

Section 1

Introduction

Stormwater runoff is part of a natural hydrologic process. However, human activities particularly urbanization and agriculture, can alter natural drainage patterns and add pollutants to rivers, lakes, and streams as well as coastal bays and estuaries, and ultimately, the ocean. Numerous studies have shown urban runoff to be a significant source of water pollution, causing declines in fisheries, restrictions on swimming, and limiting our ability to enjoy many of the other benefits that water resources provide. 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, etc.) 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 on quantity (e.g. drainage, flood control) and only to a limited extent on quality of the stormwater (e.g. sediment and erosion control). However, in recent years awareness of the need to improve water quality has increased. With this awareness federal, state and, local programs have been established to pursue the ultimate goal of reducing 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). However, 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 in newly developed areas and redeveloped areas to waters of the state. This handbook also provides guidance on developing project-specific stormwater management plans including selection and implementation of BMPs for a particular development or redevelopment project.

This handbook provides the framework for an informed selection of BMPs. However, due to the diversity in climate, receiving waters, construction site conditions, and local requirements across California, this handbook does not dictate the use of specific BMPs and therefore cannot guarantee compliance with NPDES permit requirements or local requirements specific to the user's site.

1.1.1 Users of the Handbook

This handbook provides guidance suitable for use by individuals involved in development or redevelopment site water pollution control and planning. Each user of the handbook is responsible for working within their capabilities obtained through training and experience, and for seeking the advice and consultation of appropriate experts at all times.

The target audience for this handbook includes: Developers, including their planners and engineers; contractors and subcontractors, including their engineers, superintendents, foremen, and construction staff; municipal agencies involved in site development and redevelopment

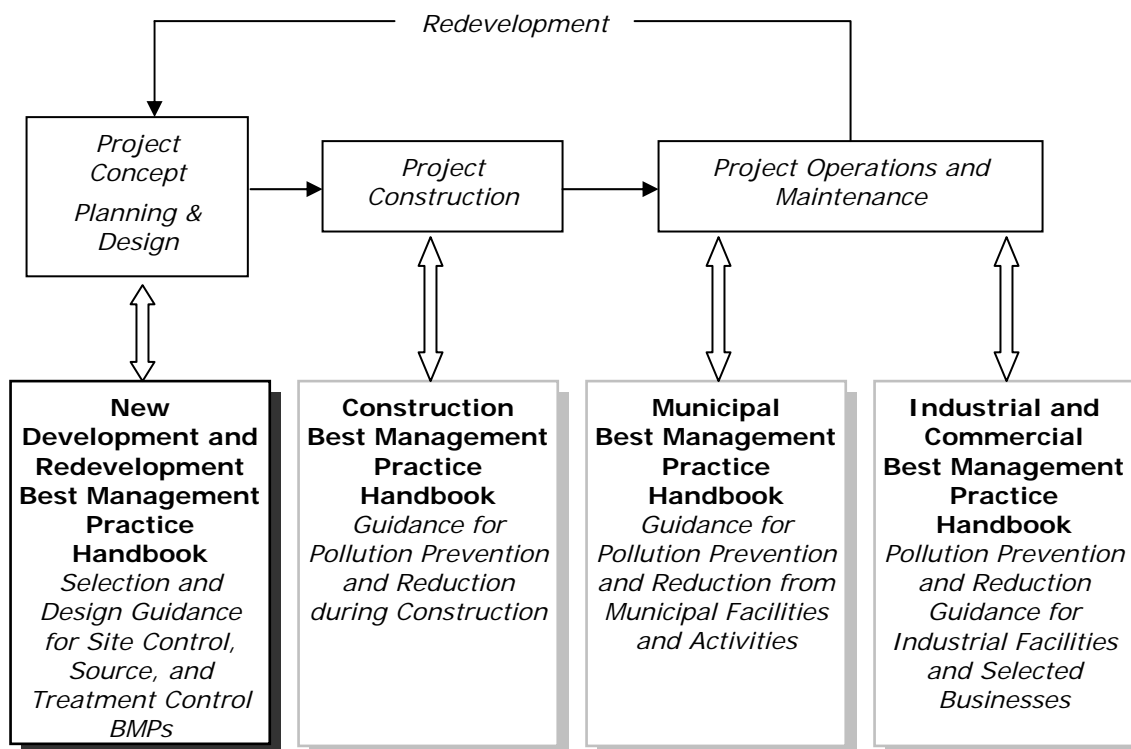
including their engineers, planners, and construction staff; regulatory agencies including permit and planning staff; and the general public with an interest in stormwater pollution control.

1.1.2 Organization of the Handbook

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

<p>Section 1 Introduction <i>This section provides a general review of the sources and impacts of urban stormwater discharges and provides an overview of the Federal and state programs regulating stormwater discharges.</i></p>	<p>Section 2 Stormwater Pollution Prevention Planning for New Development and Redevelopment <i>This section describes typical permit requirements, planning principles, and site assessment. It also covers identifying BMPs, integrating BMPs into the project, maintaining BMPs, and preparing stormwater pollution control plans.</i></p>	<p>Section 3 Site and Facility Design for Water Quality Protection <i>This section describes planning approaches to reduce, eliminate, control and treat runoff from development and redevelopment, and integration of BMPs into common site, drainage, and building features.</i></p>
<p>Section 4 Source Control BMPs <i>BMP fact sheets presented in this section address structural source control BMPs to be considered for development and redevelopment.</i></p>	<p>Section 5 Treatment Control BMPs <i>BMP fact sheets presented in this section address treatment control BMPs that may be used for development/ redevelopment sites.</i></p>	<p>Section 6 Long Term BMP Maintenance <i>This section outlines approaches to maintain BMPs, monitor BMP effectiveness, and evaluate additional BMP requirements.</i></p>
<p>Section 7 Glossary and List of Acronyms <i>This section identifies terms and abbreviations used in the handbooks.</i></p>	<p>Appendix B General Applicability of Effluent Probability Method <i>This appendix discusses concerns about the general applicability of this probability technique.</i></p>	<p>Appendix C Effluent Concentrations of Additional Metals and Nutrients <i>This appendix compares effluent concentrations of constituents not described in Section 5.</i></p>
<p>Appendix A Channel Impacts from Watershed Changes <i>This appendix describes a stream balance equation affected by changes in runoff or sediment loads.</i></p>	<p>Appendix D Rain Intensity and BMP Sizing Curves <i>This appendix includes rain intensity cumulative frequency curves and volume-based BMP sizing curves.</i></p>	

Project Lifecycle



1.1.3 Relationship to Other Handbooks

This handbook is one of four handbooks developed by the California Stormwater Quality Association (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 New Development and Redevelopment Handbook, addresses selection and implementation of BMPs to eliminate or to reduce the discharge of pollutants associated with development and redevelopment activities.

For a comprehensive understanding of stormwater pollution control throughout the life cycle of the project, it is recommended that the reader 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 development and redevelopment typically increase constituent concentrations to levels that impact water quality. Pollutants associated with stormwater include sediment, nutrients, bacteria and viruses, oil and grease, metals, organics, pesticides, and trash (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.

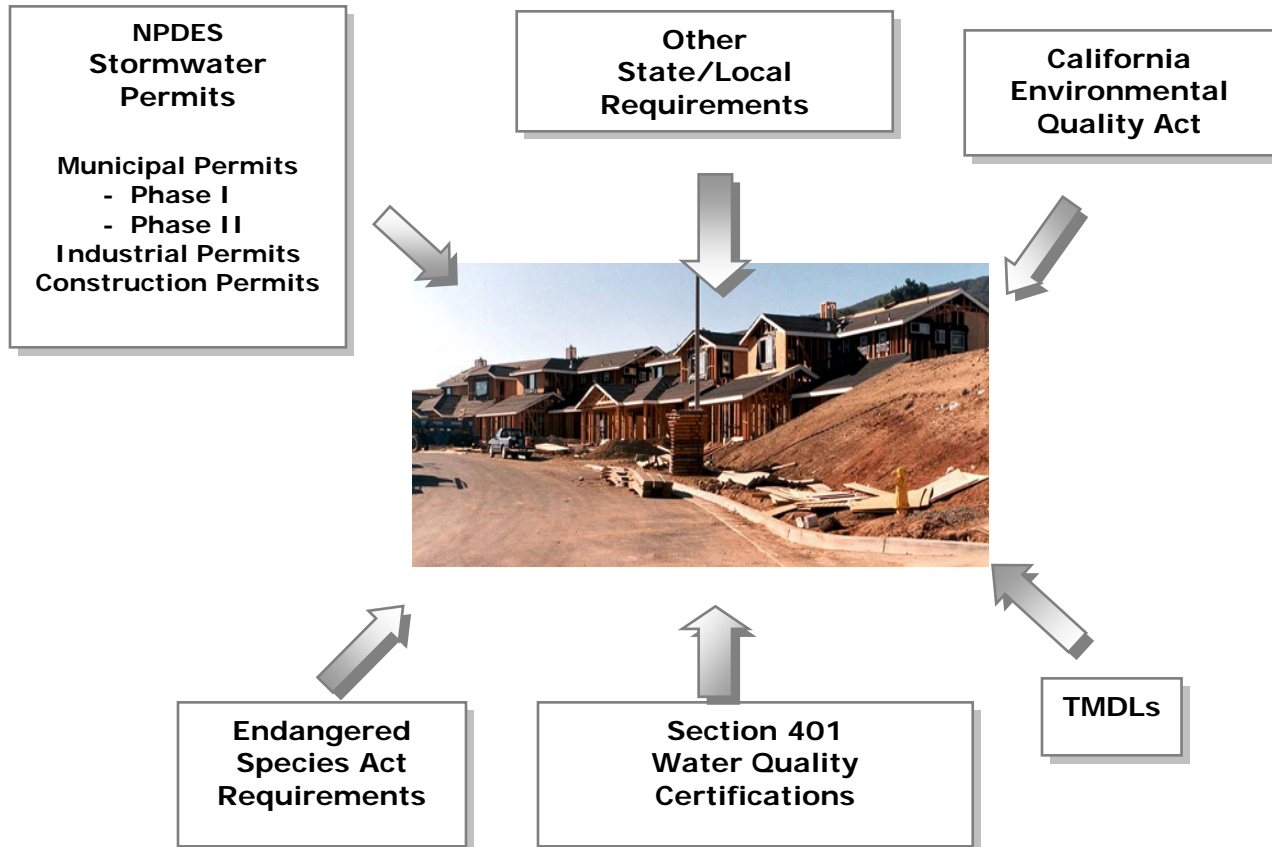
Development and redevelopment activities can result in two types of water quality impacts: erosion and sedimentation and discharge of other pollutants during construction; and long term impacts from runoff from the completed development and associated land uses. Control of water quality impacts during construction is covered in the Construction edition of the Stormwater Best Management Practice Handbook. This handbook addresses potential water quality impacts from completed development that can include the following:

- Urban activities can result in the generation of new dry-weather runoff that may contain many of the pollutants listed above
- Impervious surfaces associated with development, such as streets, rooftops, and parking lots, prevent runoff infiltration and increase the rate and volume of stormwater runoff that may increase downstream erosion potential and associated potential water quality impairment
- Urban activities and increased impervious surfaces which can increase the concentration and/or total load of many of the pollutants listed above in wet weather stormwater runoff

Table 1-1 Pollutant Impacts on Water Quality	
Sediment	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.
Nutrients	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.
Bacteria and viruses	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.
Oil and Grease	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.
Metals	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.
Organics	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.
Pesticides	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.
Gross Pollutants	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.
Vector Production	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, as amended in 1987, is the principal legislation for establishing requirements for the control of stormwater pollutants from urbanization and related activities. However, other federal, state, and local requirements deal directly or indirectly with controlling stormwater discharges. Requirements for stormwater under some of these programs, such as Basin Planning, Total Maximum Daily Loads (TMDLs), the California Environmental Quality Act (CEQA), 401 Water Quality Certifications and Endangered Species Act (ESA) are evolving, and the user is advised to contact local regulatory and/ or municipal officials for further information.



1.3.1 Federal 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 regulations that established application requirements for stormwater permits for municipal separate storm sewer systems (MS4s) serving a population of over 100,000 (Phase I communities) and certain industrial facilities, including construction sites greater than 5 acres.

On December 8, 1999, USEPA published the final regulations for communities under 100,000 (Phase II MS4s) and operators of construction sites between 1 and 5 acres.

1.3.2 State 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). Under Porter-Cologne, specific controls are implemented through permits called Waste Discharge Requirements issued by the nine Regional Water Quality Control Boards. For discharges to surface waters, the Waste Discharge Requirement also serves as NPDES permits.

1.3.3 Municipal NPDES Stormwater Programs

Phase I MS4s are required to obtain an individual NPDES stormwater permit and develop a stormwater management plan (SWMP) that is implemented by the municipality's stormwater management program. One of the elements of the municipal NPDES Stormwater Program are new development and redevelopment activities including: planning processes, design review, BMPs, outreach, and enforcement.

Smaller, Phase II communities are covered by a General Permit. Six Phase II measures are required in Phase II permits. One addresses post-construction stormwater management in new development and redevelopment, including developing, implementing, and enforcing a program to address discharges of stormwater runoff from new and redevelopment areas.

Phase I permits and the Phase II General Permit in California contain standard requirements for planning and design BMPs including minimum requirements for treatment of runoff from new development. These standards are called Standard Urban Stormwater Mitigation Plans (SUSMPs) in some permits, or equivalent terminology is used in others. These are discussed further in Section 2.

1.3.4 Other Relevant Regulatory Programs

In addition to meeting municipal stormwater program requirements under CWA section 402(p), municipalities are increasingly subject to other regulatory drivers that relate to the protection of surface water quality and beneficial uses of waterbodies in their communities. Several other regulatory programs that can significantly affect new development and redevelopment planning and design are:

- Total Maximum Daily Loads (TMDLs)
- Endangered Species Act
- CWA Section 404 Dredge and Fill Permits
- Section 401 Water Quality Certification

In the coming years, these regulatory drivers will likely have at least as much impact on the design and implementation of municipal stormwater programs and BMP selection and maintenance as current stormwater regulations.

TMDLs

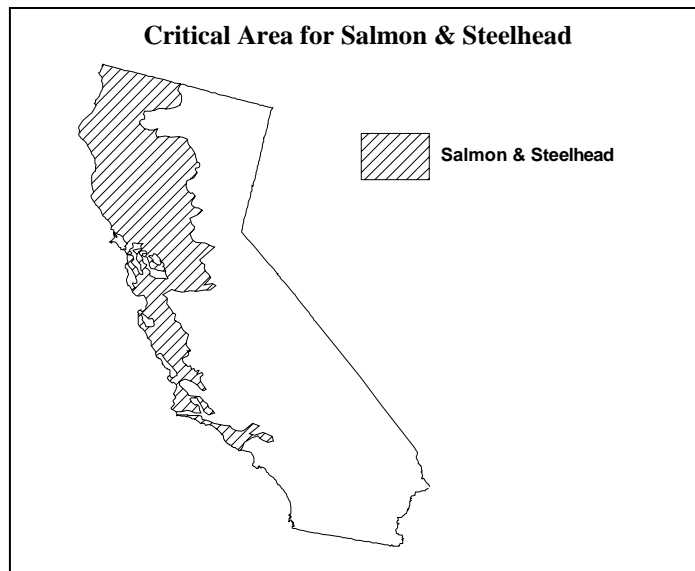
TMDL's are a regulatory mechanism to identify and implement additional controls on both point and non-point source discharges in water bodies that are impaired from one or more pollutants and are not expected to be restored through normal point source controls. States identify impairments and pollutants by putting impaired water bodies on a list as required under Section 303(d) of the CWA.

Stormwater or urban runoff is listed as a suspected source for many of the waterbody pollutant combinations in the current 303(d) list. Stormwater programs must be designed not only to be in compliance with the stormwater NPDES permit regulations, but they must also be designed to implement TMDLs in which stormwater or urban runoff is named as a source.

Endangered Species Act

Like TMDLs, Endangered Species Act issues are becoming increasingly important to stormwater program design and implementation. The presence or potential presence of an endangered species impacts stormwater management programs and the selection and maintenance of BMPs. Although there are numerous endangered species that may impact the program, two that have particular impacts are salmon and steelhead trout.

The National Marine Fisheries Service (NMFS) has designated critical habitat for salmon and steelhead trout in large areas of the north and central coast and central valley of California.



Developers or public agency intending to conduct activities in or discharge to an area that serves as a critical habitat must contact resource agencies such as NMFS, the US Fish & Wildlife Service, and the California Department of Fish & Game to learn about specific compliance requirements and actions.

CWA Section 401 Water Quality Certification

In 1972, Section 404 of the Clean Water Act (CWA) was passed. It prohibits discharging dredged or fill material into U.S. waters without a permit from the Army Corps of Engineers (USACE). Subsequent court rulings and litigation further defined "Waters of the U.S." to include virtually all surface waters, including wetlands. A 1991 Supreme Court decision eliminated federal jurisdiction

based on Commerce factors over a poorly defined set of “isolated” waters; however, such waters remain subject to state jurisdiction under the Porter-Cologne Act. Activities in waters of the United States that are regulated under this program include fills for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports), and conversion of wetlands to uplands for farming and forestry.

The basic premise of the program is that no discharge of dredged or fill material is permitted if a practicable alternative exists that is less damaging to the aquatic environment or if the nation's waters would be significantly degraded. When applying for a permit, it must be shown that:

- Steps have been taken to avoid wetland impacts where practicable.
- Potential impacts to wetlands have been minimized.
- Compensation for any remaining, unavoidable impacts through activities has been provided to restore or create wetlands.

An individual permit is usually required for potentially significant impacts. However, for most discharges that will have only minimal adverse effects, the USACE often grants up-front general permits. These may be issued on a nationwide, regional, or state basis for particular categories of activities (for example, minor road crossings, utility line backfill, and bedding) as a means to expedite the permitting process.

Anyone proposing to conduct a project that requires a federal permit (404) or involves dredge or fill activities that may result in a discharge to U.S. surface waters and/or "Waters of the State" are required to obtain a CWA Section 401 Water Quality Certification and/or Waste Discharge Requirements (Dredge/Fill Projects) from the Regional Water Quality Control Board (RWQCB), verifying that the project activities will comply with state water quality standards. The rules and regulations apply to all "Waters of the State", including isolated wetlands and stream channels that may be dry during much of the year, have been modified in the past, look like a depression or drainage ditch, have no riparian corridor, or are on private land.

Section 401 of the CWA grants each state the right to ensure that the State's interests are protected on any federally permitted activity occurring in or adjacent to “Waters of the State”. In California, the nine RWQCBs are the agency mandated to ensure protection of the State's waters. If a proposed project requires a USACE, CWA Section 404 permit and has the potential to impact Waters of the State, the RWQCB will regulate the project and associated activities through a Water Quality Certification determination (Section 401), as part of the 404 process.

However, if a proposed project does not require a federal permit, but does involve dredge or fill activities that may result in a discharge to "Waters of the State", the RWQCB has the option to regulate the project under its state authority (Porter-Cologne) in the form of Waste Discharge Requirements or Waiver of Waste Discharge Requirements. In addition, California Department of Fish and Game (DFG) may regulate the project through the Streambed Alteration Agreement process. DFG issues Streambed Alteration Agreements when project activities have the potential to impact intermittent and perennial streams, rivers, or lakes.

Developers should be aware of these permits, and make arrangements with the appropriate agency to obtain a permit and comply with permit regulations.

1.4 Definitions

Many of the common definitions for stormwater control are found in the Glossary (see Section 7). Throughout the handbook the user will find references to the following terms:

MS4 is a municipality owned separate storm sewer system. Operators of MS4s are usually permitted under Phase II of the NPDES program. 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).

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.

Source Control BMPs for design are planning methods and concepts that should be taken into consideration by developers during project design.

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

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