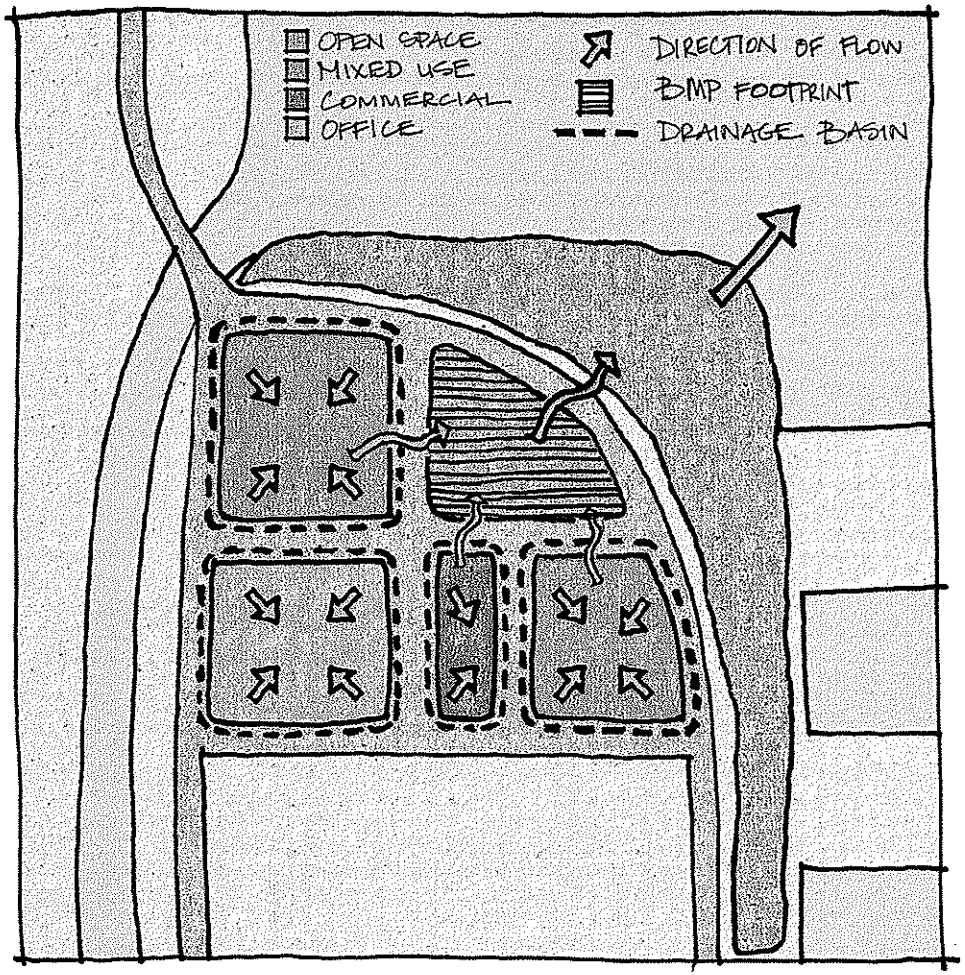
Constraints might include impermeable soils, a high water table, contaminated soils, geotechnical instability, existing utilities, and historic and cultural resources. Site-specific percolation tests and other geotechnical investigations by a certified engineer will be needed to ensure the most effective design solutions.

Step 2

Identify design and development goals

Every project applicant will begin the design process with a set of goals that will impact stormwater management requirements for the site. The program, density, and intensity of land use on a site present both opportunities and constraints for stormwater management. A project applicant intending to build a mixed-use development with high-density housing in the Bayview-Hunters Point neighborhood will approach the design process differently from a project applicant seeking to develop an industrial facility on a waterfront pier. The former might use stormwater to define the character of the public realm and create water features in community open spaces. The latter might use stormwater in cooling towers and wash-down areas to offset potable water use.





Step 3

Develop a site plan

Using the evaluation of existing conditions, along with the design and development goals, project applicants can begin to see how their project will integrate with or alter the hydrology of the site. The site plan should delineate the proposed land uses and major post-development drainage basins and should show, at the conceptual level, how water will move across the site.

Step 4

Develop a site design

Page 28 of this document introduced seven goals to guide the integration of stormwater management into site design. This section identifies strategies to achieve each goal.

Goal 1: Preserve and protect creeks, wetlands, and existing vegetation and other wildlife habitat.

- Incorporate creeks, wetlands, and existing vegetation into the site design (See Appendix D for appropriate vegetation).
- Develop setbacks that protect creeks, wetlands, and sensitive wildlife habitats and also provide usable open space for the public.
- Concentrate development in already developed areas.

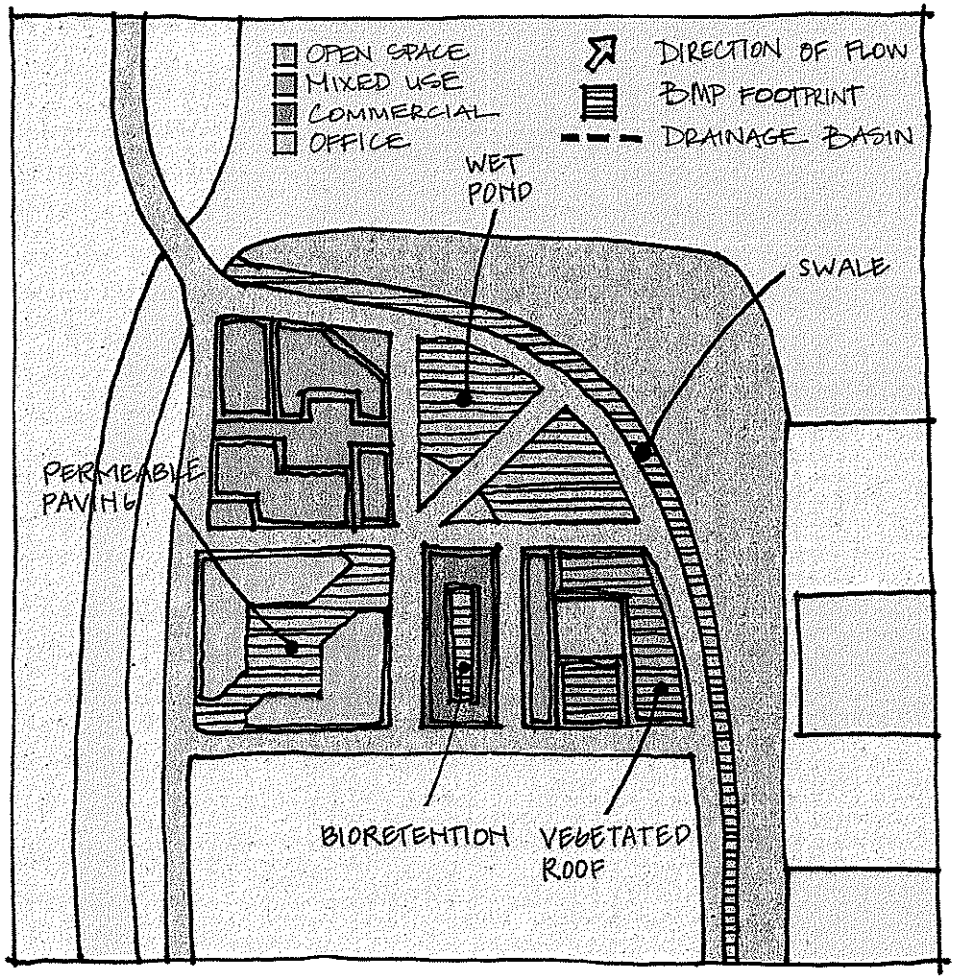
- Encourage high-density, transit-accessible development.
- Encourage clean-up and reuse of brownfield sites.
- Look at each site as an opportunity to protect, enhance, or create wildlife habitat.

Goal 2: Preserve natural drainage patterns and topography and incorporate them into site design.

- Daylight historic watercourses and make them a central element of site design.
- Design stormwater BMPs to take advantage of existing slopes and drainage paths.
- Minimize re-grading and soil impacts.
- Prioritize the use of infiltration-based BMPs where soils, groundwater, and geology allow.

Goal 3: Minimize and disconnect impervious surfaces.

- Design compact, multi-story structures, as allowed by applicable zoning regulations.
- Cluster buildings to reduce the length of streets and driveways, minimize land disturbance, and protect natural areas.
- Design narrow streets and driveways, as allowed by the local jurisdiction.
- Use landscape and permeable paving materials rather than traditional hardscape. Plazas, sidewalks, driveways, streets, parking areas, and patios can be constructed from materials such as crushed aggregate, decomposed granite, turf block, unit pavers, porous asphalt, or pervious concrete.
- Install vegetated roofs to reduce runoff from buildings.
- Minimize parking lot footprints and impacts by building structured parking with alternative roof uses and designing compact parking spaces and space-efficient circulation patterns.



Stormwater treatment facilities enhance public spaces in Portland's South Waterfront redevelopment area.

From the Site to the City

LID is implemented site by site, but each site should be considered in the context of its watershed-wide goals. Over time, incremental improvements will add up to long-term water quality protection for the Bay and Ocean, the restoration of hydrologic function in San Francisco's watersheds, and city-wide greening.

- Drain runoff from impervious areas to pervious areas. In cases where infiltration is not appropriate, landscape features can serve as treatment and conveyance structures and can be fitted with an underdrain to allow for discharge to the municipal storm sewer system or receiving waters.

Goal 4: Design the flow path of stormwater on a site all the way from the first contact to the discharge point.

- Identify the location where stormwater will first enter a site. For example, the first point of contact is often a roof. How will the water travel from the roof to a BMP? In the event that the BMP overflows, where will it discharge?
- Identify an approved discharge location (downstream conveyance system, another BMP or receiving water body) to accommodate flows beyond the capacity of each BMP.
- Design and clearly identify an overflow conveyance system to accommodate flows beyond the BMP's treatment capacity and up to a 100-year storm. All BMPs must have an approved discharge location.

Goal 5: Treat stormwater as a resource, not a waste product.

- Capture stormwater for irrigation, toilet flushing, cooling towers, vehicle wash-down areas, and other non-potable applications.
- Design multi-purpose BMPs that not only manage stormwater but also improve streetscape and public space design.
- Use stormwater for design inspiration.
- Incorporate environmental education and interpretation into LID where appropriate.

Goal 6: Treat stormwater at its source.

- Identify pollutants of concern and their sources early in the design process and install source control measures where appropriate.
- Aim for ubiquitous infiltration of stormwater on site.
- Place treatment BMPs as close to the source of runoff as possible.

Goal 7: Use treatment trains to address a broad array of pollutants.

- Combine stormwater BMPs that target different pollutants to create a treatment train. This strategy ensures higher levels of treatment and reduces the required size of each BMP in the treatment train.
- Pretreatment BMPs, such as sediment forebays, help reduce maintenance costs and improve the overall performance of stormwater BMPs.

Step 5

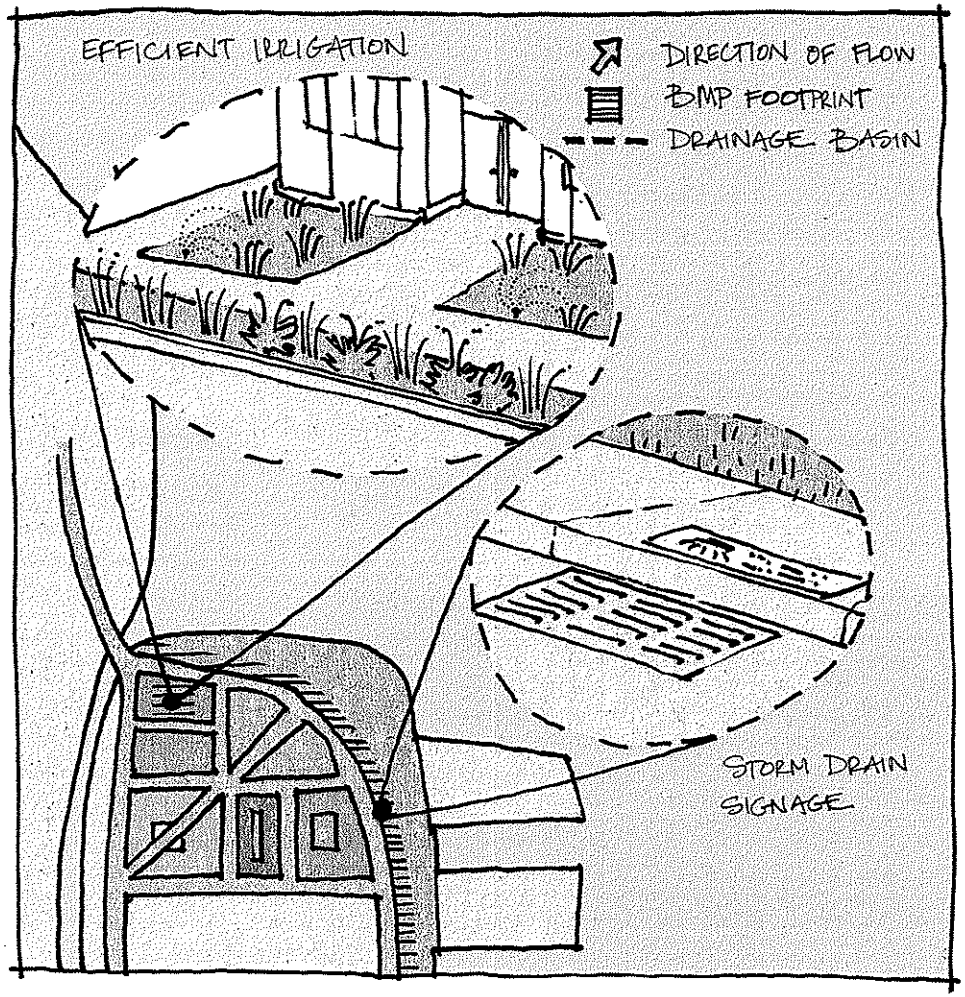
Select and locate source controls

Everyday activities such as recycling, trash disposal, and vehicle and equipment washing generate pollutants such as trash, sediments, oil and grease, nutrients, pesticides, and metals that can be mobilized by stormwater runoff and carried to receiving waters. These pollutants can be minimized by applying source control BMPs. Source control BMPs prevent pollutant generation and discharge by controlling pollution at its source, or, at a minimum, limiting pollutant exposure to stormwater.

Source control BMPs include both structural features and operational practices. Typical structural source control BMPs involve covering, berming, or hydraulically isolating a potential pollutant source area.

Operational source control measures include routine pavement sweeping and substituting traditional materials with those that are less toxic; for example, replacing traditional anodized chain link fencing with vinyl coated fencing.

Specific requirements for land uses and activities that will need to implement source control measures are found in Attachment 4 of the Phase II General Permit (http://www.waterboards.ca.gov/water_issues/programs/stormwater/docs/final_attachment4.pdf). The Fact Sheets (Appendix A) include a list of resources for source control measures. Form A of the SCP (Appendix C) guides the project proponent through the source control BMP selection process.



Source Control Requirement

The following uses and activities are required to implement specific source control measures as specified in Attachment 4 of the Phase II General Permit (http://www.waterboards.ca.gov/water_issues/programs/stormwater/docs/final_attachment4.pdf):

- 100,000 sq. ft. commercial developments
- Restaurants
- Retail gasoline outlets
- Automotive repair shops
- Parking lots

A drain adjacent to a trash compactor is connected to the sanitary sewer system. A concrete berm surrounding the trash storage area hydraulically isolates stormwater runoff in this area from the rest of the site.

Hydraulic Isolation

Hydraulic isolation is the practice of separating one drainage area from surrounding areas such that fluids cannot pass between them. This can be done using grading or constructed barriers. Hydraulic isolation allows designers to treat runoff and waste from the isolated area according to the specific pollutants found there. In some cases, hydraulically isolated areas can be connected to the sanitary sewer system rather than the storm sewer system.

Vehicle wash racks and trash compactor areas are examples of areas that can be hydraulically isolated to protect surrounding areas from the soap, grease, oil, sediments, trash and other pollutants associated with those activities.

Integrated Pest Management

Integrated Pest Management (IPM) is an ecological approach to suppressing pests. IPM uses information on the life cycle of pests, along with multiple pest control techniques, to keep pests at acceptable levels in an economical and environmentally safe way. IPM focuses on monitoring and preventing pests and using low-risk pest control techniques. Because pest problems are often symptomatic of ecological imbalances, the goal is to plan and manage ecosystems to prevent organisms from becoming pests in the first place. This means developing landscape plans that focus on the use of native or Mediterranean plant species suited to San Francisco's climate and soil conditions (Appendix D). IPM principles help to reduce or eliminate the use of pesticides; thereby reducing the risk that stormwater runoff will mobilize pesticides and carry them to collection systems or receiving water bodies.

Step 6

Select and Locate Treatment BMPs

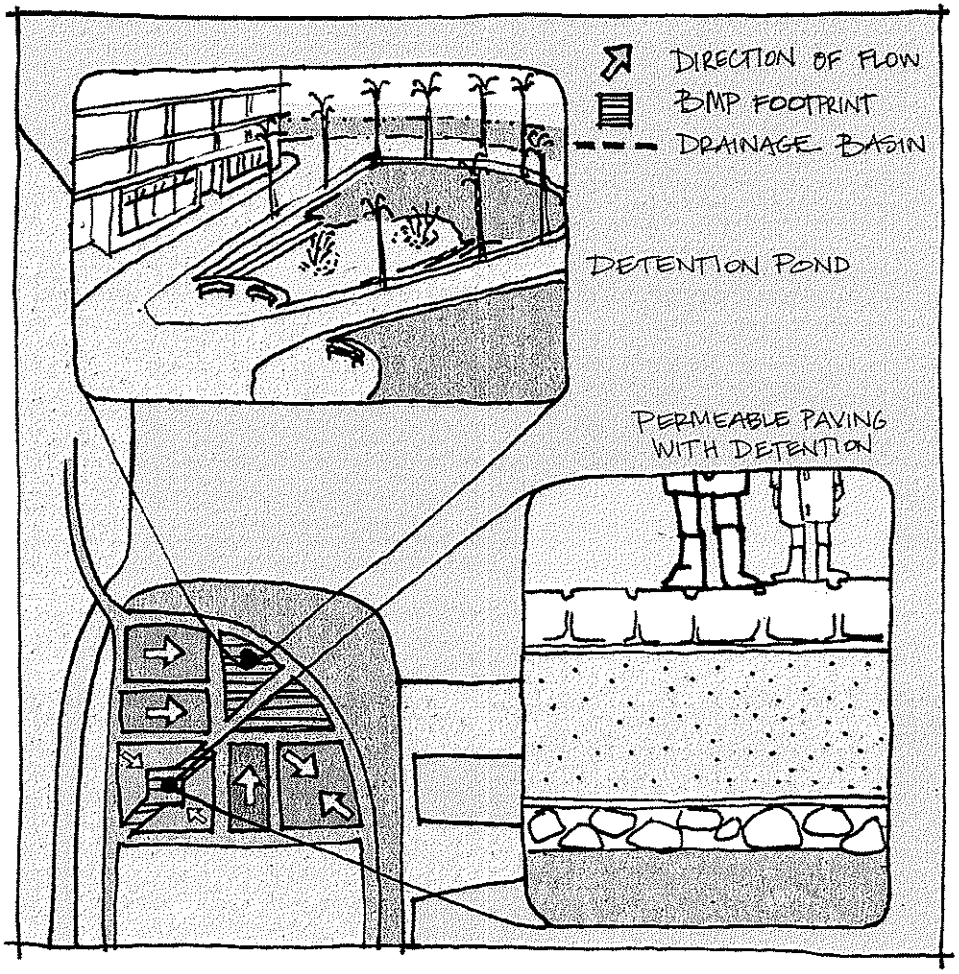
Site design and source control make significant contributions to effective stormwater management. But achieving treatment to the MEP also requires the implementation of treatment control BMPs. The selection of stormwater treatment BMPs is guided by existing site conditions, design and development goals, and the pollutants of concern for the site.

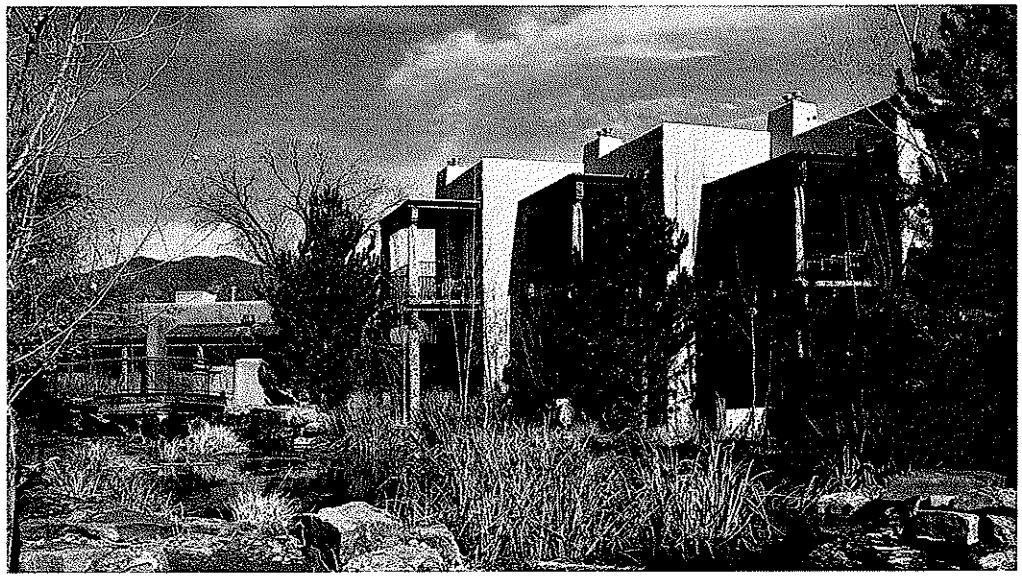
The two-step BMP selection process outlined here will help project applicants to identify a suite of site-specific treatment BMPs. The first step is to use the BMP Decision Tree (see Figure 22), to identify BMPs that are suitable for a given site. The second step is to narrow the list of suitable BMPs to the ones that target the pollutants of concern that have been identified for a given site.

The BMP Decision Tree

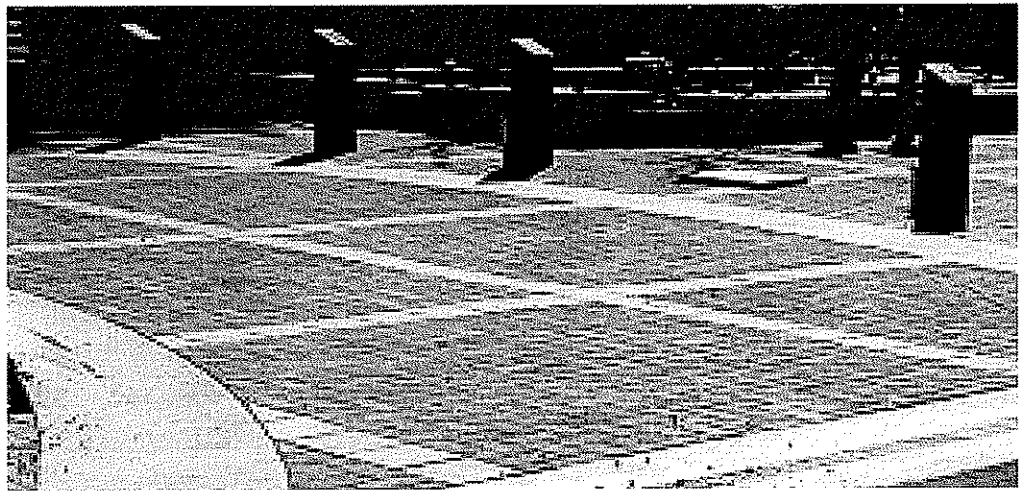
The BMP Decision Tree will help project applicants use site-specific information to select the BMPs that are most appropriate given the conditions at their site. BMPs that are not suitable will be eliminated from consideration.

The BMP Decision Tree prompts the project applicant to consider specific site characteristics that affect BMP design. The answers narrow the field of appropriate BMPs. On-site percolation tests and geotechnical investigations must be done during the site analysis to determine whether infiltration-based BMPs are feasible for the site (for instance, is there adequate depth to groundwater, which for most sites will be 10 feet). However, infiltration-





El Monte Sagrado Spa in Taos, New Mexico uses wetlands to treat stormwater so that it can be used to fill spa pools.



Permeable pavement can be integrated into a variety of hardscapes such as roads and sidewalks, plazas, terraces and patios.

based BMPs need not always be eliminated based upon this information. Rather, a modified design solution can make a BMP feasible. Vegetated swales can be used for stormwater treatment in areas with poor infiltration or contaminated soils provided that they are lined with an impermeable liner, underdrained, and constructed with clean import soil. See the BMP Fact Sheets in Appendix A for information on liners and underdrains.

Steep slopes can limit the range of appropriate BMPs for a given site because they can cause high flow rates and instability. Terracing the site is one design solution that could allow the implementation of slope-dependent BMPs on a steep site. Check dams can also be used to mitigate problems caused by steep slopes.

After all of the information has been evaluated, the BMP Decision Tree will indicate one of three outcomes for a given site:

- All BMPs are feasible;
- A subset of BMPs is feasible for unconditional implementation; or
- A subset of BMPs is feasible with conditions.

The resulting list of BMPs can then be evaluated for their effectiveness in treating the pollutants of concern for the project. Project applicants should include the results of the Decision Tree process in their SCP.

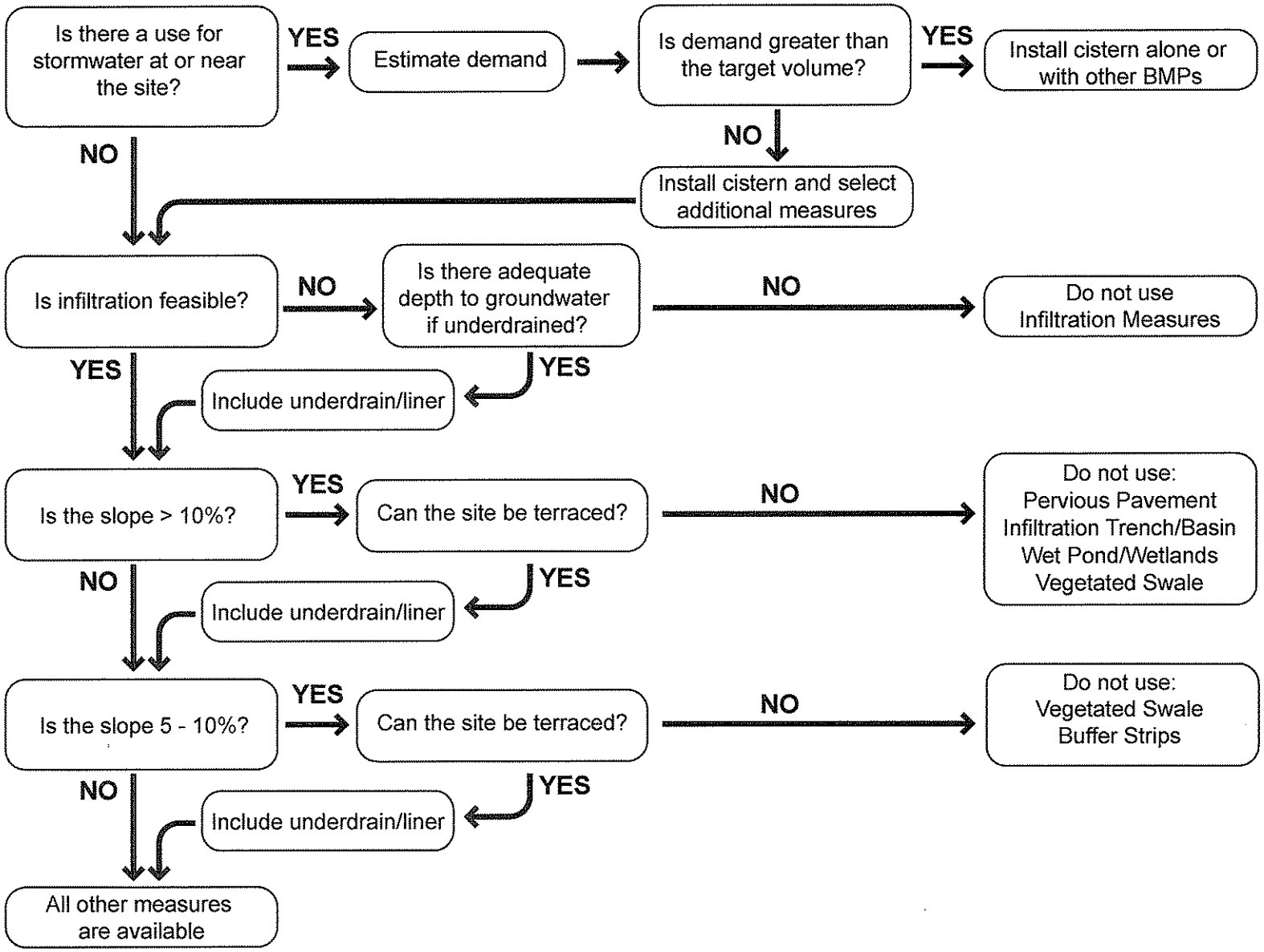
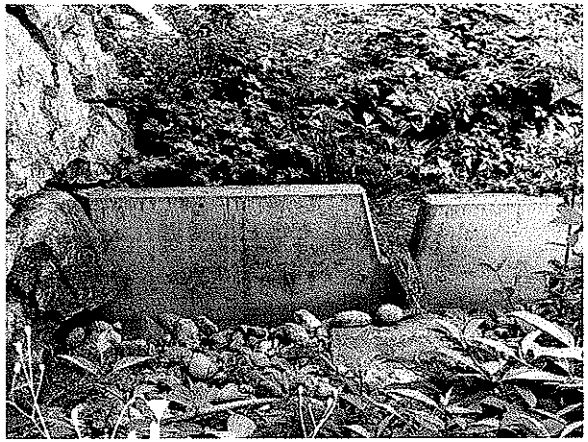
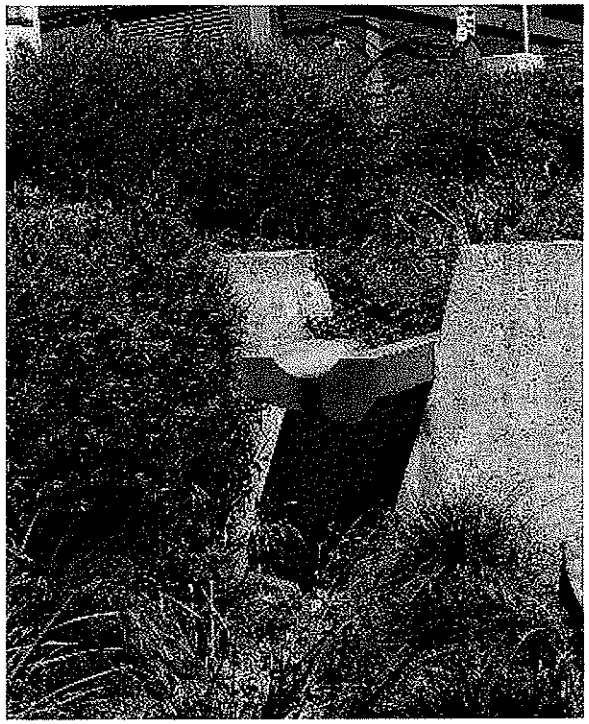


Figure 22. *Stormwater BMP Decision Tree*





Weirs (top) and cascades (bottom) make street-side bioretention possible on steep slopes in Seattle, WA.

Match BMPs with Pollutants of Concern

Table 6 includes a list of pollutants typically found in stormwater runoff and their association with common San Francisco land uses. Project applicants can use the table to screen for likely pollutants of concern, but identifying the specific commercial and industrial activities proposed for a site provides a better indication of which pollutants to target. For example, a restaurant would need to include BMPs to prevent oil and grease from contacting stormwater, and roadways in any project bring up concerns about metals, oil and grease, and sediments.

After project applicants consult Table 6 to anticipate the pollutants of concern for their proposed land uses, they can use Table 7 to identify BMPs that both treat pollutants of concern and are deemed appropriate for the physical site conditions by the BMP Decision Tree. To learn more about each BMP listed in the table, see the BMP Fact Sheets in Appendix A.

Land Use Type	Metals	Sediments	Trash	Oil and Grease	Organics	Nutrients
High Density Residential	•	•	•	•		•
Low Density Residential	•	•	•	•		•
Mixed Use	•	•	•	•	•	•
Light Industrial	•	•	•	•		
Heavy Industrial	•	•	•	•	•	
Open Space		•	•		•	•
Piers Over Water	•	•	•			
Former Shipyards	•	•	•	•	•	•

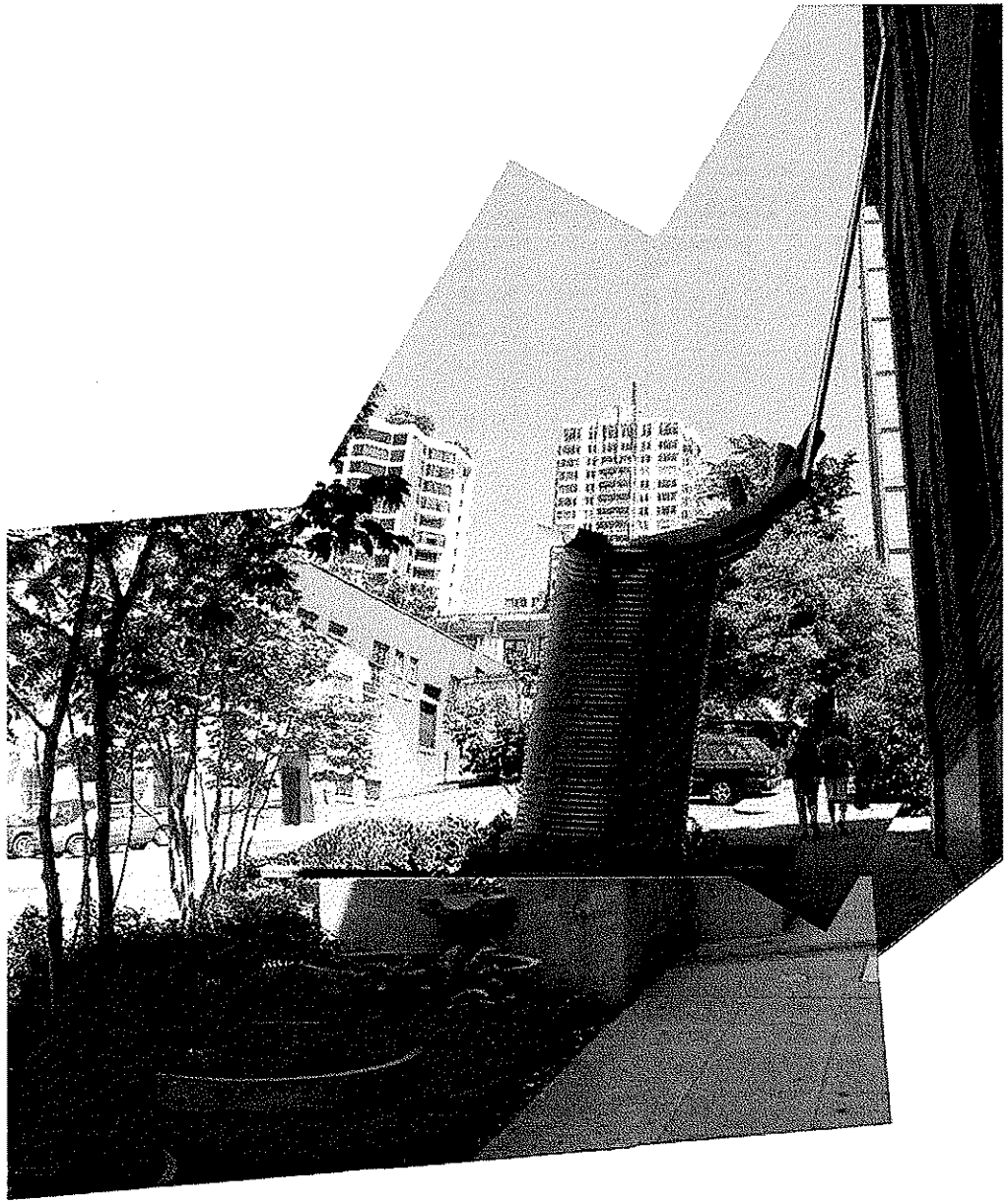
Table 6. *Typical pollutants associated with common San Francisco land uses*

Treatment Control		Metals	Sediments	Trash	Oil and Grease	Bacteria	Organics	Nutrients
Infiltration								
	Dry Well	●			●	●	●	●
	Infiltration Basin	●	○p	○p	●	●	●	●
	Infiltration Trench	●	○p	○p	●	●	●	●
	Permeable Pavement	◒	●p	○p	○	◒	◒	●
Detention								
	Constructed Wetland	●	●p	○p	●	●	●	◒
	Detention Pond	◒	◒p	○p	◒	◒	◒	○
	Detention Vault	○	◒	○	◒	○	○	○
	Wet Pond	●	●p	○p	●	●	●	◒
Bioretention								
	Flow-through Planter	●	●p	○p	●	●	●	◒
	Rain Garden	●	●p	●p	●	●	●	●
Biofiltration								
	Vegetated Buffer Strip	●	●p	◒p	◒	○	◒	○
	Vegetated Swale	◒	◒	○	◒	○	◒	○
	Media Filter	●	●p	●p	●	●	●	●
	Sand Filter	●	●	●	●	●	◒	◒
	Vegetated Rock Filter	◒	●p	○p	●	◒	●	●
	Swirl Separator	○	●	●	◒	○	○	○
	Water Quality Inlet	○	◒	◒	◒	○	○	○
	Drain Insert	◒	◒	●	◒	○	○	○
Retention								
	Rainwater Harvesting*							

○ Low ◒ Moderate ● High p Requires Pre-treatment

*Rainwater Harvesting does not provide stormwater treatment. However, it prevents polluted stormwater from reaching receiving water bodies.

Table 7. *BMPs that capture or treat pollutants typically found in stormwater runoff.*



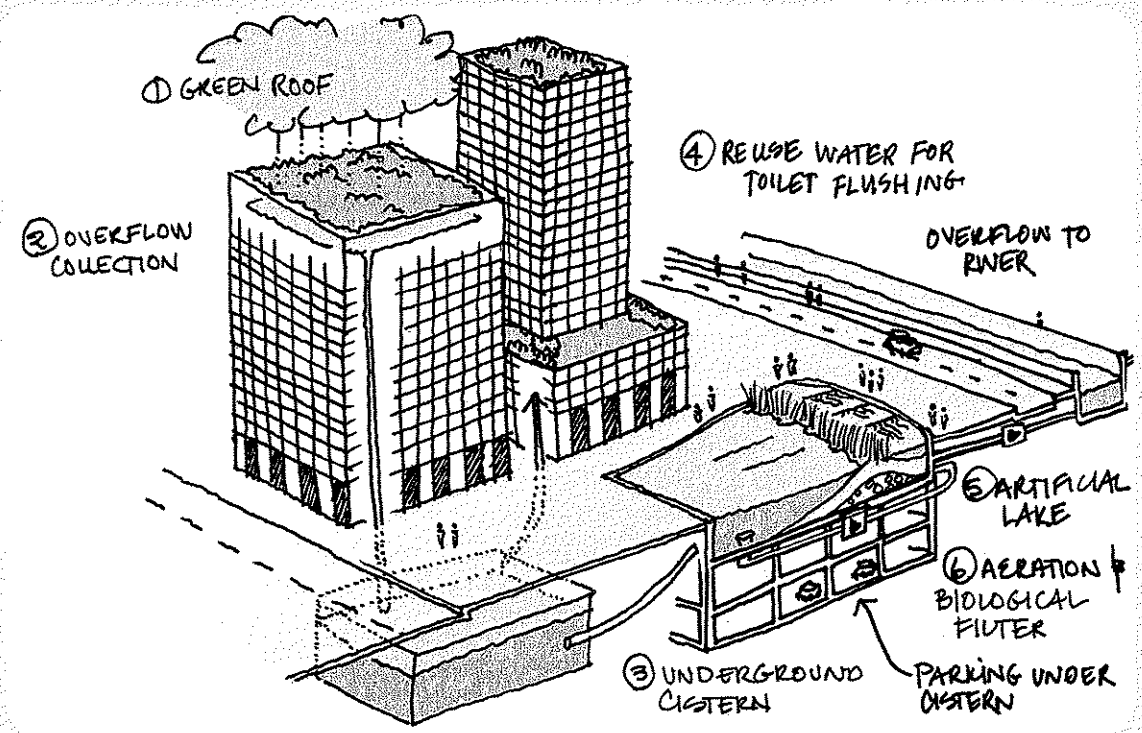
Treatment Trains

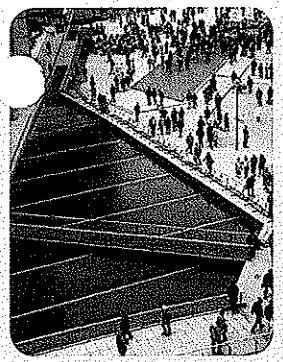
A single treatment BMP may not adequately treat the entire range of pollutants from its contributing watershed, especially in large developments involving diverse activities. For example, some treatment BMPs are designed to remove fine suspended sediment but may not be able to remove dissolved metals. Because of this, a combination of several BMPs in succession may be needed to treat all of the pollutants on a given site.

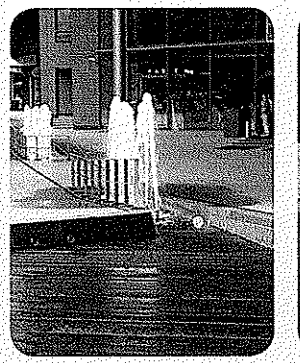
A combination of BMPs, constructed in a series to target specific pollutants, is called a treatment train. Treatment trains not only improve water quality, they also improve the long-term efficiency and reduce the maintenance requirements for each treatment BMP involved in the train. Heavy sediments and trash can negatively impact BMP performance, thus silt traps and sediment forebays are commonly used as a first step in the treatment process. In the same way that pre-rinsing dirty dishes increases the efficacy and efficiency of a dishwasher, removing sediment prior to infiltration of stormwater will improve the long-term capacity of the underlying soils to infiltrate water by preventing sediment from clogging pore spaces that allow the movement of water through the soil.

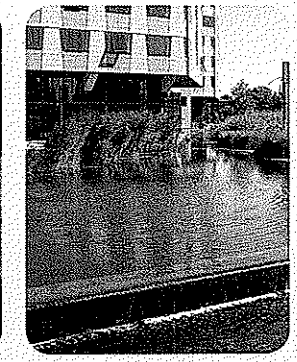
Common treatment train configurations include:

- Silt trap → Swale → Wetland
- Cistern → Rain garden
- Retention basin → Sand filter
- Vegetated strip → Infiltration trench







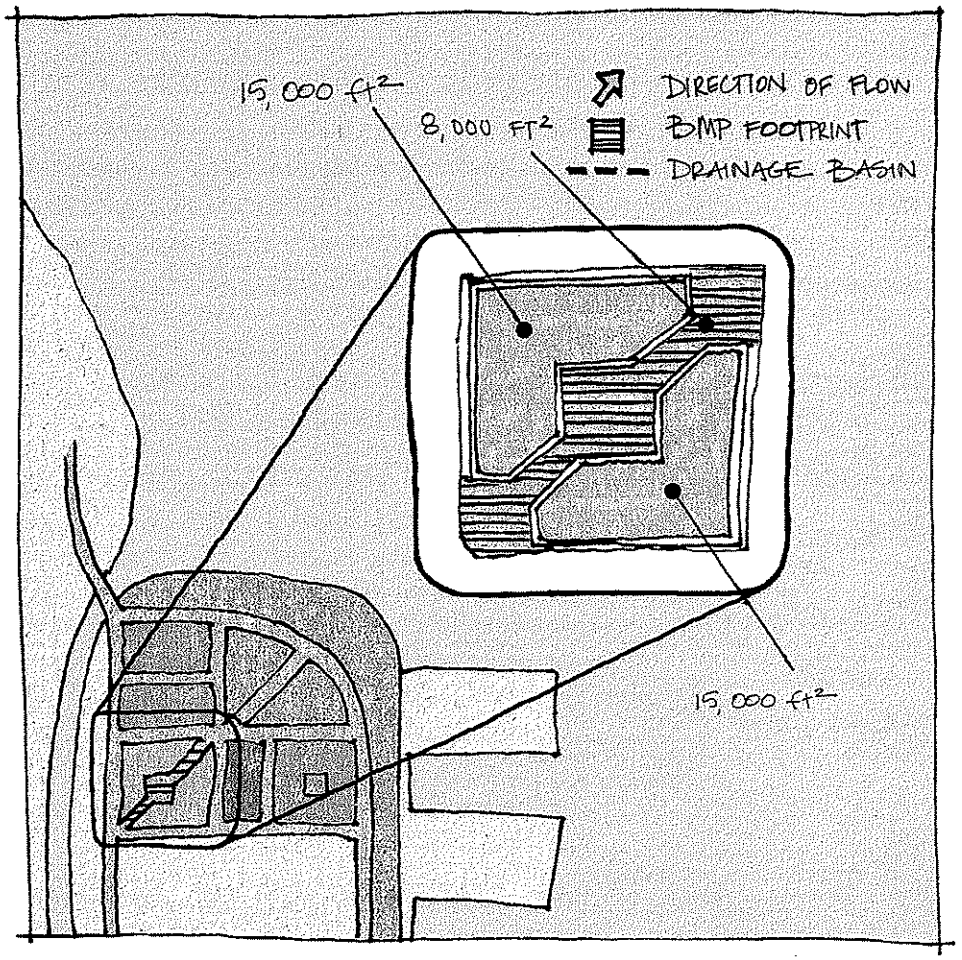


Case Study: Berlin Treatment Train

The design for Potsdamer Platz, one of Berlin's most important public squares, includes a stormwater treatment train that uses multiple stormwater management strategies (indoor use, storage, biofiltration, and outdoor use) to control both the quality and the volume of stormwater on-site. The roofs of the development, some of which are vegetated roofs and some of which are traditional, harvest rainwater to be used in the buildings for toilet flushing and irrigation. During large storm events, five underground cisterns store rainwater and then release it slowly into a series of pools and planted 'biotopes' for filtration. In the summer months, additional filters can be added to remove algae. Treated rainwater then flows through a very popular outdoor waterscape where employees and visitors gather. Like San Francisco, Berlin has an average annual rainfall of 21 inches.

Treatment Train Principles

- Think of each element in a treatment train as a separate functional unit.
- Before adding additional elements to a treatment train, analyze their performance relative to previous BMPs in the train. If the expected water quality benefits are limited, the increase in cost may outweigh the benefits.
- Do not alter or remove design measures used to reduce the size of stormwater treatment measures without a corresponding resizing of associated stormwater treatment BMPs, otherwise the capacity of the BMPs will be exceeded.

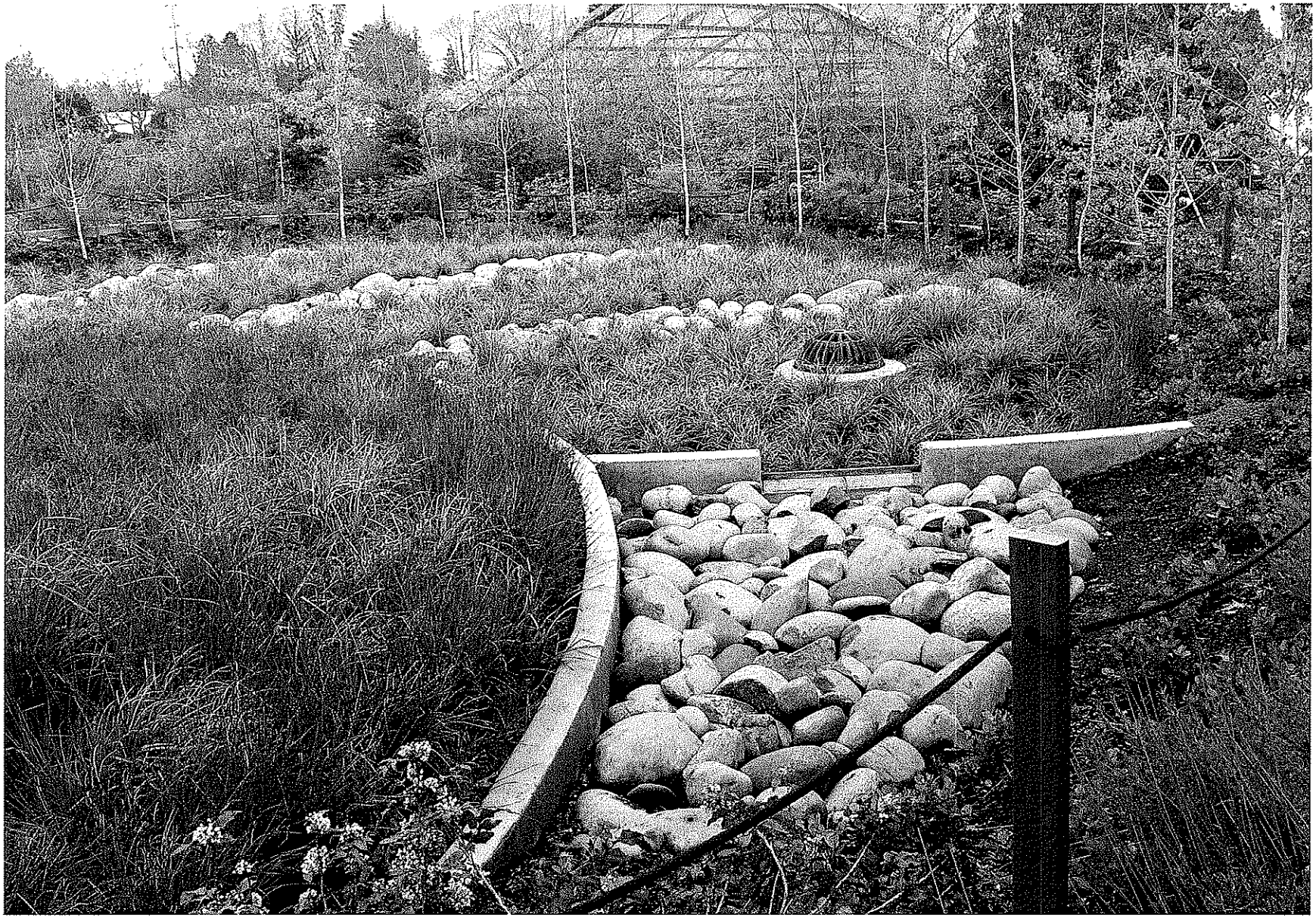


Step 7

Size Treatment BMPs

After selecting a suite of treatment BMPs that are appropriate for the site conditions and target the pollutants of concern, project applicants will need to size these BMPs to achieve the required stormwater performance standards. This section explains how to size treatment BMPs, but project applicants can also use the automated electronic sizing spreadsheets provided in Appendix B, which can also be found on the SFPUC and Port websites at www.sfwater.org and www.sfport.com. While the Port and SFPUC do not require the use of the sizing spreadsheets for BMP design, project applicants must complete Table 1 of the electronic sizing spreadsheet in Appendix B to document drainage parcels and design flow rates and volumes. This information is required in the SCP.

The performance measures discussed in this section aim to protect the water quality of receiving water bodies. They meet all regulatory requirements and are the foundation of the BMP sizing spreadsheet. For information about how the performance measures were developed, please see the resources at the end of this section.



A rain garden at Glencoe Elementary in Portland, Oregon reduces stormwater flows to Portland's collection system.

Treatment Control		Sizing Design Criteria	
		Flow-based	Volume-based
Infiltration	Dry Well		•
	Infiltration Basin		•
	Infiltration Trench		•
	Permeable Pavement		•
Detention	Constructed Wetland		•
	Detention Pond		•
	Detention Vault		•
	Wet Pond		•
Bioretention	Flow-through Planter	•	
	Rain Garden	•	• (if infiltrating)
Biofiltration	Vegetated Buffer Strip	•	
	Vegetated Swale	•	
	Media Filter	•	
	Sand Filter	•	
	Vegetated Rock Filter	•	
	Swirl Separator	•	
	Water Quality Inlet	•	
	Drain Insert	•	
Retention	Rainwater Harvesting		•

Table 8. *Treatment control measures and sizing methods*

Port Requirements

Stormwater performance measures for areas in the separate sewers operated by the Port require the capture and treatment of:

(a) The flow of stormwater runoff resulting from a rain event equal to at least 0.2 inch per hour intensity; or

(b) Eighty percent or more of the annual stormwater runoff volume, determined from unit basin storage volume capture curves for San Francisco (see Figure 23).

Performance measure (a) should be used for sizing flow-based BMPs, such as vegetated swales or flow-through planters. These are BMPs whose primary mode of pollutant removal depends on the flow rate of runoff through the BMP. Performance measure (b) should be used for sizing volume-based BMPs, such as infiltration basins or detention basins. These are BMPs whose primary mode of

Requirement

The Port's stormwater performance measures for areas served by separate storm sewers require the capture and treatment of:

(a) The **flow** of stormwater runoff resulting from a rain event equal to at least 0.2 inch per hour intensity; **or**

(b) Eighty percent or more of the annual stormwater runoff **volume** determined from design rainfall capture curves for San Francisco. The maximum drawn-down time for stormwater captured during a rain event is 48 hours.

pollutant removal depends on the volumetric capacity of the BMP. These performance measures are adapted from the General Permit.

Project applicants should determine which sizing criteria apply to each BMP and size the facility accordingly. Many BMPs can be designed to attain both flow-based and volume-based stormwater management goals, but they are most often categorized as one or the other (see Table 8).

Flow-based Sizing

The recommended method for hydraulically sizing flow-based treatment BMPs is the Uniform Intensity Approach and is used in conjunction with the Rational Method for estimating stormwater flows. It is also described in the CASQA 2003 Stormwater Best Management Practice Handbook New Development and Redevelopment. Automated electronic sizing spreadsheets can be found at www.sfwater.org and www.sfport.com, and are described in Appendix B. The Rational Method is used as follows:

1. **Identify each drainage management area on the site.** A drainage management area is a discrete area or subwatershed. The runoff from each drainage management area will drain its own treatment control BMP(s). The steps below should be applied to each drainage management area.

2. **Determine the area in acres (A)** of the drainage management area that drains to the proposed BMP(s).

3. **Assign a Runoff Coefficient**, or C-factor, to each land surface in the drainage management area. The C-factor describes the percentage of runoff generated by different types of surfaces during rain events. Surfaces that produce higher volumes of runoff, such as concrete, have relatively higher C-factors, while surfaces that produce lower volumes of runoff, such as landscaped areas, have relatively lower C-factors. Table 9 lists established C-factor values for each land surface.

4. **Calculate the Composite C-factor (C)**, a weighted average of all the C-factors for all the surfaces in the drainage management area. Multiply each C-factor by the area of the surface it applies to. Add the results and divide by the total site area.

Flow-Based Sizing

The Rational Method: Q=CiA

Where:

Q = flow in ft^3/second

C = composite runoff coefficient (composite C-factor)

i = rainfall intensity in inch/hour (0.2 inch/hr recommended)

A = drainage area in acres

Type of Surface	*Typical Range*	*Recommended Value*
Asphalt	*0.7 - 0.95*	*0.8*
Concrete	*0.8 - 0.95*	*0.9*
Brick	*0.7 - 0.85*	*0.8*
Roofs	*0.75 - 0.9*	*0.85*
Pervious Concrete	*0.1 - 0.3*	*0.2*
Pervious Asphalt	*0.1 - 0.3*	*0.2*
Paving Stones	*0.1 - 0.7*	*0.4*
Grass Pavers/Turf Blocks	*0.15 - 0.6*	*0.35*
Lawns and Grass:		
sandy soil, slope <2%	*0.05 - 0.1*	*0.08*
sandy soil, slope >7%	*0.15 - 0.2*	*0.17*
heavy soil, slope <2%	*0.13 - 0.17*	*0.15*
heavy soil, slope >7%	*0.25 - 0.35*	*0.3*
Landscaping	*0.15 - 0.3*	*0.2*
Crushed Aggregate	*0.15 - 0.3*	*0.25*

Table 9. *Typical runoff coefficients*

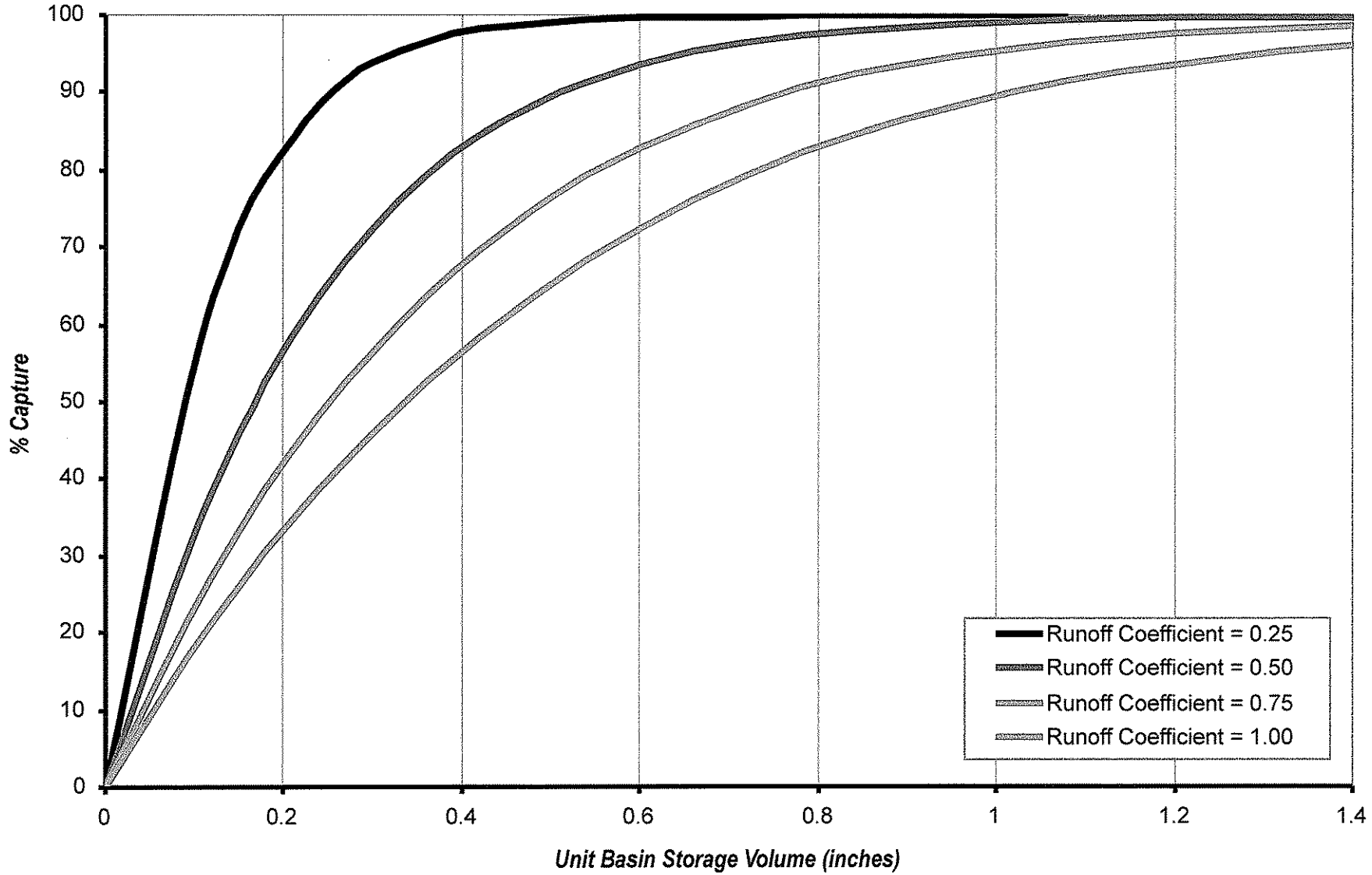


Figure 23. *Composite runoff coefficients and unit basin storage volume for 80 percent capture with 48-hour drawdown*

5. **Use a design rainfall intensity (i) of 0.2 inch per hour**. This intensity represents twice the 85th percentile hourly depth, which can be derived by ranking the hourly depth of rainfall from storms over the period of record. The General Permit specifies that, for water quality protection, the design rainfall intensity be equal to or greater than twice the 85th percentile hourly depth.

Q = CiA yields the design flow rate **(Q)**, in cubic feet per second, that a BMP must accommodate to meet the performance measures. For more information on sizing flow-based treatment BMPs, see the Fact Sheets in Appendix A and the sizing spreadsheets in Appendix B.

Volume-based Sizing

The recommended method for hydraulically sizing volume-based stormwater treatment BMPs is based upon a goal of 80% annual stormwater volume capture within a 48-hour draw-down period. This method is further described in CASQA's 2003 Stormwater Best Management Practice Handbook New Development and Redevelopment, which is available at www.cabmphandbooks.com.

The following steps explain how to calculate each variable.

1. **Identify each drainage management area on the site.** A drainage management area is a discrete area or subwatershed. The runoff from each drainage management area will drain its own treatment control BMP(s). The steps below should be applied to each drainage management area.

2. **Determine the area in acres (A)** of the drainage management area that drains to the proposed BMP.

3. **Calculate the Composite C-factor** for the drainage management area using the method described in steps 3 and 4 of the flow-based sizing section.

4. **Use the composite C-factor** to interpolate a Unit Basin Storage Volume value (in inches) from the unit basin storage volume curves in Figure 23. Interpolate between the reference C values as necessary to determine a Unit Basin Storage value. A 48-hour draw-down time is recommended, unless soils at the site are coarse.

Volume-Based Sizing

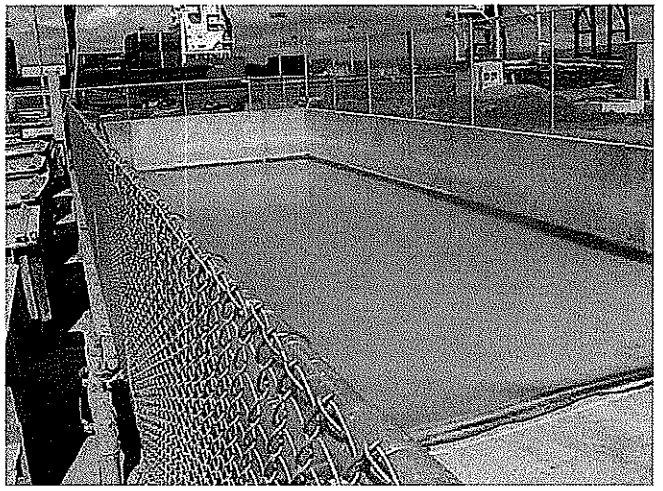
BMP Capture Volume =
BMP Drainage Area x Unit Basin Storage Volume

Where:

BMP Capture Volume = the volume of water that the BMP must capture to achieve compliance with the volume-based performance measures.

BMP Drainage Area = the contributing drainage area for the BMP.

Unit Basin Storage Volume = the depth of rainfall, in inches, that is related to a percentage of annual runoff capture. It is determined for various runoff coefficients from historical rainfall records.



Rainwater harvesting is a volume-based BMP that can be used to collect water for various types of industrial operations, resulting in reduced utility costs.

5. **Calculate the BMP Capture Volume** by multiplying the **BMP Drainage Management Area** by the **Unit Basin Storage Volume.** Convert to cubic feet for easy interpretation.

The BMP Capture Volume is the volume needed to meet regulatory standards for stormwater treatment. This or a larger volume must be used for BMP design. The BMP Capture Volume must be recorded and submitted in the SCP. The BMP Fact Sheets in Appendix A and sizing spreadsheets in Appendix B also contain information pertinent to sizing volume-based treatment BMPs.

SFPUC Requirements

Stormwater performance measures for areas in the separate sewers under the jurisdiction of the SFPUC require the capture and treatment of rainfall from a 0.75-inch design storm, which is equivalent to LEED Sustainable Sites Credit 6.2.

To meet the SFPUC performance measure and earn LEED Credit SS6.2, use the following calculation:

V = CAd, where **V** = Volume of water in cubic feet, **A** = size of the drainage management area in square feet, **C** = runoff coefficient, and **d** = rainfall depth in inches.

1. **Determine the area in square feet (A)** of the drainage management area, also known as a subwatershed, that drains to the proposed BMP.

2. **Calculate the Composite C-factor (C)** for the drainage management area using the method described in steps 3 and 4 of the flow-based sizing section.

3. **Use 0.75 inch as the design rainfall depth (d)** for the facility. This design rainfall depth corresponds to LEED Credit SS6.2 for semi-arid watersheds.

5. **Calculate the Volume** by multiplying **C**, **A**, and **d**. Divide by 12 to convert to cubic feet. The maximum allowable draw-down time is 48 hours.

The BMP must capture a volume of water equal to or greater than the volume calculated using the equation above to meet regulatory standards for stormwater treatment. The volume that the BMP will capture must be recorded and submitted in the SCP. The

BMP Sizing

V=CAd

Where:

V = volume in ft^3

C = composite runoff coefficient (composite C-factor)

A = drainage area in square feet

d = design rainfall depth in inches (use 0.75 inch)

"BMP Fact Sheets" in Appendix A and the sizing spreadsheets in Appendix B also contain information pertinent to sizing volume-based treatment BMPs.

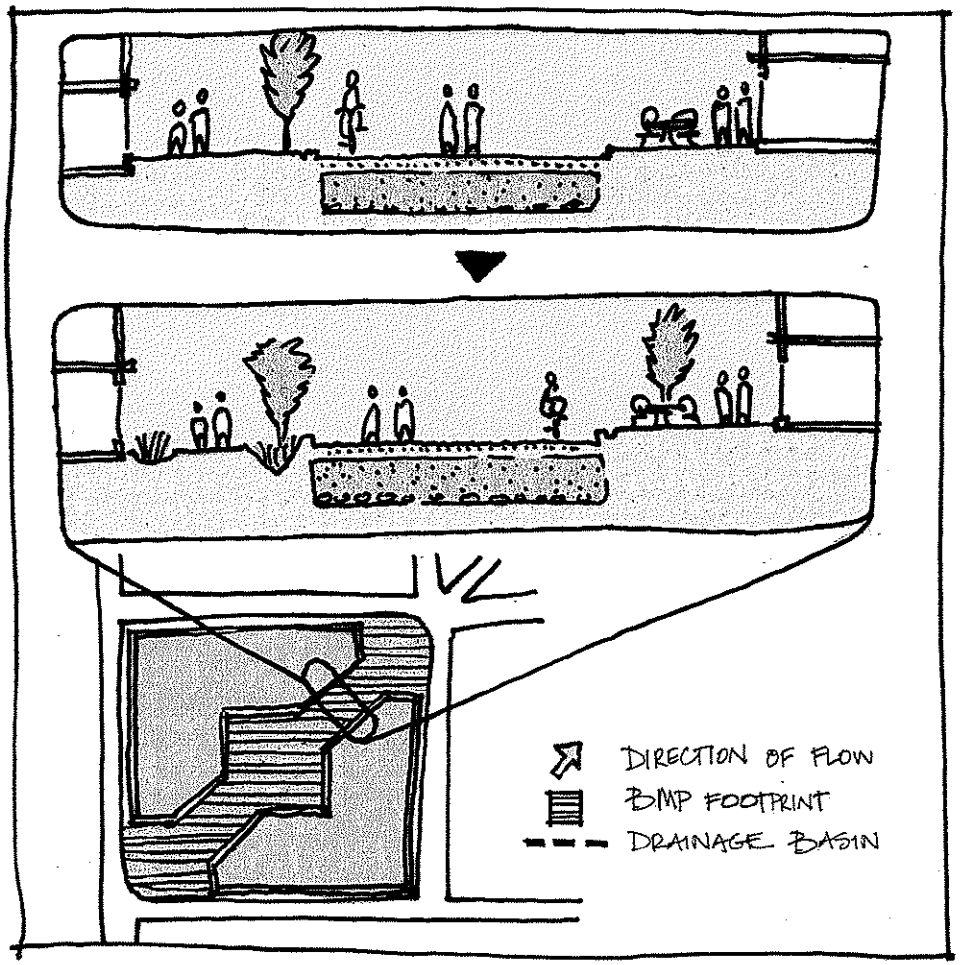
Project applicants in combined sewer areas under SFPUC jurisdiction must achieve LEED SS6.1 to reduce the flow and volume of stormwater into the collection system. SFPUC staff is in the process of creating additional guidance for achieving SS6.1. In the meantime project applicants are encouraged to consult *LEED for New Construction Version 2.2* and contact Urban Watershed Management Program staff if necessary.

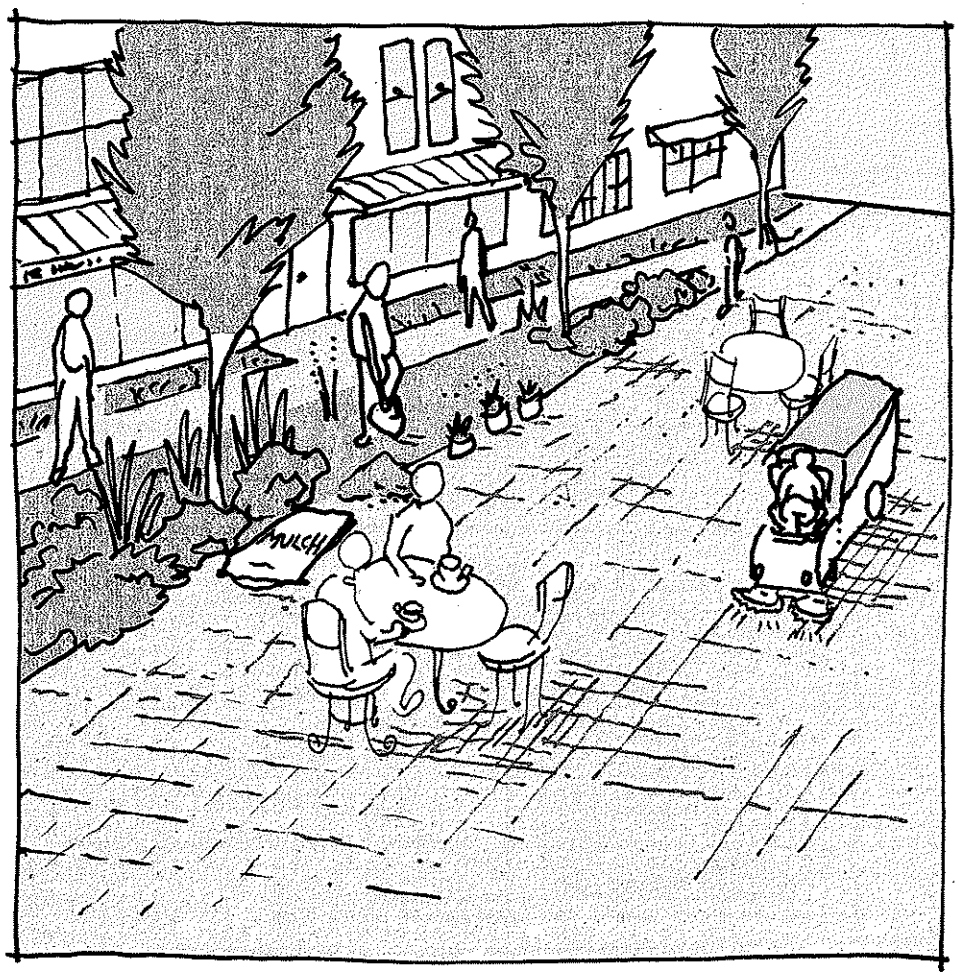
Step 8

Check against Design Goals and Modify if Necessary

After site design, source control, BMP selection, and BMP sizing are completed, project applicants should review the original design goals and evaluate whether they have been achieved. If not, an iterative design process that may include BMP relocation or resizing can ensure that the project achieves its design and development goals and complies with stormwater treatment requirements.

At this stage in the design process, there is a general understanding of how the runoff will move across the site, source control measures have been identified and located, treatment controls have been selected based on site conditions and pollutants of concern, and target water quality volumes and flow rates have been calculated. The next task is to locate and size the actual treatment controls. Sizing tools for each treatment control are





included with the Fact Sheets in Appendix B, and are available electronically at www.sfwater.org and www.sfport.com.

Step 9

Develop an Operations and Maintenance Plan

Treatment and control facilities must be regularly maintained to ensure that they continue to provide effective treatment and do not harbor mosquitoes, cause flooding, or otherwise create a nuisance. Improper maintenance is one of the most common reasons for BMP underperformance and failure.

The General Permit requires that project applicants provide verification of maintenance provisions "through such means as may be appropriate, including, but not limited to legal agreements, covenants, CEQA mitigation requirements and/or Conditional Use Permits." Stormwater facilities installed as part of new development or redevelopment projects will be incorporated into both the Port's and SFPUC's operation and maintenance verification program. An operations and maintenance plan is a required element of the SCP. To develop an operations and maintenance program for new facilities, follow these steps:

1. **Identify who will own or have operational responsibility** for the facility. In the case of Port facilities, operational responsibility will be assigned through lease and development agreements. In the case of privately owned facilities regulated by the SFPUC the property owner will be responsible for operations and maintenance.

2. **Identify applicable maintenance requirements** for each stormwater control at the facility and list the requirements into the SCP. The SCP must identify any title transfers, lease provisions, or maintenance agreements that will be executed before construction is complete.
3. **Develop an Operations and Maintenance Plan** (O&M Plan) for the site incorporating detailed requirements for each treatment and control BMP at the facility. The O&M Plan must be submitted before the building permit is finalized and a certificate of occupancy is issued. Any necessary agreements must be executed concurrent with submittal of the O&M Plan.
4. **Maintain the facilities** from the time of construction until ownership or lease is formally transferred.
5. **Formally transfer** operation and maintenance responsibilities to any new owner, occupant or lessee. **The transfer will require the new owner, occupant, or lessee to maintain facilities in perpetuity and comply with Port and SFPUC self-inspection, reporting, and verification requirements.**

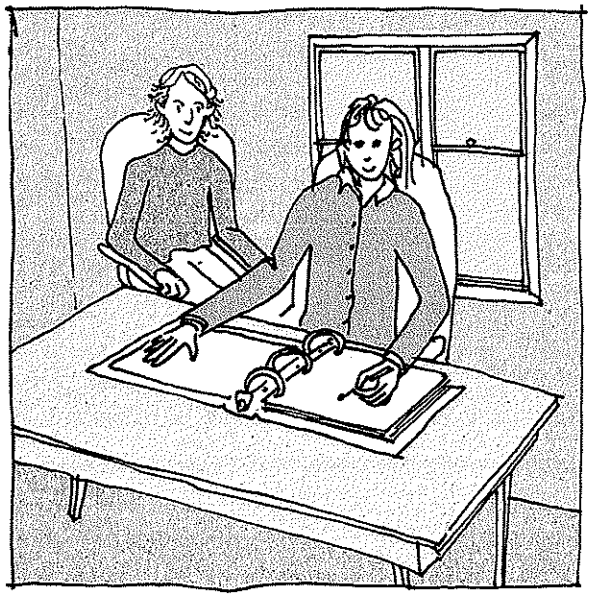
Designing to Minimize Maintenance

Streamlined maintenance and maximized performance can be achieved by considering the following design features:

- Use pretreatment systems to remove coarse sediment and litter, particularly for infiltration systems. Pretreatment systems can also reduce the velocity of flows entering the treatment BMP, reducing wear on the BMP and extending its useful life.
- Use deeper rooted vegetation in conjunction with infiltration BMPs. Good root structure helps to maintain soil porosity and reduces the maintenance needs of the BMP. For a list of recommended vegetation species, see Appendix D.
- Whenever possible, select BMPs that do not require slow-release control structures. Such structures can clog and require periodic inspection and maintenance.
- Stormwater facilities that are above-ground are more likely to be visible and therefore receive maintenance.

Regular inspections are required in order to maintain the effectiveness of treatment control BMPs. Inspection and maintenance activities can be divided into two functions:

Mulching is an important part of BMP maintenance.



1. Scheduled routine inspection and maintenance, and
2. Non-routine repair and maintenance.

Routine inspection can reveal potential problems with BMP operations and help to ensure the highest level of pollutant removal. Routine maintenance refers to activities performed on a regular basis to keep the BMP in good working order. These activities are generally not complicated (sediment removal, landscape work, etc.) and can be performed by most facility maintenance staff. Typical maintenance activities are described in each of the BMP Fact Sheets included in Appendix A.

Step 10

Compile the Stormwater Control Plan

A Stormwater Control Plan (SCP) with exhibits – as described in the SCP template (Appendix C) – must be submitted to the Port or SFPUC as part of the planning approval process. The completed SCP must include the following information:

- Information on Project Owner/Developer and Design Team
- Project location
- Project description
- A site plan showing proposed project
- Any soils or geotechnical reports necessary to complete stormwater design
- Site analysis for locating and sizing BMPs
- A site drainage plan showing direction of stormwater flow to the point where it enters the storm sewer system or receiving waters
- Stormwater sizing calculations
- A post-construction O&M Plan
- Refer to Appendix C for a template of an SCP.

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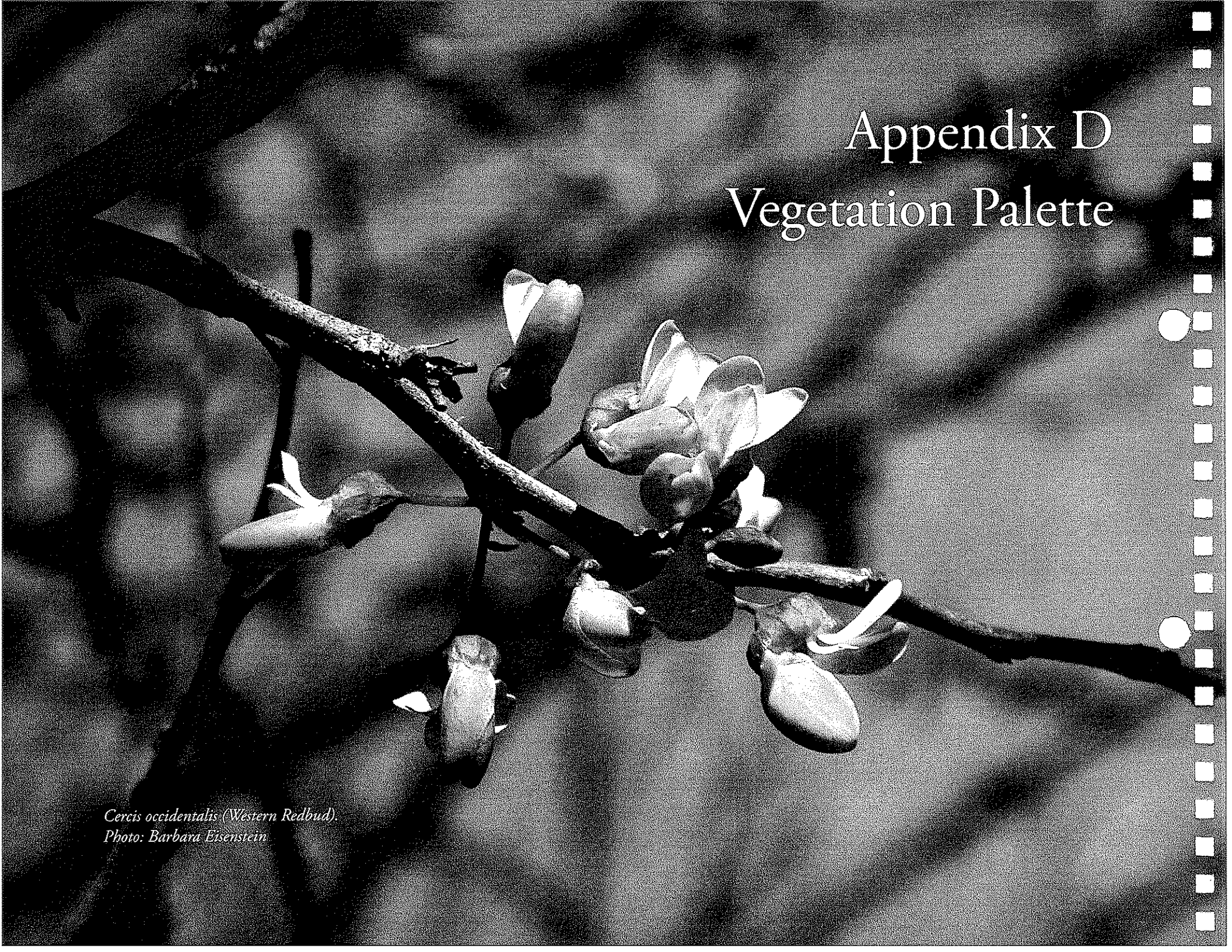
November 2009 Version - Updates and errata will be published as necessary

Appendix D
Vegetation Palette



Cercis occidentalis (Western Redbud).
Photo: Barbara Eisenstein

Low impact design (LID) offers an important opportunity to integrate San Francisco's native landscape into ongoing urban development, creating ecologically significant patches of habitat that also function as stormwater management facilities.

Using native plant species in stormwater swales, vegetated roofs, constructed wetlands, and other stormwater best management practices (BMPs) not only creates local habitat and ecosystem value but also offers the potential to save money, energy, and often time for developers and homeowners. Because native species are uniquely adapted to San Francisco's Mediterranean climate, they generally require less water and maintenance—fertilizer and pest control—than other, more traditional plant species used in landscaping. In addition, native landscapes require fewer if any pesticides, can reduce fire hazard, support native wildlife, and create a distinctive sense of place unique to the San Francisco Bay Area.

The following vegetation palette complements the "LID Native Plant List for San Francisco," published by the California Native Plant Society (CNPS) and accessible at http://stormwater.sfwater.org; the "Shoreline Plants: A Guide for the San Francisco Bay," published by the San Francisco Bay Conservation and Development Commission; and existing Bay Area native landscaping guidebooks by providing detailed descriptions of plant species appropriate for the San Francisco Bay Area. The list may include several native plant species that are currently extirpated (X), endangered (E), threatened (T), and rare (R). A species is considered native when it has existed in an area prior to the influx of Europeans. According to the California Endangered Species Act (CESA), a species listed

Sunset Circle parking lot at Lake Merced.

as endangered must be a California native that is: "in serious danger of becoming extinct throughout all, or a significant portion of its range." Threatened species are vulnerable to extinction in the near future. According to CEQA Guidelines, a species is considered rare when either it exists in such small numbers throughout all or a significant portion of its range that it may become endangered if its environment is altered or the species is likely to become endangered within the foreseeable future. CNPS manages a Rare Plant Program, in which over 1,400 plant species in California, nearly 25% of the state's native flora, are designated as at-risk or a potential conservation concern by a network of over 500 botanists. Species included in the CNPS Rare Plant Program are identified in the palette as species of local concern (SLC).

The vegetation palette can be used in conjunction with other regional landscaping reference books, such as: *Plants and Landscapes for Summer-Dry Climates*, published by the East Bay Municipal Utility District, and the *Sunset Western Garden Book*, published by Sunset Magazine. These are excellent resources for researching and selecting more commonly used California native and drought-tolerant plants.

It is important to group plants based on their cultural preferences: the amount of sun and water they need, as well as their soil and maintenance requirements. Additionally, creating a sustainable landscape requires the selection of plants compatible to the site's existing topographic and soil conditions.

Topography and Soil

Site conditions influence the layout of a native garden. It is important to consider the degree and direction of any slopes present at the project site. As slopes become steeper, soil drainage improves. Therefore, species that require well-drained soils may be planted on a slope that has "heavy," clay soils. However, plants that require regular water may not be well-suited to slopes due to an increase in water runoff. Slopes also affect sun exposure, as south-facing slopes receive more solar energy than north-facing slopes.

Soil texture influences both watering and fertilizing practices and determines which species of plants will thrive at a particular site. The use of plants that are adapted to the native soils present at the site reduces the need for soil amendments, fertilizers, under-drains, and/or excess water application.

Mulch

Mulching is the application of organic or inorganic materials to the surface of the soil around plants. Mulching maintains soil moisture levels between watering, prevents the growth of weeds, and reduces the risk of soil compaction from foot traffic or heavy rains. Organic mulch, such as wood chips and chopped green waste, contributes nutrients to the soil as it breaks down. Generally, two to four inches of mulch applied around the root zone of each plant is sufficient. It is important to not mulch near the plant crown to prevent fungus and disease, as many native species are extremely sensitive to crown burial. Inorganic mulch, such as gravel, pebbles, and decomposed granite, are well-suited for chaparral, wildflower, and desert plantings that suffer in moist conditions.

Water

California native plants are adapted to San Francisco's Mediterranean climate and can often tolerate long periods of drought. Enduring the summer, dry months requires a well-established, deep root system. Less frequent, generous applications of water allow oxygen to re-enter the root zone and promotes the growth of a substantial root system. Most native plant species thrive with a low-frequency, long duration watering schedule. Irrigating plants as they establish prevents stress, helping plants to deal with pests and disease. It is important to group plants with similar water needs to ensure plant health and reduce excess runoff.

Natives are best planted in the fall, winter or early spring. Winter planting mimics natural plant establishment cycles, thereby minimizing plant stress. In the summer, dry months, many native plants go dormant—maintaining their size and shape and ceasing to produce new growth. Cut back on watering for well-established plants in the summer months. Generally, a plant is established after two to three years or when the plant has doubled or tripled its size from the time of its planting.

Efficient irrigation practices rely on determining both when to apply water and the proper quantity of water required to ensure plant health. To assist landscape managers in efficient irrigation practice, the University of California Cooperative Extension and the California Department of Water Resources published *A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California*. The guide includes calculation methods to estimate landscape irrigation demand based on local climate, site conditions, and plant species. The

Mulch and plantings at Mint Plaza.

Rosa californica (California Wild Rose).
Photo: Barbara Eisenstein

benefits of estimating the proper irrigation water demand of the landscape include: saving water and energy; reducing labor, pesticide, and fertilizer costs; improving landscape health; preventing groundwater contamination; and reducing runoff and drainage loads.

Recycled Water and Salinity

Recycled water is treated wastewater. Recycled water can be used for landscape irrigation. However, treated wastewater often contains more salts and nutrients than are found in potable water. Plants sensitive to salts may not be well-suited to the application of recycled wastewater. A series of studies by both the University of California at Davis and several Northern California water utility companies found that plants that were sensitive to recycled water applied overhead responded well to recycled water applied through a drip irrigation system. In addition, sprinkler-applied recycled water often had no negative effects if the water was applied infrequently and deeply, allowing for both salts to leach below the root zone and time for the leaves to dry out.

Pest Management

The use of chemical pesticides and fertilizers in the garden increases the risk of pollution to the Ocean, Bay and other receiving water bodies. Both stormwater and runoff water from irrigating lawns and planting areas can carry chemical pesticides and fertilizers into storm drains. During intense storm events, untreated stormwater and sewage can enter the Bay, threatening the health of Bay habitat and ultimately the entire Bay Area ecosystem. A benefit of planting native California and Mediterranean plants is the reduced need for both chemical pesticides and fertilizers. Native plants attract beneficial insects and wildlife that reduce the need for chemical pest management. In addition, native plants are adapted to the soil and climate of the Bay Area and require less fertilizer than non-native plants. Both proper plant care—watering, pruning, and mulching—and plant siting can support the health of the landscape and strengthen the plant's natural defenses against disease.

Wildlife

Native gardens have the potential to attract birds, butterflies, and beneficial insects. Native plants provide food and shelter for wildlife, and wildlife is critical for propagating plant species through pollination. It is important to avoid using pesticides in order to not harm wildlife.

Native plants have a critical role in the support of local wildlife. In a study on the effects of landscaping with native plants versus non-native plants in a suburban context, researchers of the Department of Entomology and Wildlife Ecology, University of Delaware, found that native landscapes supported significantly greater butterfly and bird populations. Evidence cited in the study showed that 90% of insect herbivores, an important food source of terrestrial birds, required native plant species to reproduce. The results of this study empower property developers and owners to make landscape choices that can promote habitat biodiversity, support local wildlife, and enhance environmental quality while partially mitigating for the loss of habitat associated with development.

Acer macrophyllum (Big Leaf Maple).
Photo: Barbara Eisenstein

Additional Landscaping Resources

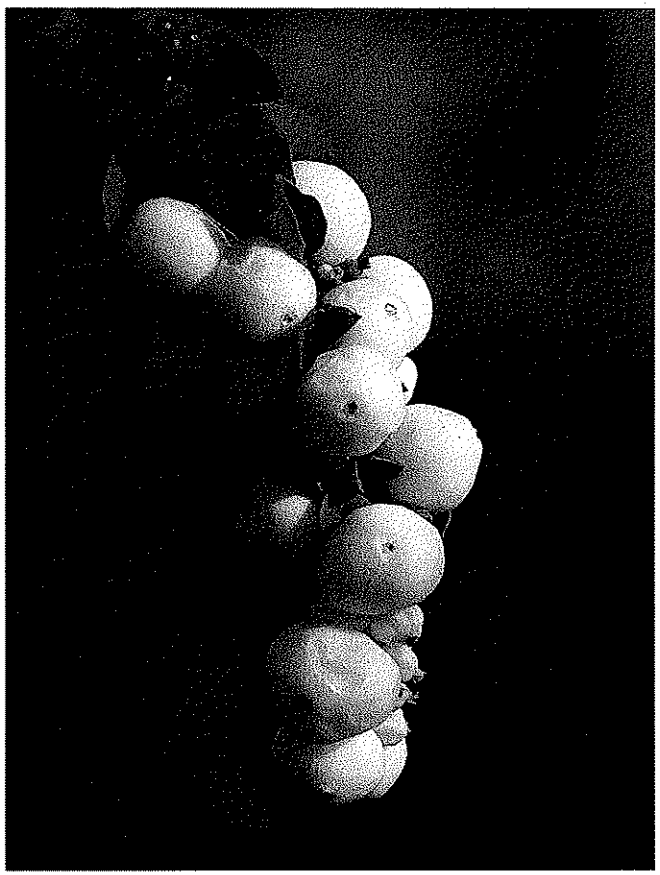
Several resources for landscaping best management practices include the *Bay-Friendly Landscape Guidelines* and the *Sustainable Sites Initiative.*

The *Bay-Friendly Landscape Guidelines*, published by StopWaste.Org (a joint project of Alameda County Waste Management Authority and Alameda County Source Reduction and Recycling Board), describes practices for sustainable landscaping that are inspired by natural systems where nothing goes to waste: inputs are limited to available site resources, and species diversity supports landscape stability. The Guidelines offers methods for reducing and reusing waste at the site, maintaining soil health, supporting native flora and fauna diversity, and minimizing environmental impacts in the construction and maintenance of Bay Area landscapes. A scorecard to rate projects, as well as additional resources and references for best management practices are included in the Guidelines.

The Guidelines makes the direct connection between landscaping practices and the hydrologic cycle. Landscaping practices that maintain soil quality through mulching, composting, and reducing or eliminating the use of chemical fertilizers and pesticides can increase the capacity of the soil to infiltrate stormwater runoff, store water and nutrients to support plants, facilitate groundwater recharge, and filter pollutants.

Several requirements to qualify as a "Bay-Friendly Landscape" follow: applying recycled mulch to a minimum depth of three inches for all soil; diverting 50-percent of landscape construction and demolition waste; eliminating species that require shearing; eliminating all invasive species listed by Cal-IPC; specifying that 75-percent of plants shall be California natives, Mediterranean, and/or climate adapted plants requiring little to no summer water;

San Francisco Stormwater Design Guidelines



Symphoricarpos albus (Common Snowberry).
Photo: Barbara Eisenstein

reducing turf area to a size that requires no more than 25-percent of the total site irrigation demand; installing weather-based irrigation controllers; and eliminating sprinklers or spray heads from areas less than eight feet in width.

The *Sustainable Sites Initiative* (SSI), a collaborative project of the American Society of Landscape Architects, Lady Bird Johnson Wildflower Center, and the United States Botanic Garden, provides draft guidelines and performance benchmarks for site planning, design, and operation and maintenance to achieve environmental, social, and economic balance in the integration of natural and built systems. SSI aims to complement LEED by extending project guidelines to the landscape with performance benchmarks that address site ecology and regional conditions, providing a rating of ecosystem benefits.

The draft performance benchmarks and rating system focus on the following five factors: hydrology, soils, vegetation, materials, human health, and well-being. Points will be allocated for increasing pervious surface area, incorporating draught-tolerant, regionally appropriate plant species, and sourcing plant materials from approved nurseries and growers that use sustainable practices. SSI asserts that maintaining and improving soil conditions affect BMP performance. Points are awarded for preserving healthy soils present at a site, while avoiding soil compaction in the construction process.

Other systems approaches to be incorporated into the rating system are reusing existing materials in the site design and construction, recycling yard waste, and managing micro-climate with vegetation and facilities siting. These approaches aim to reduce energy consumption associated with both disposing of materials to land fills and building heating and cooling costs. SSI encourages the use of the draft "Guidelines and Performance Measures" to pursue LEED innovation credit. The draft can be found at www.sustainablesites.org.

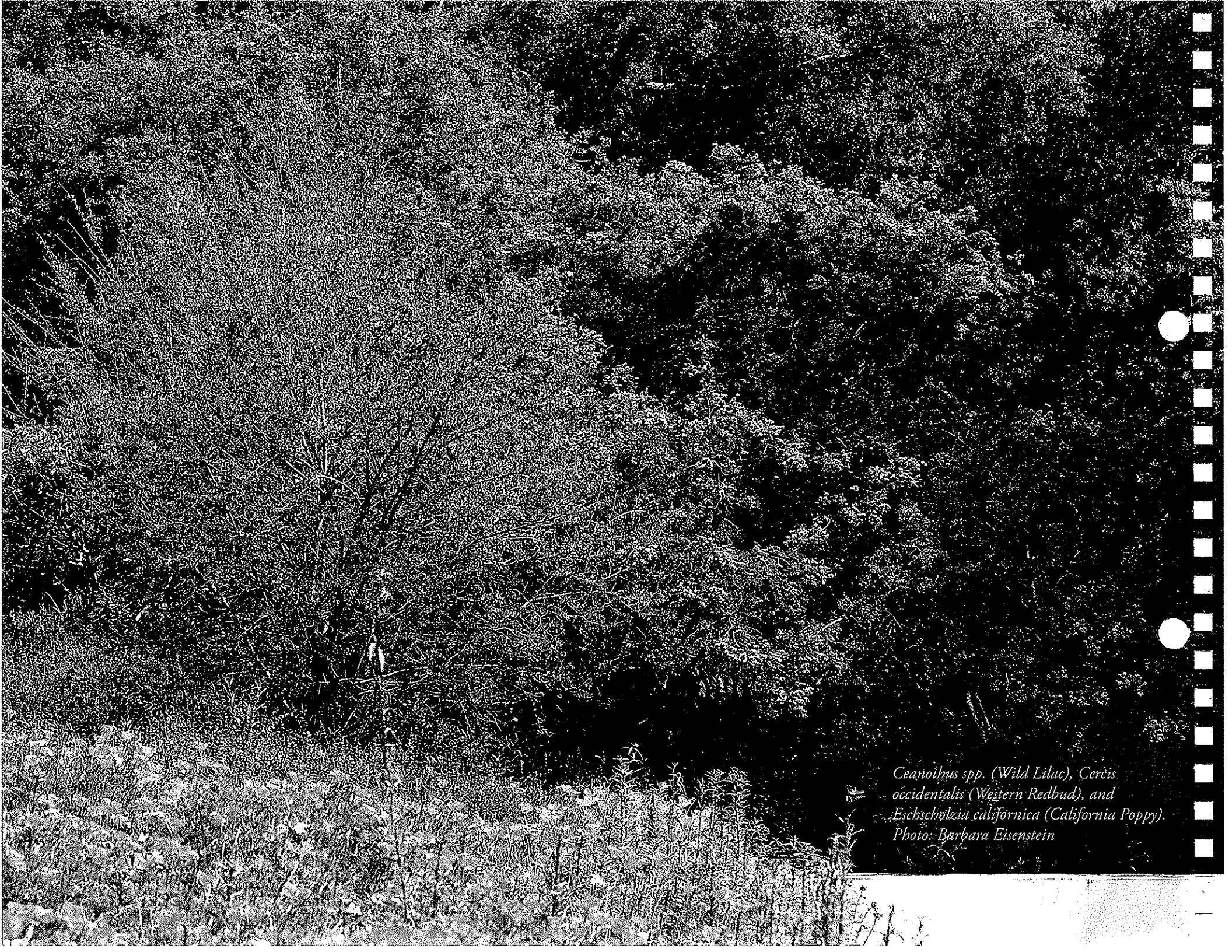
Vegetation Palette

The following vegetation palette combines data from several plant databases and major reference books to create a diverse palette specific to the San Francisco Bay Area. The plants can be combined with Mediterranean and non-native plants not listed, depending on their growing conditions and cultural requirements. The criteria for including plants in the *Guidelines* include the following characteristics:

- Well-suited to specific BMPs
- Attractive to wildlife and beneficial insects
- Locally appropriate

Plants are listed by both scientific and common names and plant type. The palette includes information on cultural preferences: soil, water, sun; native status; bloom time and color; and habitat value. Several lists of plants that follow the table of plants highlight the following: species adapted to LID, species of concern, species adapted to clay soils, species that flower, and species with habitat value.

Eschscholzia californica (California Poppy).
Photo: Barbara Eisenstein



Ceanothus spp. (Wild Lilac), Cercis occidentalis (Western Redbud), and Eschscholzia californica (California Poppy). Photo: Barbara Eisenstein

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			Swale	Buffer Strip	Wetland	Rock filter	Rain garden	Flow-through plante	Above ground plant	Clay	Loam	Sand	Regular	Moderate	Low	Drought tolerant	Full sun	Partial shade	Shade			Habitat value	Insects	Bees	Butterfly	Hummingbird	Birds	
Abronia umbellata*†	Pink Sand Verbena	perennial										●								SLC	white / pink							does well in poor soils
Acer macrophyllum*†	Big Leaf Maple	tree	●		●	●				●	●	●	●	●			●	●	●	SLC	Spring; yellow	●			●			no salinity tolerance
Acer negundo*†	Box Elder	tree	●	●	●	●	●	●	●	●	●										Summer - Fall; yellow-green	●			●			does well in poor soils
Acer rubrum	Red Maple	tree	●	●	●	●	●	●	●	●	●	●	●	●			●	●			Spring; light brown / reddish	●			●			limited success in San Francisco
Acer saccharinum	Silver Maple	tree	●	●	●	●	●	●	●	●	●		●	●			●	●			Spring; green / yellow	●			●			aggressive roots are hard on sidewalks and sewers
Achillea millefolium**†	Yarrow	shrub					●				●	●			●		●				Summer - Fall; multi-colored	●	●	●	●			ground cover
Acorus gramineus	Sweet Flag	grass					●		●				●				●	●	●									rich soil
Adiantum jordanii*	California Maidenhair Fern	fern	●		●					●	●		●					●	●	SLC								
Aesculus californica**†	California Buckeye; California Chestnut	tree		●						●	●	●		●		●	●	●		SLC	Summer; white	●			●	●		prefers well-drained soil
Agrostis exarata*	Bentgrass	grass			●	●				●	●	●		●			●					●						
Agrostis hallii†	Hall's Bentgrass	grass											●				●											
Agrostis pallens**†	Bentgrass	grass			●	●	●										●	●										lawn substitute, good in turf-block pavers, reguires water to stay green through summer; tolerates poor soils
Alnus spp.*†	Alder	tree	●	●	●	●	●	●	●		●	●	●				●	●	●			●			●			
Amsinckia lunaris	Bentflower Fiddleneck	annual																	●		Spring; yellow							
Aquilegia formosa**	Western Columbine	perennial			●	●					●	●	●	●			●	●		SLC		●		●	●	●	●	
Arabis blepharophylla*	Coast Rockcress; Rose Rockcress	perennial												●			●			SLC	rose	●			●			requires good drainage

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Arctostaphylos densiflora*†	Howard McMinn Manzanita; McMinn's Vine Hill Manzanita	shrub		•			•	•	•						•		•	•			Spring; whitish-pink	•			•	•	•	good screen; prefers acid to neutral soils
Arctostaphylos hookeri ssp. franciscana*†	Franciscan Manzanita	shrub												•	•		•	•		X	Spring	•			•	•	•	prefers acid to neutral soils
Arctostaphylos hookeri ssp. ravenii*†	Presidio Manzanita	shrub		•			•	•	•					•	•		•	•		E		•			•	•	•	prefers acid to neutral soils
Arctostaphylos tomentosa crustacea*	Lake Merced Brittleleaf Manzanita	shrub												•	•		•	•		SLC		•			•	•	•	prefers acid to neutral soils
Aristolochia californica**	Pipevine	vine								•	•	•	•					•			Winter - Spring; cream	•				•		
Armeria maritima*†	Sea Thrift	perennial			•	•	•				•	•			•		•				Spring - Summer; purple / white	•		•				ground cover
Artemisia californica**†	Coastal Sagebrush	shrub										•			•	•	•											
Artemisia douglasiana*†	Mugwort	perennial			•	•									•		•	•										provide good drainage
Artemisia pycnocephala*	Beach Wormwood; Coastal Sagewort; Sandhill Sage	shrub										•			•	•	•											
Asarum caudatum	Wild Ginger	perennial					•					•			•		•	•										ground cover
Asclepias fascicularis	Narrow-leafed Milkweed; Mexican Whorled Milkweed	perennial								•							•				Summer; white	•		•	•	•		most favored monarch butterfly host in California
Aster radulinus*	Rough Leaved Aster	perennial								•	•	•	•				•			SLC	Summer - Fall; lavander							
Astragalus gambellianus*	Milk Vetch; Dwarf Loco Weed	perennial																		SLC		•			•			
Astragalus nuttallii**	Nuttall's Milk-Vetch; Loco Weed	perennial																		SLC		•			•			
Atriplex californica†	California Saltbush	perennial			•	•									•	•	•			SLC		•					•	
Baccharis pilularis**†	Coyote Bush; Coyote Brush	shrub								•	•	•			•		•				Summer; white	•	•				•	intolerant to shade

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Baccharis salicifolia	Mule-fat	shrub			●	●				●	●	●			●		●				Spring; yellow	●			●			intolerant to shade
Betula spp.*	Birch	tree	●	●	●	●	●	●	●				●				●					●			●			not good for lawn or near parked cars
Bouteloua dactyloides	Buffalo Grass	grass	●	●				●		●	●	●				●	●				Summer; yellow							
Bromus carinatus*†	California Brome	annual	●	●	●		●	●		●	●			●		●						●			●			
Calamagrostis nutkaensis**	Pacific Reedgrass	grass			●					●	●	●	●	●			●	●	●	SLC								
Calystegia purpurata	Morning Glory	vine										●					●	●										requires well-drained soil
Carex comosa	Bristly Sedge; Longhair Sedge	grass	●	●	●	●	●	●	●												Summer; green	●			●			
Carex densa*	Dense Sedge	grass	●	●	●	●	●	●	●	●	●		●							SLC		●			●			
Carex praegracilis†	Clustered Field Sedge	grass	●	●			●	●	●	●	●	●	●	●			●	●			Spring; green	●			●			no salinity tolerance; can be used as lawn substitute
Carex tumulicola*†	Berkeley Sedge; Slender Sedge	grass	●	●			●	●	●	●								●				●			●			lawn substitute
Carpenteria californica*†	Bush Anemone; Tree Anemone	shrub												●	●		●	●										
Carya illinoinensis	Pecan	tree	●	●	●	●	●	●	●		●	●	●				●					●						no salinity tolerance
Carya ovata	Buttonbush; Shagbark Hickory	tree	●	●	●	●	●	●	●		●	●	●				●	●			Spring; yellow							no salinity tolerance
Casuarina spp.	She-oak	tree	●	●	●	●	●	●	●			●			●	●	●											good screen
Ceanothus 'Julia Phelps'*	Julia Phelps Ceanothus	shrub		●			●		●	●	●	●			●		●				Spring; blue	●		●	●	●	●	prefers well-drained soils
Cerastium arvense*	Field Chickweed	perennial			●	●														SLC	white							
Cercis occidentalis†	Western Redbud	tree		●			●	●		●	●	●			●	●	●	●			Spring; magenta / white	●		●		●		excellent for seldom-watered banks
Chenopodium californicum*	California Goosefoot	perennial											●				●			SLC								

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Cirsium andrewsii*	Franciscan Thistle	perennial			•															SLC	Spring - Summer	•			•			
Clarkia rubicunda†	Farewell to Spring; Ruby Chalice Clarkia	annual								•			•				•				Summer; pink / purple							
Claytonia perfoliata**	Miner's Lettuce	annual			•	•					•	•					•	•	•		Spring; white							
Clematis lasiantha	Pipestems; Chapparal Clematis	vine													•		•				Spring							
Clematis ligusticifolia	Virgin's Bower; Western White Clematis	vine			•	•				•	•	•						•			Spring - Summer							erosion control, reclamation, along stream banks
Cornus stolonifera	Redwig; Red-Osier Dogwood	tree		•				•		•	•	•					•				Summer; white	•					•	can be used for windbreaks; low salinity tolerance; no tolerance to shade
Corylus cornuta californica*†	California Hazelnut; Western Hazelnut	shrub or tree								•	•	•	•				•	•		SLC	Winter; yellow							good for slopes; no salinity tolerance
Croton californicus*	California Croton	shrub																		SLC								
Cupressus macrocarpa*	Monterey Cypress	tree												•	•		•											
Danthonia californica*†	California Oatgrass	grass			•	•				•	•			•			•	•										
Delphinium californicum*	California Larkspur	perennial			•	•							•				•			SLC	white	•				•		
Deschampsia cespitosa*†	Tufted Hairgrass	grass		•	•	•	•		•	•	•	•	•	•			•	•				•			•			
Dicentra formosa	Bleeding Hearts; Pacific Bleeding Heart	perennial			•	•	•			•	•	•	•					•	•		Spring; purple	•		•	•	•		ground cover
Diospyros virginiana*	Persimmon	tree	•	•	•	•	•	•	•	•	•		•	•			•	•	•		Summer; yellow							fragrant
Disporum hookeri*	Fairy Bells; Hooker's Fairy Bell; Drops of Gold	perennial																		SLC								good for slopes
Distichlis spicata*†	Salt Grass	grass	•	•	•	•				•	•			•		•	•				Summer; yellow	•						intolerant to shade
Dryopteris expansa	Spreading Wood Fern	fern			•	•							•					•	•									

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Eleocharis macrostachya*	Creeping Spike Rush; Pale Spikerush; Wire Grass	grass			●	●	●		●											SLC								
Elymus glaucus**†	Blue Wild Rye	grass	●	●	●	●				●	●	●			●			●										
Epilobium canum spp. canum*	California Fuchsia; Hummingbird Trumpet	shrub	●	●			●		●						●	●	●	●			Spring; red	●				●		
Equisetum hyemale**	Scourgrush Horsetail; Scouring Rush	perennial	●	●			●	●	●	●	●					●					Spring; white							drought tolerant but thrives in moist soils
Erigeron foliosus var. franciscensis*	San Francisco Leafy Fleabane; Franciscan Erigeron	perennial																		SLC		●			●			
Erigeron glaucus†	Seaside Daisy; Seaside Fleabane	perennial			●	●						●		●		●	●	●				●	●		●			
Eriogonum fasciculatum*†	California Buckwheat	shrub		●			●		●	●	●	●		●	●	●					Fall; pink/white	●	●		●			erosion control; intolerant to shade; prefers well-drained soils
Eriogonum giganteum*†	St. Catherine's Lace	shrub												●	●	●	●				Summer; white / lavander	●			●		●	prefers well-drained soils
Eriogonum latifolium*†	Coast Buckwheat	shrub										●			●		●					●	●		●			
Eriogonum parvifolium*	Dune Buckwheat	shrub													●		●					●	●		●			prefers well-drained soils
Erysimum franciscanum**	San Francisco Wallflower	perennial										●					●	●		SLC		●		●				requires good drainage
Eschscholzia californica*†	California Poppy	perennial		●	●	●	●		●	●	●		●	●	●		●				Spring - Summer; yellow / orange	●		●				no salinity tolerance
Eucalyptus citriodora	Lemon-scented Gum	tree	●	●	●	●	●	●	●				●	●	●		●				Year-round; white	●				●		
Eucalyptus erythrocorys	Red-cap Gum	tree	●	●	●	●	●	●	●				●	●	●		●				Year-round; yellow	●				●		

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Euthamia occidentalis*	Western Goldenrod; Western Goldentop; Western Flat Topped Goldenrod	perennial			●	●				●	●	●					●			SLC	Summer; yellow							intolerant to shade
Festuca californica*†	California Fescue	grass					●	●	●	●	●	●	●	●		●	●			SLC								
Festuca idahoensis*†	Idaho Fescue; Blue Bunchgrass	grass	●	●	●	●	●	●	●	●	●	●	●	●			●	●			Summer; yellow	●			●			intolerant to shade; good slope stabilizer
Festuca rubra*†	Red Fescue; Idaho Fescue	grass	●	●	●	●	●	●	●			●	●				●	●				●			●			can be used as a lawn substitute; erosion control
Fragaria chiloensis*†	Coastal Strawberry; Beach Strawberry	perennial	●				●	●	●			●	●				●	●			Spring; white							ground cover
Fragaria vesca**	Mountain Strawberry; Woodland Strawberry	perennial	●				●		●			●	●				●	●			Spring; white							ground cover
Frankenia salina*†	Yerba Reuma; Alkali Heath; Alkali Seaheath	shrub			●	●														SLC								
Fraxinus latifolia*	Oregon Ash	tree	●	●	●	●	●	●	●	●	●	●					●	●										
Fremontodendron 'California Glory'*†	Flannel Bush	shrub										●			●		●				Spring; yellow							requires good drainage; no water once established; no salinity tolerance
Garrya elliptica*†	Coast Silktassel; Wavyleaf Silktassel	shrub or tree		●				●						●		●	●	●		SLC	Winter; yellow-green	●		●	●		●	requires good drainage; good screen
Gaultheria shallon*†	Salal	shrub	●				●		●	●	●	●	●				●	●	●		Spring; white	●		●	●			
Gilia capitata ssp. chamissonis*	Blue Coast Gilia; Dune Gilia; Chamisso's Gilia; Bluehead Gilia	annual	●						●					●	●		●			SLC		●		●	●			requires well-drained soils
Gleditsia triacanthos	Honey Locust	tree	●	●	●	●	●	●	●		●		●	●			●				Spring; yellow							intolerant to shade
Gnaphalium californicum*	California Everlasting	biennial																			white	●			●			
Grevillea robusta	Silk Oak	tree								●	●	●		●	●	●	●				Summer; yellow	●		●	●		●	intolerant to shade

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Grindelia hirsutula var. maritima*†	San Francisco Gumplant; Coastal Gumweed	shrub								●	●	●		●	●	●	●	●		SLC								
Helianthus annuus	Common Sunflower	annual								●	●		●				●				Summer - Fall; yellow / red	●		●	●			Fragrant; medicinal; used for fuel
Heliotropium curassavicum*	Seaside Heliotrope; Salt Heliotrope	annual			●	●				●	●						●	●		SLC	Spring; white	●			●			high salinity tolerance; intolerant to shade
Heteromeles arbutifolia**†	Toyon	shrub		●			●		●			●		●			●	●				●		●		●	●	good screen
Heuchera micrantha*	Crevice Alumroot	perennial								●			●	●					●	SLC	Spring - Summer; white	●				●		grow best in well-drained, humus-rich soil
Hordeum brachyantherum**†	Meadow Barley	grass	●	●	●	●				●	●	●		●			●				Spring; purple	●						tolerates poor soils
Iris douglasiana**†	Douglas Iris; Pacific Iris	perennial			●	●	●		●	●	●	●		●	●	●	●	●				●			●	●	●	requires well-drained soil
Iris longipetala*	Coast Iris	perennial					●		●	●	●	●		●	●	●	●	●	●			●				●		no salinity tolerance
Juglans hindsii*	Northern California Walnut	tree			●											●	●					●					●	
Juncus spp.†	Rushes (various)	grass	●		●	●	●		●	●	●	●	●				●	●										
Juncus xiphioides*	Irisleaf Rush	grass	●	●	●	●	●	●	●	●	●	●	●				●	●		SLC								
Koeleria macrantha**†	Prairie Junegrass	grass	●	●	●		●	●	●		●	●	●				●				Spring - Summer; yellow							
Lasthenia glabrata*	Gold Fields; Yellowray Goldfields	annual			●	●															Spring							
Lavatera assurgentiflora*†	Tree Mallow	shrub						●			●	●		●			●				Spring - Summer; pink / purple	●			●			requires good drainage; intolerant to shade
Linaria canadensis*	Blue Toadflax	annual										●	●				●	●		SLC	blue							
Liquidambar styraciflua	American Sweet Gum; Redgum	tree	●	●	●	●	●	●	●	●	●	●	●	●			●	●			Spring; green							

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Lithophragma heterophyllum*	Hill Star; Hillside Woodland; Woodland Star	perennial															●	●		SLC								good on steep slopes
Lotus formosissimus*	Harlequin Lotus; Seaside Bird's-foot Trefoil	perennial			●	●															multi-colored	●		●				
Lotus scoparius**	Common Deerweed	shrub		●	●	●	●		●													●		●	●			
Lupinus albifrons*†	Silver Bush Lupin	shrub	●	●	●	●	●		●			●			●		●				Spring; purple	●		●	●			prefers good draiange
Magnolia grandiflora	Southern Magnolia	tree					●		●	●	●		●						●		Spring; white							
Magnolia virginia	Sweet Bay	tree	●	●	●	●	●	●	●	●	●	●	●				●	●			Summer; white							
Melaleuca quinquenervia†	Cajeput Tree	tree	●	●	●	●	●	●	●				●	●	●		●											
Melica californica*†	California Melic	grass	●	●	●	●	●	●	●		●	●							●		Summer; yellow							tolerates poor soil
Mimulus aurantiacus*†	Sticky Monkeyflower	perennial	●	●			●	●	●	●		●			●		●	●			Spring - Summer; orange	●			●	●		
Mimulus guttatus**	Creek Monkeyflower; Seep-spring Monkeyflower	perennial	●	●	●	●	●	●	●	●	●	●	●				●					●			●	●		
Miscanthus sinensis	Japanese Silver Grass	grass	●	●	●	●	●	●	●	●	●	●					●				Summer; yellow							
Monardella villosa Benth. ssp. franciscana (Elmer) Jokerst*	San Francisco Coyote Mint; Coyote Mint	shrub													●		●				Spring - Summer	●				●		requires well-drained soils
Muhlenbergia rigens*†	Deer Grass; Mule Grass	grass	●	●			●	●	●	●	●	●					●				Summer; yellow	●						requires good drainage; streambank stabilization
Myrica californica*†	Pacific Wax Myrtle	tree		●			●		●	●	●	●		●			●	●			yellow	●						good informal hedge, wind break
Nassella lepida*†	Foothill Needlegrass	grass	●	●	●	●	●		●	●	●		●				●				Spring; yellow							tolerates poor soils
Nassella pulchra*†	Purple Needlegrass	grass	●	●			●	●	●	●	●	●			●		●			R	Spring; yellow							

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			Swale	Buffer Strip	Wetland	Rock filter	Rain garden	Flow-through plante	Above ground plant	Clay	Loam	Sand	Regular	Moderate	Low	Drought tolerant	Full sun	Partial shade	Shade			Habitat value	Insects	Bees	Butterfly	Hummingbird	Birds	
Nemophila menziesii*	Baby Blue Eyes	annual					●						●				●	●			Spring; blue	●	●	●				ground cover; bulb cover
Nyssa sylvatica	Black Tupelo; Blackgum	tree	●	●	●	●	●	●	●		●	●	●	●			●	●	●		Spring; greenish-white	●						
Oxalis oregana	Redwood Sorrel	perennial					●					●	●						●		Spring; pink							ground cover
Oxydendrum arboreum	Lily of the Valley Tree; Sourwood; Sorrel Tree	tree	●	●	●	●	●	●	●		●	●	●				●	●	●		Summer; yellow							not good in lawns
Pellaea andromedaefolia*	Coffee Fern; Coffee Cliffbrake	fern										●			●		●			SLC								requires good drainage
Penstemon spp.*†	Penstemon; Beard Tongue	perennial									●	●		●	●		●	●			Summer; multi-colored	●		●	●	●		erosion control; requires good drainage
Phacelia californica*	Scorpionflower; California Phacelia	perennial										●			●		●	●			purple	●		●				
Picea sitchensis	Sitka Spruce	tree	●	●	●	●	●	●	●	●	●	●		●			●	●			Spring; yellow							
Platanus occidentalis	American Sycamore	tree	●	●	●	●	●	●	●	●	●	●	●	●			●				Spring; red	●			●			
Platanus racemosa*	California Sycamore	tree	●	●	●	●	●	●	●		●	●	●	●			●					●			●			
Platanus x acerifolia†	London Plane Tree	tree	●	●	●	●	●	●	●	●	●	●	●	●			●	●			Spring; yellow							good street or lawn tree
Poa unilateralis Vasey*	Ocean Bluff Blue Grass; San Francisco Bluegrass	grass			●	●																						
Polypodium scouleri*	Leather Leaf Fern; Leathery Polypody	fern																●	●									
Polystichum munitum*†	Western Sword Fern	fern	●				●			●	●		●				●	●										does best in rich, well-drained soils
Populus trichocarpa*	California Poplar; Black Cottonwood; Western Balsam Poplar	tree			●					●	●	●					●				Spring; yellow	●			●			intolerant to shade
Potentilla rivalis*	Brook Cinquefoil	annual			●	●											●	●		SLC								
Prunus emarginata**	Bitter Cherry	shrub or tree										●		●			●			SLC	Spring; white	●		●	●			

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Scientific Name	Common Name	Plant Type	BMP							Soil			Water				Sun			Status	Bloom time; Color	Habitat Value						Notes
			Swale	Buffer Strip	Wetland	Rock filter	Rain garden	Flow-through plante	Above ground plant	Clay	Loam	Sand	Regular	Moderate	Low	Drought tolerant	Full sun	Partial shade	Shade			Habitat value	Insects	Bees	Butterfly	Hummingbird	Birds	
Prunus ilicifolia*†	Hollyleaf Cherry; Islais Cherry	shrub or tree								●	●	●	●	●		●	●					●			●			good screen; requires good drainage; avoid planting near sidewalk: fruit stains
Prunus virginiana var. demissa*	Western Chokeberry	shrub																		SLC	Spring; white	●		●	●			good screen; erosion control
Quercus agrifolia**†	Coast Live Oak	tree		●			●		●	●	●	●					●	●				●					●	erosion control; good screen
Quercus chrysolepis**	Canyon Live Oak	tree								●	●	●					●	●	●	SLC		●					●	erosion control
Quercus macrocarpa	Bur Oak	tree		●	●	●	●	●	●	●	●	●		●			●				Spring; yellow	●						
Quercus palustris	Pin Oak	tree	●	●	●	●	●	●	●	●	●						●				Spring; yellow							intolerant to shade
Rhamnus californica**†	Coffeeberry; California Buckthorn	shrub	●				●	●	●		●	●			●		●	●				●			●		●	good screen
Rhamnus crocea**	Redberry Buckthorn	shrub													●		●	●		SLC	Spring; white	●			●		●	requires good drainage
Ribes divaricatum*	Spreading Gooseberry	shrub			●	●											●	●		SLC		●			●	●	●	
Ribes menziessi*	Canyon Gooseberry	shrub															●	●		SLC		●			●	●	●	
Ribes sanguineum**	Red-Flowering Currant	shrub									●	●		●	●		●	●	●		Spring; red	●		●	●	●	●	
Rosa californica**†	California Wild Rose	shrub		●	●	●	●	●		●	●	●	●				●	●	●		Summer; pink	●			●			excellent for bank stabilization
Rosa gymnocarpa**	Wood Rose	shrub									●		●				●			SLC	Spring; purple	●		●	●			
Rubus ursinus**†	California Blackberry	shrub		●	●	●	●	●	●	●	●	●							●		Spring; white	●		●		●		
Salicornia virginica*	Pickleweed; Virginia Glasswort	perennial			●						●	●		●			●				Spring; green	●						high salinity tolerance; no shade tolerance
Salix lasiolepis*†	Arroyo Willow	tree		●	●	●	●		●	●	●	●	●				●	●				●			●		●	
Salvia clevelandii*	Cleveland Sage; Fragrant Sage	shrub								●	●	●			●	●	●				Summer; purple	●		●	●	●		
Salvia mellifera*†	Black Sage	shrub		●						●	●	●			●		●				Spring - Summer; lavender	●		●	●	●		prefers good drainange
Salvia spathacea**	Hummingbird Sage; Pitcher Sage	perennial		●			●	●		●	●	●		●			●	●		SLC	Spring; rose / lilac	●		●	●	●		

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Scientific Name	Common Name	Plant Type	BMP							Soil			Water				Sun			Status	Bloom time; Color	Habitat Value						Notes
			Swale	Buffer Strip	Wetland	Rock filter	Rain garden	Flow-through plante	Above ground plant	Clay	Loam	Sand	Regular	Moderate	Low	Drought tolerant	Full sun	Partial shade	Shade			Habitat value	Insects	Bees	Butterfly	Hummingbird	Birds	
Sambucus nigra cerulea*	Blue Elderberry	shrub or tree		●			●		●	●	●	●			●		●	●				●			●	●	●	
Satureja douglasii*†	Yerba Buena	perennial											●			●	●	●										prefers coastal influence; moist, rich soil
Scirpus californicus*	Bulrush	perennial			●	●				●	●	●	●				●				Spring; brown	●						intolerant to shade
Scirpus maritimus*		grass		●		●	●	●	●	●	●	●				●	●			SLC								
Scrophularia californica**†	Bee Plant; California Figwort	perennial	●		●	●											●	●										
Sedum spathulifolium*	Broadleaf Stonecrop	succulent perennial					●		●						●	●	●				Spring - Summer; yellow	●		●				
Sequoia sempervirens*	Coast Redwood	tree									●	●					●	●	●		Fall; yellow							good screen
Sidalcea malviflora**†	Checkerbloom; Checker Mallow	perennial								●	●			●			●				Spring; pink	●			●			
Sisyrinchium bellum**†	Blue-eyed Grass	perennial		●	●	●	●	●	●	●	●		●	●			●	●			Spring; blue							
Sisyrinchium californicum**	Yellow-eyed Grass	perennial	●		●	●				●	●		●	●			●	●		SLC	Spring - Summer; yellow							prefers moist conditions
Solanum umbelliferum*	Nightshade	shrub	●																●	SLC	Year-round; blue							
Solidago confinis*†		perennial		●			●		●	●	●	●		●	●	●	●	●		SLC	Summer - Fall; yellow	●	●					not-too-rich soil
Spartina foliosa*†	Pacific Cordgrass; California Cordgrass	grass	●		●	●							●	●			●			SLC								
Suaeda californica*†	California Seablite	shrub			●	●																						
Symphoricarpos albus**	Common Snowberry	shrub		●	●	●	●	●	●	●	●	●		●	●			●			Spring; pink	●		●	●		●	prefers heavy, clay soils
Tanacetum camphoratum*	Dune Tansy; Camphor Tansy	perennial	●										●	●			●			SLC	yellow							
Taxodium distichum	Bald Cypress	tree			●	●				●	●	●	●	●	●		●				Spring; purple	●						
Thuja occidentalis	Arborvitae	tree	●	●	●	●	●	●	●	●	●	●	●	●			●	●	●		Spring	●						
Tradescantia virginiana*	Virgina Spiderwort	perennial	●	●			●	●	●	●	●						●	●			Spring; mult-color							no salinity tolerance

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Scientific Name	Common Name	Plant Type	BMP							Soil			Water				Sun			Status	Bloom time; Color	Habitat Value						Notes
			Swale	Buffer Strip	Wetland	Rock filter	Rain garden	Flow-through plante	Above ground plant	Clay	Loam	Sand	Regular	Moderate	Low	Drought tolerant	Full sun	Partial shade	Shade			Habitat value	Insects	Bees	Butterfly	Hummingbird	Birds	
Typha latifolia*	Common Cattail	perennial		●	●	●	●	●	●	●	●	●						●			Spring; brown	●						
Umbellularia californica*†	California Bay Laurel	tree	●		●	●				●	●	●	●	●	●		●	●	●	SLC	Spring; yellow							
Vaccinium ovatum*†	California Huckleberry; Evergreen Huckleberry	shrub					●		●		●	●	●	●		●	●	●	●	SLC	Spring; whitish-pink	●		●	●		●	
Vitis californica 'Roger's Red'*†	California Wild Grape	vine			●	●				●	●	●			●	●	●	●										
Vulpia myuros	Zorro Annual Fescue	grass								●	●	●				●	●				Winter; yellow	●						acid soil; no shade tolerance
Woodwardia fimbriata*	Giant Chain Fern	fern	●		●	●							●					●	●	SLC								

Achillea millefolium (Yarrow).
Photo: Barbara Eisenstein

Species Adapted to LID

Trees

Acer macrophyllum, Big Leaf Maple
Acer negundo, Box Elder
Acer rubrum, Red Maple
Acer saccharinum, Silver Maple
Aesculus californica, California Buckeye
Alnus spp., Alder
Betula spp., Birch
Carya ovata, Buttonbush
Carya illinoinensis, Pecan
Casuarina spp., She-oak
Cercis occidentalis, Western Redbud
Cornus stolonifera, Redwig
Diospyros virginiana, Persimmon
Eucalyptus citriodora, Lemon-scented Gum
Eucalyptus erythrocorys, Red-cap Gum
Fraxinus latifolia, Oregon Ash
Garrya elliptica, Coast Silktassel
Gleditsia triacanthos, Honey Locust
Juglans hindsii, Northern California Walnut
Liquidambar styraciflua, American Sweet Gum
Magnolia grandiflora, Southern Magnolia
Magnolia virginia, Sweet Bay
Melaleuca quinquenervia, Cajeput Tree
Myrica californica, Pacific Wax Myrtle
Nyssa sylvatica, Black Tupelo
Oxydendrum arboreum, Lily of the Valley Tree
Picea sitchensis, Sitka Spruce
Platanus occidentalis, American Sycamore
Platanus racemosa, California Sycamore
Platanus x acerifolia, London Plane Tree
Populus trichocarpa, Black Cottonwood
Quercus agrifolia, Coast Live Oak
Quercus macrocarpa, Bur Oak
Quercus palustris, Pin Oak
Salix lasiolepis, Arroyo Willow
Taxodium distichum, Bald Cypress
Thuja occidentalis, Arborvitae
Umbellularia californica, California Bay Laurel

Shrubs

Achillea millefolium, Yarrow
Arctostaphylos densiflora, Howard McMinn Manzanita
Arctostaphylos hookeri ssp. ravenii, Presidio Manzanita
Baccharis salicifolia, Mule-fat
Ceanothus 'Julia Phelps', Julia Phelps Ceanothus
Epilobium canum spp. canum, California Fuchsia
Eriogonum fasciculatum, California Buckwheat
Frankenia salina, Alkali Heath
Gaultheria shallon, Salal
Heteromeles arbutifolia, Toyon
Lavatera assurgentiflora, Tree Mallow
Lotus scoparius, Common Deerweed
Lupinus albifrons, Silver Bush Lupin
Rhamnus californica, Coffeeberry
Ribes divaricatum, Spreading Gooseberry
Rosa californica, California Wild Rose
Rubus ursinus, California Blackberry
Salvia mellifera, Black Sage
Sambucus nigra cerulea, Blue Elderberry
Suaeda californica, California Seablite
Symphoricarpos albus, Common Snowberry
Vaccinium ovatum, California Huckleberry

Perennials

Aquilegia formosa, Western Columbine
Armeria maritima, Sea Thrift
Artemisia douglasiana, Mugwort
Asarum caudatum, Wild Ginger
Atriplex californica, California Saltbush
Cerastium arvense, Field Chickweed
Cirsium andrewsii, Franciscan Thistle
Delphinium californicum, California Larkspur
Dicentra formosa, Bleeding Hearts
Equisetum hyemale, Scourgrush Horsetail
Erigeron glaucus, Seaside Daisy

Perennials (cont.)

Eschscholzia californica, California Poppy
Euthamia occidentalis, Western Goldenrod
Fragaria chiloensis, Coastal Strawberry
Fragaria vesca, Mountain Strawberry
Heuchera micrantha, Crevice Alumroot
Iris douglasiana, Douglas Iris
Iris longipetala, Coast Iris
Lessingia filaginifolia, Wooly Aster
Lotus formosissimus, Harlequin Lotus
Mimulus aurantiacus, Sticky Monkeyflower
Mimulus guttatus, Creek Monkeyflower
Oxalis oregana, Redwood Sorrel
Salicornia virginica, Pickleweed
Salvia spathacea, Hummingbird Sage
Scirpus californicus, Bulrush
Scrophularia californica, California Figwort
Sisyrinchium bellum, Blue-eyed Grass
Sisyrinchium californicum, Yellow-eyed Grass
Solidago confinis
Tradescantia virginiana, Virgina Spiderwort
Typha latifolia, Common Cattail

Biennials, Annuals and Succulents

Bromus carinatus, California Brome
Claytonia perfoliata, Miner's Lettuce
Gilia capitata ssp. chamissonis, Bluehead Gilia
Heliotropium curassavicum, Seaside Heliotrope
Lasthenia glabrata, Gold Fields
Nemophila menziesii, Baby Blue Eyes
Potentilla rivalis, Brook Cinquefoil
Sanicula maritima, Adobe Sanicle
Sedum spathulifolium, Broadleaf Stonecrop
Vulpia myuros, Zorro Annual Fescue

Ferns

Adiantum jordanii, California Maidenhair Fern
Dryopteris expansa, Spreading Wood Fern
Polystichum munitum, Western Sword Fern
Woodwardia fimbriata, Giant Chain Fern

Grasses

Acorus gramineus, Sweet Flag
Agrostis exarata, Bentgrass
Agrostis pallens, Bentgrass
Bouteloua dactyloides, Buffalo Grass
Calamagrostis nutkaensis, Pacific Reedgrass
Carex comosa, Bristly Sedge
Carex densa, Dense Sedge
Carex praegracilis, Clustered Field Sedge
Carex tumulicola, Berkeley Sedge
Danthonia californica, California Oatgrass
Deschampsia cespitosa, Tufted Hairgrass
Distichlis spicata, Salt Grass
Eleocharis macrostachya, Creeping Spike Rush
Elymus glaucus, Blue Wild Rye
Festuca californica, California Fescue
Festuca idahoensis, Idaho Fescue
Festuca rubra, Red Fescue
Hordeum brachyantherum, Meadow Barley
Juncus spp., Rushes (various)
Juncus xiphiodes, Irisleaf Rush
Koeleria macrantha, Prairie Junegrass
Melica californica, California Melic
Miscanthus sinensis, Japanese Silver Grass
Muhlenbergia rigens, Deer Grass
Nassella lepida, Neddlegrass
Nassella pulchra, Purple Needlegrass
Poa unilateralis Vasey, San Francisco Bluegrass
Scirpus maritimus
Spartina foliosa, California Cordgrass

Vines

Clematis lasiantha, Pipestems
Clematis ligusticifolia, Virgin's Bower
Vitis californica 'Roger's Red', California Wild Grape

Fragaria chiloensis (Coastal Strawberry). Photo: Barbara Eisenstein

Top: Iris douglasiana (Pacific Coast Iris) and Sisyrinchium bellum (Blue-eyed Grass), bottom: Platanus racemosa (California Sycamore). Photo: Barbara Eisenstein

Species of Concern

Trees

Acer macrophyllum, Big Leaf Maple
Aesculus californica, California Buckeye
Corylus cornuta californica, California Hazelnut
Garrya elliptica, Coast Silktassel
Prunus emarginata, Bitter Cherry
Quercus chrysolepis, Canyon Live Oak
Umbellularia californica, California Bay Laurel

Shrubs

Arctostaphylos hookeri ssp. franciscana, Franciscan Manzanita
Arctostaphylos hookeri ssp. ravenii, Presidio Manzanita
Arctostaphylos tomentosa crustacea, Lake Merced Brittleleaf Manzanita
Croton californicus, California Croton
Frankenia salina, Yerba Reuma
Grindelia hirsutula var. maritima, San Francisco Gumplant
Prunus ilicifolia ilicifolia, Islais Cherry
Prunus virginiana var. demissa, Western Chokeberry
Rhamnus crocea, Redberry Buckthorn
Ribes divaricatum, Spreading Gooseberry
Ribes menziessi, Canyon Gooseberry
Rosa gymnocarpa, Wood Rose
Salvia mellifera, Black Sage
Solanum umbelliferum, Nightshade
Vaccinium ovatum, California Huckleberry

Perennials

Abronia umbellata, Pink Sand Verbena
Aquilegia formosa, Western Columbine
Arabis blepharophylla, Coast Rockcress
Aster radulinus, Rough Leaved Aster
Astragalus gambellianus, Milk Vetch
Astragalus nuttallii, Nuttall's Milk-Vetch
Atriplex californica, California Saltbush
Cerastium arvense, Field Chickweed
Chenopodium californicum, California Goosefoot
Cirsium andrewsii, Franciscan Thistle
Delphinium californicum, California Larkspur
Disporum hookeri, Fairy Bells
Erigeron foliosus var. franciscensis, San Francisco Leafy Fleabane
Erysimum franciscanum, San Francisco Wallflower
Euthamia occidentalis, Western Goldenrod
Heuchera micrantha, Crevice Alumroot
Lithophragma heterophyllum, Woodland Star
Sisyrinchium californicum, Yellow-eyed Grass
Solidago confinis
Tanacetum camphoratum, Dune Tansy

Biennials and Annuals

Amsinckia menziesii, Menzies' Fiddleneck
Castilleja exserta ssp. latifolia, Purple Owl's Clover
Clarkia davyi, Davy's Clarkia
Gilia capitata ssp. chamissonis, Blue Coast Gilia
Heliotropium curassavicum, Seaside Heliotrope
Layia carnosa, Beach Layia
Linanthus rosaceus, Rose Linanthus
Linaria canadensis, Blue Toadflax
Potentilla rivalis, Brook Cinquefoil

Ferns

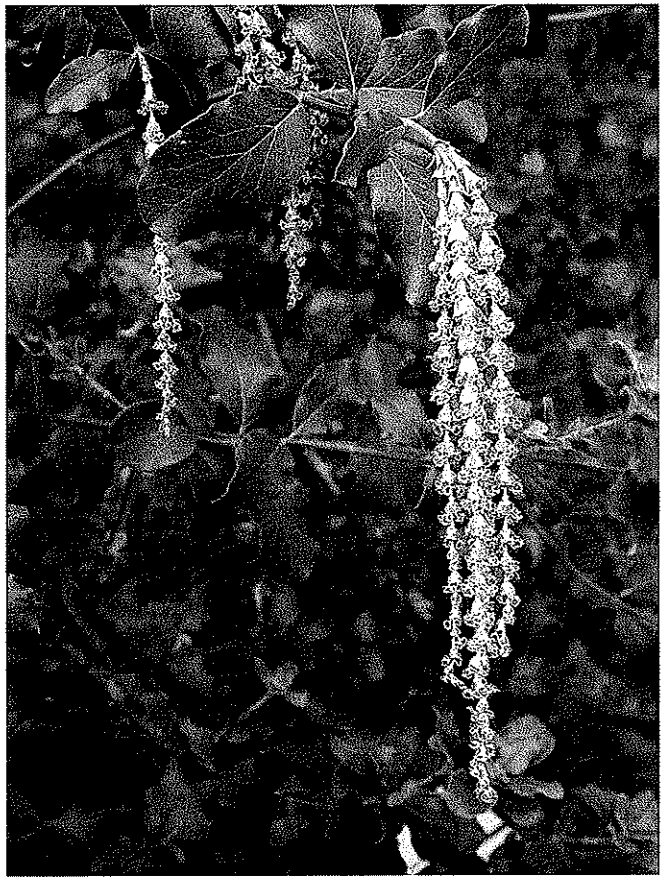
Adiantum jordanii, California Maidenhair Fern
Pellaea andromedaefolia, Coffee Fern

Ferns (cont.)

Woodwardia fimbriata, Giant Chain Fern

Grasses

Calamagrostis nutkaensis, Pacific Reedgrass
Carex densa, Dense Sedge
Eleocharis macrostachya, Pale Spikerush
Festuca californica, California Fescue
Juncus xiphiodes, Irisleaf Rush
Nassella pulchra, Purple Needle Grass
Scirpus maritimus
Spartina foliosa, California Cordgrass



Garrya elliptica (Coast Silktassel).
Photo: Barbara Eisenstein

Species Adapted to Clay Soils

Trees

Acer macrophyllum, Big Leaf Maple
Acer negundo, Box Elder
Acer rubrum, Red Maple
Acer saccharinum, Silver Maple
Aesculus californica, California Buckeye
Cercis occidentalis, Western Redbud
Corylus cornuta californica, California Hazelnut
Cornus stolonifera, Redwig
Diospyros virginiana, Persimmon
Fraxinus latifolia, Oregon Ash
Grevillea robusta, Silk Oak
Liquidambar styraciflua, American Sweet Gum
Magnolia grandiflora, Southern Magnolia
Magnolia virginia, Sweet Bay
Myrica californica, Pacific Wax Myrtle
Picea sitchensis, Sitka Spruce
Platanus occidentalis, American Sycamore
Platanus x acerifolia, London Plane Tree
Populus trichocarpa, Black Cottonwood
Quercus agrifolia, Coast Live Oak
Quercus chrysolepis, Canyon Live Oak
Quercus macrocarpa, Bur Oak
Quercus palustris, Pin Oak
Salix lasiolepis, Arroyo Willow
Taxodium distichum, Bald Cypress
Thuja occidentalis, Arborvitae
Umbellularia californica, California Bay Laurel

Shrubs

Baccharis pilularis, Coyote Bush
Baccharis salicifolia, Mule-fat
Ceanothus 'Julia Phelps', Julia Phelps Ceanothus
Eriogonum fasciculatum, California Buckwheat
Gaultheria shallon, Salal
Grindelia hirsutula var. maritima, San Francisco Gumplant
Prunus ilicifolia, Islais Cherry
Rosa californica, California Wild Rose
Rubus ursinus, California Blackberry
Salvia clevelandii, Cleveland Sage
Salvia mellifera, Black Sage
Symphoricarpos albus, Common Snowberry

Perennials

Asclepias fascicularis, Narrow-leafed Milkweed
Aster radulinus, Rough Leaved Aster
Dicentra formosa, Pacific Bleeding Heart
Equisetum hyemale, Scourgrush Horsetail
Eschscholzia californica, California Poppy
Euthamia occidentalis, Western Goldenrod
Heuchera micrantha, Crevice Alumroot
Iris douglasiana, Douglas Iris
Iris longipetala, Coast Iris
Mimulus aurantiacus, Sticky Monkeyflower
Mimulus guttatus, Creek Monkeyflower
Salvia spathacea, Hummingbird Sage
Scirpus californicus, Bulrush
Sidalcea malviflora, Checkerbloom
Sisyrinchium bellum, Blue-eyed Grass
Sisyrinchium californicum, Yellow-eyed Grass
Solidago confinis
Tradescantia virginiana, Virgina Spiderwort
Typha latifolia, Common Cattail

Annuals

Bromus carinatus, California Brome
Clarkia rubicunda, Farewell to Spring

Annuals

Helianthus annuus, Common Sunflower
Heliotropium curassavicum, Seaside Heliotrope
Vulpia myuros, Zorro Annual Fescue

Ferns

Adiantum jordanii, California Maidenhair Fern
Polystichum munitum, Western Sword Fern

Grasses

Agrostis exarata, Bentgrass
Bouteloua dactyloides, Buffalo Grass
Calamagrostis nutkaensis, Pacific Reedgrass
Carex densa, Dense Sedge
Carex praegracilis, Clustered Field Sedge
Carex tumulicola, Berkeley Sedge
Danthonia californica, California Oatgrass
Deschampsia cespitosa, Tufted Hairgrass
Distichlis spicata, Salt Grass
Elymus glaucus, Blue Wild Rye
Elymus trachycaulus, Slender Wheatgrass
Festuca californica, California Fescue
Festuca idahoensis, Blue Bunchgrass
Hordeum brachyantherum, Meadow Barley
Juncus spp., Rushes (various)
Juncus xiphiodes, Irisleaf Rush
Miscanthus sinensis, Japanese Silver Grass
Muhlenbergia rigens, Deer Grass
Nassella lepida, Foothill Needlegrass
Nassella pulchra, Purple Needlegrass
Scirpus maritimus

Vines

Aristolochia californica, Pipevine
Clematis ligusticifolia, Virgin's Bower
Vitis californica "Roger's Red", California Wild Grape

Cercis occidentalis (Western Redbud).
Photo: Barbara Eisenstein

Species that Flower

Trees

Acer macrophyllum, Big Leaf Maple
Acer negundo, Box Elder
Acer rubrum, Red Maple
Acer saccharinum, Silver Maple
Aesculus californica, California Buckeye
Carya ovata, Buttonbush
Cercis occidentalis, Western Redbud
Cornus stolonifera, Redwig
Corylus cornuta californica, California Hazelnut
Diospyros virginiana, Persimmon
Eucalyptus citriodora, Lemon-scented Gum
Eucalyptus erythrocorys, Red-cap Gum
Garrya elliptica, Coast Silktassel
Grevillea robusta, Silk Oak
Liquidambar styraciflua, American Sweet Gum
Magnolia grandiflora, Southern Magnolia
Magnolia virginia, Sweet Bay
Myrica californica, Pacific Wax Myrtle
Nyssa sylvatica, Black Tupelo
Picea sitchensis, Sitka Spruce
Platanus occidentalis, American Sycamore
Platanus x acerifolia, London Plane Tree
Populus trichocarpa, California Poplar
Prunus emarginata, Bitter Cherry
Quercus palustris, Pin Oak
Sequoia sempervirens, Coast Redwood
Taxodium distichum, Bald Cypress
Thuja occidentalis, Arborvitae
Umbellularia californica, California Bay Laurel
Gleditsia triacanthos, Honey Locust
Oxydendrum arboreum, Lily of the Valley Tree
Quercus macrocarpa, Bur Oak

Shrubs

Achillea millefolium, Yarrow
Arctostaphylos densiflora, Howard McMinn Manzanita
Arctostaphylos hookeri ssp. franciscana, Franciscan Manzanita
Baccharis pilularis, Coyote Bush
Baccharis salicifolia, Mule-fat
Ceanothus 'Julia Phelps', Julia Phelps Ceanothus
Epilobium canum spp. canum, California Fuchsia
Eriogonum fasciculatum, California Buckwheat
Eriogonum giganteum, St. Catherine's Lace
Fremontodendron 'California Glory', Flannel Bush
Gaultheria shallon, Salal
Heteromeles arbutifolia, Toyon
Lavatera assurgentiflora, Tree Mallow
Lupinus albifrons, Silver Bush Lupin
Monardella villosa Benth. ssp. franciscana (Elmer) Jokerst, San Francisco Coyote Mint
Prunus virginiana var. demissa, Western Chokeberry
*Rhamnus crocea,*Redberry Buckthorn
Ribes sanguineum, Red-Flowering Currant
Rosa californica, California Wild Rose
Rosa gymnocarpa, Wood Rose
Rubus ursinus, California Blackberry
Salvia clevelandii, Cleveland Sage
Salvia mellifera, Black Sage
Solanum umbelliferum, Nightshade
Symphoricarpos albus, Common Snowberry
Vaccinium ovatum, California Huckleberry

Perennials

Abronia umbellata, Pink Sand Verbena
Arabis blepharophylla, Coast Rockcress
Armeria maritima, Sea Thrift
Asclepias fascicularis, Narrow-leafed Milkweed
Aster radulinus, Rough Leaved Aster
Astragalus gambellianus, Milk Vetch
Astragalus nuttallii, Nuttall's Milk-Vetch

Perennials (cont.)

Cerastium arvense, Field Chickweed
Cirsium andrewsii, Franciscan Thistle
Delphinium californicum, California Larkspur
Dicentra formosa, Pacific Bleeding Heart
Equisetum hyemale, Scourgrush Horsetail
Eschscholzia californica, California Poppy
Euthamia occidentalis, Western Goldenrod
Fragaria chiloensis, Coastal Strawberry
Fragaria vesca, Mountain Strawberry
Heuchera micrantha, Crevice Alumroot
Lotus formosissimus, Seaside Bird's-foot Trefoil
Mimulus aurantiacus, Sticky Monkeyflower
Oxalis oregana, Redwood Sorrel
Penstemon spp., Penstemon
Phacelia californica, California Phacelia
Salicornia virginica, Pickleweed
Salvia spathacea, Hummingbird Sage
Scirpus californicus, Bulrush
Sidalcea malviflora, Checkerbloom
Sisyrinchium bellum, Blue-eyed Grass
Sisyrinchium californicum, Yellow-eyed Grass
Solidago confinis
Tanacetum camphoratum, Dune Tansy
Tradescantia virginiana, Virgina Spiderwort
Typha latifolia, Common Cattail

Biennials, Annuals and Succulents

Amsinckia lunaris, Bentflower Fiddleneck
Astragalus tener var. tener, Alkali Milk-Vetch
Clarkia davyi, Davy's Clarkia
Clarkia rubicunda, Farewell to Spring
Claytonia perfoliata, Miner's Lettuce
Gnaphalium californicum, California Everlasting
Helianthus annuus, Common Sunflower
Heliotropium curassavicum, Seaside Heliotrope
Lasthenia glabrata, Gold Fields
Layia platyglossa, Coastal Tidytips
Linaria canadensis, Blue Toadflax
Nemophila menziesii, Baby Blue Eyes
Sedum spathulifolium, Broadleaf Stonecrop
Vulpia myuros, Zorro Annual Fescue

Grasses

Bouteloua dactyloides, Buffalo Grass
Carex comosa, Bristly Sedge
Carex praegracilis, Clustered Field Sedge
Distichlis spicata, Salt Grass
Festuca idahoensis, Blue Bunchgrass
Hordeum brachyantherum, Meadow Barley
Koeleria macrantha, Prairie Junegrass
Melica californica, California Melic
Miscanthus sinensis, Japanese Silver Grass
Muhlenbergia rigens, Mule Grass
Nassella lepida, Neddlegrass
Nassella pulchra, Purple Needlegrass

Vines

Aristolochia californica, Pipevine
Clematis lasiantha, Pipestems
Clematis ligusticifolia, Virgin's Bower

Fremontedendron californicum. Photo: Barbara Eisenstein

Top: Lavatera assurgentiflora (Tree Mallow), bottom: Eriogonum fasciculatum (California Buckwheat). Photo: Barbara Eisenstein

Species with Habitat Value

Trees

Acer macrophyllum, Big Leaf Maple
Acer negundo, Box Elder
Acer rubrum, Red Maple
Acer saccharinum, Silver Maple
Aesculus californica, California Buckeye
Alnus spp., Alder
Betula spp., Birch
Carya illinoinensis, Pecan
Cercis occidentalis, Western Redbud
Cornus stolonifera, Redwig
Diospyros virginiana, Persimmon
Eucalyptus citriodora, Lemon-scented Gum
Eucalyptus erythrocorys, Red-cap Gum
Garrya elliptica, Coast Silktassel
Grevillea robusta, Silk Oak
Juglans hindsii, Northern California Walnut
Myrica californica, Pacific Wax Myrtle
Nyssa sylvatica, Black Tupelo
Platanus occidentalis, American Sycamore
Platanus racemosa, California Sycamore
Populus trichocarpa, California Poplar
Prunus emarginata, Bitter Cherry
Quercus agrifolia, Coast Live Oak
Quercus chrysolepis, Canyon Live Oak
Quercus macrocarpa, Bur Oak
Salix lasiolepis, Arroyo Willow
Taxodium distichum, Bald Cypress
Thuja occidentalis, Arborvitae

Shrubs

Achillea millefolium, Yarrow
Arctostaphylos densiflora, Howard McMinn Manzanita
Arctostaphylos hookeri ssp. franciscana, Franciscan Manzanita
Arctostaphylos hookeri ssp. ravenii, Presidio Manzanita
Arctostaphylos tomentosa crustacea, Lake Merced Brittleleaf Manzanita
Baccharis pilularis, Coyote Bush
Baccharis salicifolia, Mule-fat
Ceanothus 'Julia Phelps', Julia Phelps Ceanothus
Delphinium californicum, California Larkspur
Epilobium canum spp. canum, California Fuchsia
Eriogonum fasciculatum, California Buckwheat
Eriogonum giganteum, St. Catherine's Lace
Eriogonum latifolium, Coast Buckwheat
Eriogonum parvifolium, Dune Buckwheat
Gaultheria shallon, Salal
Heteromeles arbutifolia, Toyon
Lavatera assurgentiflora, Tree Mallow
Lotus scoparius, Common Deerweed
Lupinus albifrons, Silver Bush Lupin
Monardella villosa Benth. ssp. franciscana (Elmer) Jokerst, San Francisco Coyote Mint
Prunus ilicifolia, Islais Cherry
Prunus virginiana var. demissa, Western Chokeberry
Rhamnus californica, California Buckthorn
Rhamnus crocea, Redberry Buckthorn
Ribes divaricatum, Spreading Gooseberry
Ribes menziessi, Canyon Gooseberry
Ribes sanguineum, Red-Flowering Currant
Rosa californica, California Wild Rose
Rosa gymnocarpa, Wood Rose
Rubus ursinus, California Blackberry
Salvia clevelandii, Cleveland Sage
Salvia mellifera, Black Sage
Sambucus nigra cerulea, Blue Elderberry
Symphoricarpos albus, Common Snowberry
Vaccinium ovatum, California Huckleberry

Perennials

Aquilegia formosa, Western Columbine

Perennials (cont.)

Arabis blepharophylla, Coast Rockcress
Armeria maritima, Sea Thrift
Asclepias fascicularis, Narrow-leafed Milkweed
Astragalus gambellianus, Milk-Vetch
Astragalus nuttallii, Nuttall's Milk-Vetch
Atriplex californica, California Saltbush
Cirsium andrewsii, Franciscan Thistle
Delphinium californicum, California Larkspur
Dicentra formosa, Pacific Bleeding Heart
Erigeron foliosus var. franciscensis, San Francisco Leafy Fleabane
Erigeron glaucus, Seaside Daisy
Erysium franciscanum, San Francisco Wallflower
Eschscholzia californica, California Poppy
Heuchera micrantha, Crevice Alumroot
Iris douglasiana, Douglas Iris
Iris longipetala, Coast Iris
Acer negundo, Box Elder
Lotus formosissimus, Harlequin Lotus
Lotus scoparius, Common Deerweed
Mimulus aurantiacus, Sticky Monkeyflower
Mimulus guttatus, Creek Monkeyflower
Penstemon spp., Penstemon
Phacelia californica, California Phacelia
Salvia spathacea, Hummingbird Sage
Salicornia virginica, Pickelweed
Scirpus californicus, Bulrush
Sidalcea malviflora, Checkerbloom
Solidago confinis
Typha latifolia, Common Cattail

Biennials, Annuals and Succulents

Bromus carinatus, California Brome
Gilia capitata ssp. chamissonis, Blue Coast Gilia
Heliotropium curassavicum, Seaside Heliotrope
Hesperolinon congestum, Marin Dwarf-Flax
Nemophila menziesii, Baby Blue Eyes
Sedum spathulifolium, Broadleaf Stonecrop

Grasses

Agrostis exarata, Bentgrass
Carex comosa, Bristly Sedge
Carex densa, Dense Sedge
Carex praegracilis, Clustered Field Sedge
Carex tumulicola, Berkeley Sedge
Deschampsia cespitosa, Tufted Hairgrass
Distichlis spicata, Salt Grass
Festuca idahoensis, Blue Bunchgrass
Festuca rubra, Red Fescue
Hordeum brachyantherum, Meadow Barley
Muhlenbergia rigens, Deer Grass
Vulpia myuros, Zorro Annual Fescue

Vines

Aristolochia californica, Pipevine

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