

# Section 1

## Introduction

Stormwater runoff is part of a natural hydrologic process. Human activities particularly urbanization and agriculture, can alter natural drainage patterns and add pollutants to rivers, lakes, and streams as well as coastal bays, estuaries, and ultimately, the ocean. Numerous studies have shown urban runoff to be a significant source of water pollution, causing declines in fisheries, restricting swimming, and limiting our ability to enjoy many of the other benefits that water resources provide (USEPA, 1992). Urban runoff in this context includes all flows discharged from urban land uses into stormwater conveyance systems and receiving waters and includes both dry weather non-stormwater sources (e.g., runoff from landscape irrigation, water line and hydrant flushing) and wet weather stormwater runoff. In this handbook, urban runoff and stormwater runoff are used interchangeably.

For many years, the effort to control the discharge of stormwater focused mainly on the quantity (e.g. drainage, flood control) and, only to a limited extent, on the quality of the stormwater (e.g. sediment and erosion control). In recent years, however, awareness of the need to improve water quality has increased. With this awareness, federal, state, and local programs have been established to reduce pollutants contained in stormwater discharges to our waterways. The emphasis of these programs is to promote the concept and the practice of preventing pollution at the source, before it can cause environmental problems (USEPA, 1992). Where further controls are needed, treatment of polluted runoff may be required.

### 1.1 Handbook Purpose and Scope

The purpose of this handbook is to provide general guidance for selecting and implementing Best Management Practices (BMPs) to reduce pollutants in runoff from municipal operations. Federal and state programs require selected municipalities to reduce the discharge of pollutants in their stormwater discharges to the maximum extent practicable (MEP) using an array of control measures including BMPs. It is not the intent of this handbook to dictate the actual selection of BMPs (this will be done by the municipality), but rather to provide the framework for an informed selection of BMPs for the program.

Although MEP has not been defined by the federal regulations, the use of this handbook and the selection process presented herein should assist municipalities in achieving MEP. In selecting BMPs that will achieve MEP, it is important to remember that municipalities will be responsible to reduce the discharge of pollutants in stormwater to the maximum extent practicable. The following factors should be considered in deciding if a BMP is practicable:

- **Pollutant Removal** - Will the BMP remove (or control) the pollutant(s) of concern?
- **Regulatory Compliance** - Is the BMP compatible with stormwater regulations as well as other regulations for air, hazardous wastes, solid waste disposal, groundwater protection, etc.?
- **Public Acceptance** - Does the BMP have public support?

- Implementation - Is the BMP compatible with land uses, facilities, or activities in question?
- Cost - Will the cost for implementing the BMP significantly exceed the pollution control benefits? Does a revenue stream exist for ongoing maintenance?
- Technical Feasibility - Is the BMP technically feasible considering soils, geography, water resources, etc.?

Ultimately, the municipality must implement and maintain the selected BMPs and prepare and adhere to a schedule for implementation and maintenance.

### **1.1.1 Users of the Handbook**

This handbook is primarily designed to assist municipal staff with incorporating pollution prevention controls into their overall stormwater management program and specifically publicly owned/operated facilities (fixed facilities) and field activities (field programs). Users include public and private sector engineers, planners, environmental specialists, and stormwater program managers. Managers and employees of the various municipal facilities and municipal field programs may find this handbook especially helpful when implementing and evaluating the effectiveness of these stormwater management efforts.

### **1.1.2 Organization of the Handbook**

The handbook is organized to assist the user in selecting and implementing best management practices to reduce impacts of stormwater discharges on receiving waters. The handbook consists of the following sections:

**Section 1  
Introduction**

*This section provides a general review of the sources and impacts of municipal stormwater discharges and provides an overview of the federal and state programs regulating stormwater discharges.*

**Section 2  
Stormwater Pollution Prevention Planning for Municipal Operations**

*This section describes a process to follow in identifying and selecting BMPs for pollutant generating activities.*

**Section 3**

**Source Control BMPs**

*BMP fact sheets presented in this section address BMPs (or procedures) to control or eliminate sources of stormwater pollutants. These BMPs should be considered in all efforts to reduce pollutants from municipal operations*

**Section 4  
Treatment Control BMPs**

*BMP fact sheets presented in this section address BMPs that remove pollutants from runoff (treatment controls). These fact sheets focus on the maintenance requirements of these controls.*

**Section 5  
BMP Implementation and Evaluation**

*This section outlines development of a program to monitor BMP effectiveness and evaluate additional BMP requirements. Topics include site inspections, BMP monitoring, recordkeeping, and BMP review/modifications.*

**Section 6  
Glossary and List of Acronyms**

*This section identifies terms and abbreviations used in the handbooks.*

**Appendix A  
Inventory of Municipal Operations**

*This appendix provides an example of an inventory of municipal operations that may be sources of pollutants in stormwater runoff.*

**Appendix B  
Assessment of Municipal Operations**

*This appendix provides an example worksheet for assessing fixed facilities to determine the level of BMP implementation.*

**Appendix C  
BMP Selection Process**

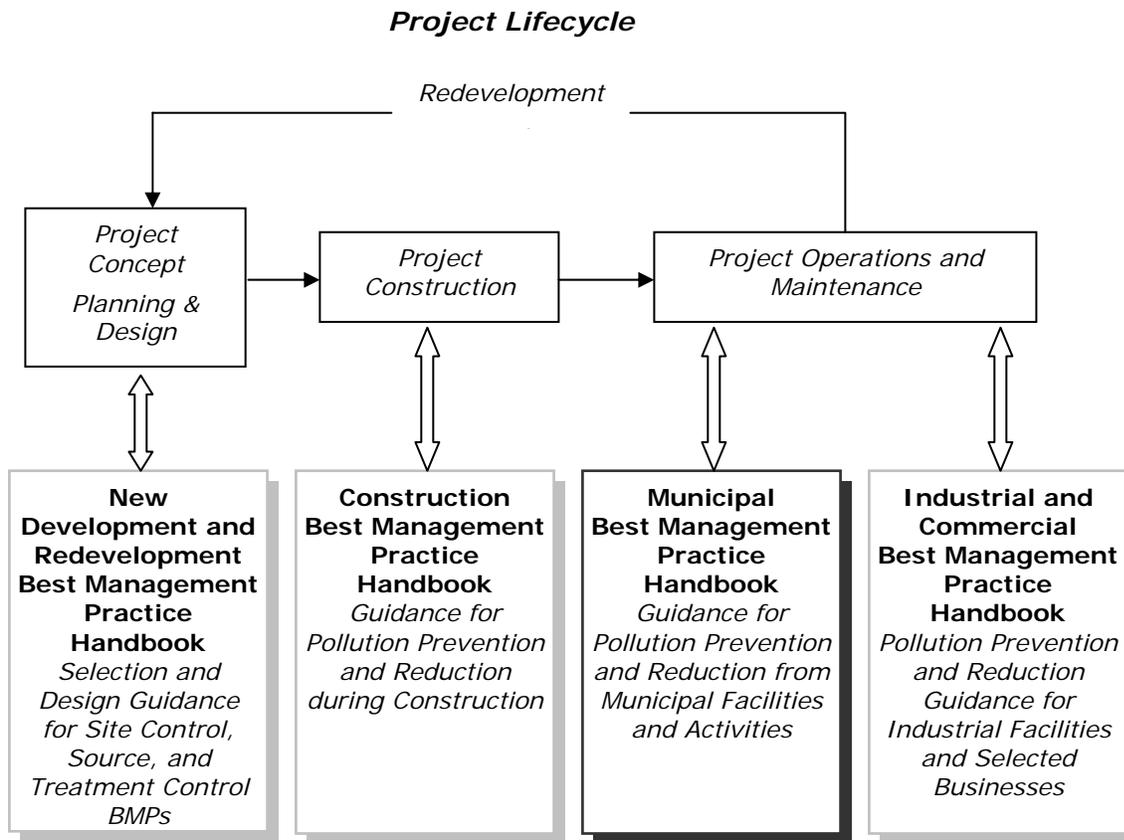
*This appendix provides an example of BMP selection for a fixed facility.*

**Appendix D  
Contract/Lease Agreement**

*This appendix provides example lease language for fixed facilities.*

### 1.1.3 Relationship to Other Handbooks

This handbook is one of four handbooks developed by the California Stormwater Quality Associations (CASQA) to address BMP selection. Collectively, the four handbooks address BMP selection throughout the life of a project, from planning and design through construction and into operation and maintenance. Individually, each handbook is geared to a specific target audience during each stage of a project.



This handbook, the Municipal Handbook, provides information primarily for municipalities to use in selecting and implementing control measures for municipal operations including fixed facilities and field programs. In this context, information provided in Section 4, Treatment Control BMPs, is focused on maintenance requirements for existing treatment control BMPs. If a new treatment control BMP is being considered at an existing or new municipal facility, the reader is referred to the New Development and Redevelopment Handbook.

For a comprehensive understanding of stormwater pollution controls throughout the life cycle of development, it is recommended that the readers obtain and become familiar with all four handbooks. Typically, municipal stormwater program managers, regulators, environmental organizations, and stormwater quality professionals will have an interest in all four handbooks. For a focused understanding of stormwater pollution control during a single phase of the project life cycle, a reader may obtain and become familiar with the handbook associated with the appropriate phase. Typically, contractors, construction inspectors, industrial site operators, commercial site operators, some regulators, and some municipal staff may have an interest in a single handbook.

## 1.2 Stormwater Pollutants and Impacts on Water Quality

Stormwater runoff naturally contains numerous constituents; however, urbanization and urban activities (including municipal activities) typically increase constituent concentrations to levels that may impact water quality. Pollutants associated with stormwater include sediment, nutrients, bacteria and viruses, oil and grease, metals, organics, pesticides, and gross pollutants (floatables). In addition, nutrient-rich stormwater runoff is an attractive medium for vector production when it accumulates and stands for more than 72 hours. Stormwater pollutants are described in Table 1-1.

### Municipal Activities Generating Pollutants

Municipalities conduct various activities that are sources of pollutants in stormwater runoff. For the purpose of this handbook, these activities are categorized according to whether they occur at a specific location (fixed facility) or across a broader and non-specific area (field programs). Some of these activities are summarized in the list below. All activities are discussed in more detail in Section 2. These activities must be addressed through the implementation of BMPs to minimize or eliminate the pollutants from entering the local water bodies or drainage system.

#### Typical Municipal Operations that Generate Pollutants

##### ***Fixed Facilities Activities***

Building Maintenance & Repair

Parking Lot Maintenance

Landscape Maintenance

Waste Handling and Disposal

Vehicle Fueling and Storage Tank Filling

Equipment Maintenance & Repair

Vehicle and Equipment Storage

Vehicle and Equipment Cleaning

Material Handling & Storage

Material Loading & Unloading

Minor Construction

Over Water Activities

##### ***Field Program Activities***

Street Sweeping and Cleaning

Street Repair and Maintenance

Bridge and Structure Maintenance

Sidewalk Surface Cleaning

Graffiti Cleaning

Sidewalk Repair

Controlling Litter

Fountain Maintenance

Landscape Mowing/Trimming/Planting

Fertilizer & Pesticide Management

Controlling Illicit Connections

Controlling Illegal Dumping

Solid Waste Collection and Recycling

**Table 1-1 Pollutant Impacts on Water Quality**

|                             |  |
|-----------------------------|--|
| <b>Sediment</b>             | Sediment is a common component of stormwater, and can be a pollutant. Sediment can be detrimental to aquatic life (primary producers, benthic invertebrates, and fish) by interfering with photosynthesis, respiration, growth, reproduction, and oxygen exchange in water bodies. Sediment can transport other pollutants that are attached to it including nutrients, trace metals, and hydrocarbons. Sediment is the primary component of total suspended solids (TSS), a common water quality analytical parameter.  |
| <b>Nutrients</b>            | Nutrients including nitrogen and phosphorous are the major plant nutrients used for fertilizing landscapes, and are often found in stormwater. These nutrients can result in excessive or accelerated growth of vegetation, such as algae, resulting in impaired use of water in lakes and other sources of water supply. For example, nutrients have led to a loss of water clarity in Lake Tahoe. In addition, un-ionized ammonia (one of the nitrogen forms) can be toxic to fish.  |
| <b>Bacteria and viruses</b> | Bacteria and viruses are common contaminants of stormwater. For separate storm drain systems, sources of these contaminants include animal excrement and sanitary sewer overflow. High levels of indicator bacteria in stormwater have led to the closure of beaches, lakes, and rivers to contact recreation such as swimming.  |
| <b>Oil and Grease</b>       | Oil and grease includes a wide array of hydrocarbon compounds, some of which are toxic to aquatic organisms at low concentrations. Sources of oil and grease include leakage, spills, cleaning and sloughing associated with vehicle and equipment engines and suspensions, leaking and breaks in hydraulic systems, restaurants, and waste oil disposal.  |
| <b>Metals</b>               | Metals including lead, zinc, cadmium, copper, chromium, and nickel are commonly found in stormwater. Many of the artificial surfaces of the urban environment (e.g., galvanized metal, paint, automobiles, or preserved wood) contain metals, which enter stormwater as the surfaces corrode, flake, dissolve, decay, or leach. Over half the trace metal load carried in stormwater is associated with sediments. Metals are of concern because they are toxic to aquatic organisms, can bioaccumulate (accumulate to toxic levels in aquatic animals such as fish), and have the potential to contaminate drinking water supplies. |
| <b>Organics</b>             | Organics may be found in stormwater in low concentrations. Often synthetic organic compounds (adhesives, cleaners, sealants, solvents, etc.) are widely applied and may be improperly stored and disposed. In addition, deliberate dumping of these chemicals into storm drains and inlets causes environmental harm to waterways.   |
| <b>Pesticides</b>           | Pesticides (including herbicides, fungicides, rodenticides, and insecticides) have been repeatedly detected in stormwater at toxic levels, even when pesticides have been applied in accordance with label instructions. As pesticide use has increased, so too have concerns about adverse effects of pesticides 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.                       |
| <b>Gross Pollutants</b>     | Gross Pollutants (trash, debris, and floatables) may include heavy metals, pesticides, and bacteria in stormwater. Typically resulting from an urban environment, industrial sites and construction sites, trash and floatables may create an aesthetic "eye sore" in waterways. Gross pollutants also include plant debris (such as leaves and lawn-clippings from landscape maintenance), animal excrement, street litter, and other organic matter. Such substances may harbor bacteria, viruses, vectors, and depress the dissolved oxygen levels in streams, lakes, and estuaries sometimes causing fish kills.                 |
| <b>Vector Production</b>    | Vector production (e.g., mosquitoes, flies, and rodents) is frequently associated with sheltered habitats and standing water. Unless designed and maintained properly, standing water may occur in treatment control BMPs for 72 hours or more, thus providing a source for vector habitat and reproduction (Metzger, 2002).   |

## 1.3 Regulatory Requirements

The federal Clean Water Act (CWA), as amended in 1987, is the principal legislation for establishing requirements for the control of stormwater pollutants. Enforcement of the CWA and other laws such as the Endangered Species Act and California's Porter-Cologne Act has generated a number of federal, state and local requirements and programs that deal directly or indirectly with controlling stormwater discharges. In the following sections, various programs are discussed in relationship to control of pollutants in stormwater from municipal storm drain systems. These programs are expected to evolve over the next several years and the user is advised to contact local regulatory and/or municipal officials for further information.

### 1.3.1 Federal NPDES Programs

In 1972, provisions of the federal Water Pollution Control Act, also referred to as the Clean Water Act (CWA), were amended so that discharge of pollutants to waters of the United States from any point source is effectively prohibited, unless the discharge is in compliance with a National Pollutant Discharge Elimination (NPDES) permit. The 1987 amendments to the CWA added Section 402(p), which established a framework for regulating municipal, industrial, and construction stormwater discharges under the NPDES program. On November 16, 1990, USEPA published final Phase I regulations that established application requirements for stormwater permits for municipal separate storm sewer systems (MS4s) serving a population of over 100,000 and certain industrial facilities, including construction sites greater than 5 acres. These regulations were revised in July 1998 (USEPA, 1998). On December 8, 1999, USEPA published the final Phase II regulations for communities under 100,000 and operators of construction sites between 1 and 5 acres (USEPA, 1999).

### 1.3.2 State NPDES Programs

The state Porter-Cologne Act (Water Code 13000, et seq.) is the principal legislation for controlling stormwater pollutants in California. The Act requires development of Basin Plans for drainage basins within California. Each plan serves as a blueprint for protecting water quality within the various watersheds. These basin plans are used in turn to identify more specific controls for discharges (e.g., wastewater treatment plant effluent, urban runoff, and agriculture drainage). Specific controls are implemented through permits called Waste Discharge Requirements.

In California, the federal NPDES stormwater permitting program is administered by the State Water Resources Control Board (SWRCB) through the nine Regional Water Quality Control Boards (RWQCBs) by issuing joint Waste Discharge Requirements and NPDES permits. SWRCB and RWQCBs use three types of NPDES permits to regulate stormwater discharges. These include:

- Individual Permits
- Area Wide Permits
- General Permits

The current set of stormwater NPDES permits in California includes a combination of stormwater discharge type and permit type (Table 1-2). The following sections describe minimum requirements in each of the municipal discharge-permit combinations.

| <b>Permit type</b> | <b>Discharge Type</b>   |                     |                   |
|--------------------|-------------------------|---------------------|-------------------|
|                    | <b>Municipal</b>        | <b>Construction</b> | <b>Industrial</b> |
| Individual         | Phase I MS4<br>Caltrans |                     | Facility-specific |
| Area Wide          | Phase I MS4s            |                     |                   |
| General            | Phase II MS4            | Phase I and II      | Phase I           |

### 1.3.3 Municipal NPDES Stormwater Programs

Municipalities with a population of over 100,000 or that have been determined to be a significant contributor of pollutants are required to obtain an individual NPDES stormwater permit. These municipalities are classified as Phase I communities and are typically referred to as MS4s (municipal separate storm sewer systems). To meet CWA Section 402(p) requirements, Phase I MS4s are required to implement a stormwater management program that contains the following elements:

- **Program Management**: including program structure, institutional arrangements, legal authority, and fiscal resources
- **Illicit Discharges**: including prohibition of illicit connections and dumping, and enforcement procedures.
- **Industrial / Commercial Discharges**: including identification of sources, BMPs, outreach, inspections, staff training, and coordination with state General Permit.
- **New Development and Re-development**: including planning processes, local permits, staff training, post-construction structural BMPs, and outreach.
- **Construction**: including erosion and grading permits, construction BMPs, site inspections, enforcement, and coordination with state General Permit.
- **Public Agency (Municipal) Operations**: including inventory and BMPs for corporation yards, parks and recreation, storm drain system operation and maintenance, streets and roads, flood control, public facilities, and ponds, fountains and other public water bodies. (This is a primary focus of this handbook.)
- **Public Information and Participation**: including general and focused outreach, school education programs, citizen participation, and effectiveness evaluation of the public information program.

- **Program Evaluation:** including performance standards, annual and sub-annual reports, internal reporting and record keeping, and Stormwater Management Plan revisions.
- **Monitoring:** including system characterization, source identification, control measure effectiveness, pollutant loading, and data management

Smaller, Phase II communities (under 100,000 population) are covered by a General Permit. Phase II communities are required to develop and implement a stormwater management plan with the following six minimum control measures:

- **Public Education and Outreach** - Distributing educational materials and performing outreach to inform citizens about the impacts polluted stormwater runoff discharges can have on water quality.
- **Public Involvement and Participation** - Providing opportunities for citizens to participate in program development, implementation, and review, including effectively publicizing public hearings or participation.
- **Illicit Discharge Detection and Elimination** - Developing and implementing a plan to detect and eliminate illicit discharges to the storm drain system including illicit connections and illegal dumping.
- **Construction Site Runoff Control** - Developing, implementing, and enforcing an erosion and sediment control program for construction activities that disturb one or more acres of land.
- **Pollution Prevention / Good Housekeeping for Municipal Operations** - Developing and implementing a program to prevent or reduce pollutant runoff from municipal operations. (This is a primary focus of this handbook.)
- **Post-Construction Stormwater Management in New Development and Redevelopment** - Developing, implementing, and enforcing a program to address discharges of stormwater runoff from new and redevelopment areas.

In addition to the six measures listed above, the stormwater management plan must identify measurable goals (or performance standards) for each minimum control measure. Measurable goals will be used by the MS4 and the RWQCB to gauge compliance and evaluate the effectiveness of individual BMPs or control measures and the stormwater management program as a whole. Phase II communities must also monitor their efforts and prepare annual reports demonstrating that the community has implemented the minimum control measures and complied with the measurable goals.

## 1.4 Definitions

Many of the common definitions for stormwater control are found in the Glossary (see Section 6). Throughout the handbook, the user will find references to the following terms:

**NPDES Permit for Stormwater Discharges** NPDES is an acronym for National Pollutant Discharge Elimination System. NPDES is the national program for administering and regulating Sections 307, 318, 402 and 405 of the Clean Water Act (CWA). In California, the State Water Resources Control Board (SWRCB) has issued a General Permit for stormwater discharges associated with Phase II communities. For Phase I communities the Regional Water Quality Control Boards issue individual NPDES permits to either an individual permittee or a group of permittees.

**Notice of Intent (NOI)** is a formal notice to the SWRCB submitted by a Phase II municipality. The NOI provides information on the permittee, location of discharge, type of discharge and certifies that the permittee will comply with conditions of the Phase II General Permit. The NOI is not a permit application and does not require approval.

A **Best Management Practice (BMP)** is defined as any program, technology, process, siting criteria, operating method, measure, or device which controls, prevents, removes, or reduces pollution.

**Source Control BMPs** are operational practices that prevent pollution by reducing potential pollutants at the source. They typically do not require maintenance or construction.

**Treatment Control BMPs** are methods of treatment to remove pollutants from stormwater.

**Non-Stormwater Discharge** is any discharge to municipal separate storm sewer that is not composed entirely of stormwater.

**Vector** as defined in the California Health & Safety Code, Section 2200, is any animal capable of transmitting the causative agent of human disease or capable of producing human discomfort or injury, including, but not limited to, mosquitoes, flies, other insects, ticks, mites, and rodents.

## 1.5 References and Resources

California Department of Transportation, *Guidance Manual: Stormwater Monitoring Protocols*, 2nd ed., July 2000. Available at [www.dot.ca.gov/hq/env/stormwater/special/index.htm](http://www.dot.ca.gov/hq/env/stormwater/special/index.htm)

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United States Environmental Protection Agency (U.S.E.P.A). *Measurable Goals Guidance for Phase II Small MS4s*,  
<http://cfpub.epa.gov/npdes/stormwater/measurablegoals/part4.cfm#sub7>

United States Environmental Protection Agency (U.S.E.P.A.). *NPDES Stormwater Sampling Guidance Document*. 1992, EPA 833-B-92-001, U.S. Environmental Protection Office, Office of Wastewater Enforcement and Compliance, Washington, DC.

<http://www.swrcb.ca.gov/stormwtr/municipal.html#phaseii>. This link on the State Water Resources Control Board website provides Phase I MS4 area wide permits in each region, a link to Phase I and II resources.

<http://cfpub.epa.gov/npdes/stormwater/swphase1.cfm>. This link on the USEPA website provides an overview of the Phase I NPDES stormwater program and specific information on requirements pertaining to Phase I stormwater discharges.

### Municipal Programs

City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. Model Urban Runoff Program, A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. July 1998 (Revised February 2002).

City of Watsonville, City of Monterey, Monterey Bay National Marine Sanctuary, California Coastal Commission, and Central Coast Regional Water Quality Control Board, 2000. Model Urban Runoff Program, Supplementary 2000 Workbook: A Resource for Implementing Your Municipal Urban Runoff Program.

Los Angeles County Stormwater Quality Model Programs. Public Agency Activities  
[http://ladpw.org/wmd/npdes/model\\_links.cfm](http://ladpw.org/wmd/npdes/model_links.cfm)

Orange County Stormwater Program.  
[http://www.ocwatersheds.com/StormWater/swp\\_documents\\_intro.asp](http://www.ocwatersheds.com/StormWater/swp_documents_intro.asp)

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Plan. 2001. Municipal Activities Model Program Guidance. November 2001.

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**Santa Clara Valley Urban Runoff Pollution Prevention Program. 1997 Urban Runoff Management Plan. September 1997, updated October 2000.**