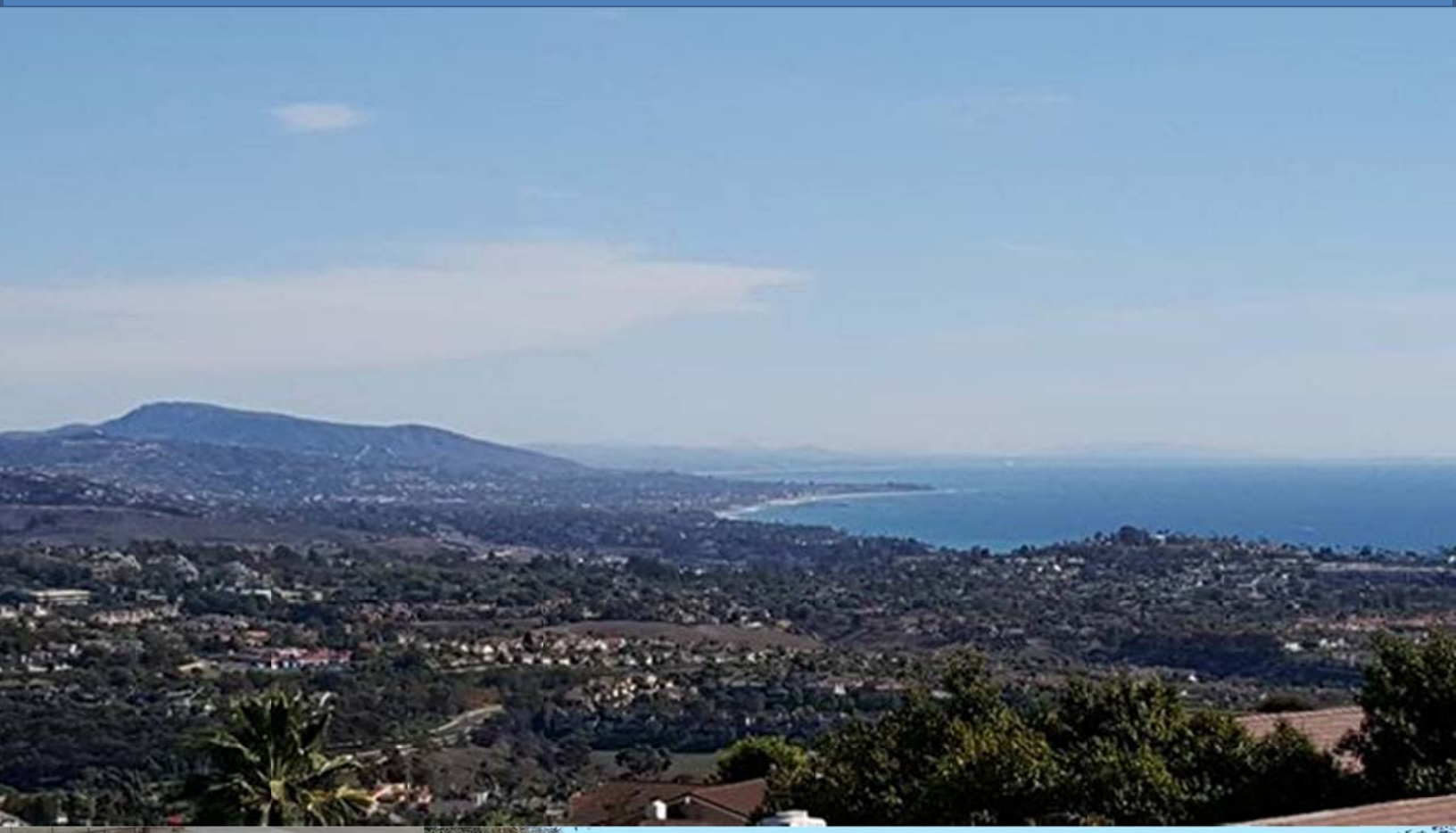
CITY OF LAGUNA NIGUEL WATER QUALITY LOCAL IMPLEMENTATION PLAN







DRAFT APRIL 1, 2017

LOCAL IMPLEMENTATION PLAN
FOR THE
CITY OF LAGUNA NIGUEL

Version 1: February 2003
Revised November 2003
Revised November 2004
Revised November 2005
Revised December 2010

Current Revision: March 2017

TABLE OF CONTENTS

Section		Page
	Acronyms	i
	Glossary	ii
1.0	**INTRODUCTION**	**1-1**
1.1	**Background**	**1-1**
1.2	**Regulatory Requirements**	**1-3**
1.3	**Objectives of the Local Implementation Plan**	**1-3**
1.4	**Permittee Commitments**	**1-4**
1.5	**Description of Drainage Area and Climate**	**1-5**
1.5.1	Geography and Climate	1-5
1.5.2	Watersheds	1-6
1.5.3	Land Use	1-6
1.5.4	Beneficial Uses and Impaired Waters/Environmentally Sensitive Areas (ESAs)	**1-8**
1.6	**Program Assessment and Modification**	**1-9**
2.0	**PROGRAM MANAGEMENT**	**2-1**
2.1	**Introduction**	**2-1**
2.2	**Countywide Coordination**	**2-1**
2.3	**City Internal Coordination/Implementation**	**2-4**
2.4	**City External Partnerships**	**2-10**
2.5	**Fiscal Analysis**	**2-11**
2.6	**Data Management and Permit Reporting Requirements**	**2-12**
2.7	**NPDES Permit Responsibilities**	**2-13**
2.8	**Program Representation**	**2-13**
3.0	**JURISDICTIONAL WORK PLAN**	**3-1**
3.1	**Introduction**	**3-1**
3.2	**DAMP, LIP, and Watershed Work Plans**	**3-1**
3.3	**Framework for Program Assessment**	**3-1**
3.4	**Framework for BMP Selection and Effectiveness Assessment**	**3-2**
3.5	**Water Quality Monitoring**	**3-3**
3.5.1	WQIP Monitoring and Assessment Program	3-3
3.6	**Water Quality Improvement Strategies**	**3-3**
3.6.1	DAMP/LIP Strategies	3-3
3.6.2	WQIP Strategies	3-4
3.7	**Reporting**	**3-5**
4.0	**LEGAL AUTHORITY**	**4-1**
4.1	**Introduction**	**4-1**
4.2	**Regulatory Requirements**	**4-1**
4.3	**Authority of Control Pollutant Discharges**	**4-1**
4.3.1	Other City of Laguna Niguel Pollution Prevention Codes/Ordinances	4-2
4.3.2	Water/Sewer Agency Pollution Prevention Ordinances and Programs	4-3

4.3.3	Roles and Responsibilities Beyond City Jurisdiction	4-4
4.4	**Enforcement**	**4-5**
4.5	**Assessment**	**4-5**
4.6	**Reporting**	**4-6**
5.0	**MUNICIPAL ACTIVITIES**	**5-1**
5.1	**Introduction**	**5-1**
5.1.1	Municipal Program Management	5-1
5.2	**Municipal Inventory and Source Identification**	**5-1**
5.3	**General BMP Implementation**	**5-1**
5.3.1	BMP Implementation for Management of Pesticides, Herbicides, and Fertilizers	5-3
5.3.2	BMP Implementation for Flood Control Structures	5-3
5.3.3	BMP Implementation for Sweeping of Municipal Areas	5-4
5.3.4	BMP Implementation for Irrigation Runoff Prevention from Municipal Facilities	5-4
5.4	**Operation and Maintenance of Municipal Separate Storm Sewers (MS4s) and Structural Controls**	**5-4**
5.4.1	Municipal Post Construction BMP Inspection and Treatment Controls	5-4
5.4.2	Maintenance of MS4 and Facilities	5-5
5.4.3	Prevention of Infiltration from Sanitary Sewer to MS4	5-5
5.5	**Inspection of Municipal Areas and Activities**	**5-6**
5.6	**Training and Education of Municipal Staff and Contractors**	**5-7**
6.0	**TRAINING AND PUBLIC EDUCATION**	**6-1**
6.1	**Principal Permittee County-wide Programs**	**6-1**
6.1.1	Model Public Education Program	6-1
6.1.2	Related County Programs	6-2
6.1.3	Foundational Campaign Elements	6-2
6.1.4	Action Campaigns	6-3
6.2	**City Educational Programs**	**6-4**
6.2.1	Municipal Personnel Education	6-4
6.2.2	City Subcontractor Education	6-4
6.2.3	Private Developer and Construction Contractor Education	6-5
6.2.4	Industrial and Commercial Site Owners and Mobile Business Education	6-5
6.2.5	Homeowners Association and Resident Outreach	6-6
6.3	**Water/Sewer District Educational Programs**	**6-7**
6.4	**Public Participation**	**6-7**
6.4.1	Facilitating Public Input/Feedback	6-7
6.4.2	Public Reporting	6-7
6.4.3	Speakers Bureau	6-8
6.5	**Reporting**	**6-8**
7.0	**DEVELOPMENT PLANNING**	**7-1**
7.1	**Introduction**	**7-1**
7.1.1	Overview	7-1

7.2	**Prioritization**	**7-1**
7.2.1	Priority Projects	7-1
7.2.2	Non-Priority Projects	7-3
7.3	**Project Review and Approval**	**7-4**
7.3.1	Discretionary Review	7-4
7.3.2	Plan Check: Issuance of Grading or Building Permits	7-4
7.3.3	Permit Closeout, Certificates of Use and Certificates of Occupancy	7-5
7.4	**BMP Maintenance Tracking**	**7-6**
7.5	**Reporting**	**7-7**
8.0	**CONSTRUCTION COMPONENT**	**8-1**
8.1	**Introduction**	**8-1**
8.2	**Inventory of Construction Projects**	**8-1**
8.3	**Project Review and Approval**	**8-1**
8.4	**Construction BMPs**	**8-2**
8.4.1	Minimum Performance Requirements	8-2
8.4.2	Designated Construction BMPs	8-3
8.5	**City Inspection and Reporting**	**8-5**
8.5.1	Minimum Inspection Frequencies	8-5
8.5.2	Enforcement Actions	8-6
8.5.3	Non-Compliance Reporting	8-7
8.6	**Reporting**	**8-7**
9.0	**EXISTING DEVELOPMENT**	**9-1**
9.1	**Introduction**	**9-1**
9.2	**Commercial and Industrial Program**	**9-1**
9.2.1	Source Identification and Inventory	9-1
9.2.2	BMP Implementation	9-3
9.2.3	Inspection	9-7
9.3	**Residential Program**	**9-8**
9.3.1	Source Identification and Inventory	9-9
9.3.2	Best Management Practices	9-9
9.3.3	BMP Implementation	9-10
9.4	**Post Construction BMP Inspection and Verification**	**9-11**
9.5	**Immediate Threats to Water Quality**	**9-11**
9.6	**Enforcement**	**9-12**
9.7	**Plan for Retrofitting Existing Development**	**9-12**
9.8	**Reporting**	**9-12**
10.0	**ILLEGAL DISCHARGES/ILLICIT CONNECTIONS**	**10-1**
10.1	**Introduction**	**10-1**
10.1.1	Overall Program Structure	10-1
10.2	**Prevention and Detection**	**10-2**
10.3	**Investigation**	**10-3**
10.3.1	Source Investigations	10-3
10.3.2	Documentation	10-4

10.4	**Elimination and Enforcement**	10-4
10.4.1	Choosing the Type of Enforcement	10-4
10.4.2	Verbal Warnings and Educational Letters	10-5
10.4.3	Administrative Remedies	10-5
10.4.4	Criminal Remedies	10-6
10.5	**Non-Sewage Spill Incident Response**	**10-8**
10.5.1	Incident Response	10-8
10.5.2	Regulatory Reporting	10-9
10.6	**Sewage Spill Incident Response**	**10-9**
10.6.1	Program Responsibilities	10-10
10.6.2	Management Measures	10-10
10.6.3	Response	10-11
10.7	**Reporting**	**10-11**

TABLES

Table 1.1	303(d) Listed Waterbodies Potentially Affected By Activities in the City of Laguna Niguel	1-8
Table 1.2	Other Environmentally Sensitive Areas Potentially Affected By Activities in the City of Laguna Niguel	1-9
Table 2.1	City Participation in Countywide Program	2-3
Table 2.2	City of Laguna Niguel Internal Implementation of the LIP	2-4
Table 3.1	Priority Pollutants and Sources	3-2
Table 3.2	Required Reductions for Bacteria in Aliso Watershed	3-5
Table 7.1	Priority Project Categories	7-2
Table 8.1	Minimum Construction Site Performance Requirements	8-2
Table 8.2	Construction BMPs	8-3
Table 8.3	Construction Site Inspection Frequency	8-5
Table 8.4	Enforcement Actions for Construction Projects	8-6
Table 9.1	Minimum BMPs for Commercial and Industrial Facilities	9-3
Table 9.2	Minimum BMPs for Residential Activities	9-9

FIGURES

Figure 1.1	Rainfall Measured in Inches at Laguna Niguel Station No. 216 from Each Water Year From 1985	1-5
Figure 1.2	Regional Location Map – South Orange County Watershed Management Area Showing City Boundaries and Watersheds	1-7

EXHIBITS

Exhibit 1.I	Land Use
Exhibit 1.II	Environmentally Sensitive Areas
Exhibit 2.I	Runoff Management Program Organizational Chart
Exhibit 2.II	Fiscal Analysis Template
Exhibit 2.III	JRMP Annual Report Forms
Exhibit 3.II	JRMP Annual Report Forms
Exhibit 3.I	Summary of Jurisdictional and Watershed Strategies – City of Laguna Niguel
Exhibit 4.I	Runoff Water Quality Ordinance
Exhibit 4.II	Letter of Legal Authority
Exhibit 4.III	Enforcement Response Plan
Exhibit 5.I	Municipal Facilities Inventory Map 2017
Exhibit 5.II	Activity-Specific BMP Checklists
Exhibit 5.III	BMPs by Facility and Program With Inspection Checklist
Exhibit 5.IV	Treatment Control BMPs Inventory and Tracking
Exhibit 5.V	Municipal Separate Storm Sewer System Map
Exhibit 5.VI	Municipal Facility Inspection Form
Exhibit 5.VII	Orange County Fire Authority Waste Water Discharge/Best Management Practice Standard Operating Procedures
Exhibit 6.I	Training and Public Education Activities
Exhibit 7.I	Standard Conditions of Approval
Exhibit 8.I	Construction BMP Fact Sheets
Exhibit 8.II	Standard Plans for Selected Construction BMPs
Exhibit 8.III	Construction Site Inspection Checklist
Exhibit 9.I	Activity-Specific BMP Checklists
Exhibit 9.II	Inspection Form
Exhibit 9.III	Commercial and Industrial Facilities Inventory Map
Exhibit 9.IV	Residential Management Areas Map
Exhibit 10.I	Incident Response
Exhibit 10.I	Notification and Response Procedures
Exhibit 10.II	Agency Notification List
Exhibit 10.III	Recommended Field Investigation Equipment and Supplies
Exhibit 10.IV	Water Quality Problems and Illicit Discharge Investigations
Exhibit 10.V	Authorized Inspectors Field Spill Response Procedures
Exhibit 10.VI	MS4 Permittee Sewage Spill Response Procedure
Exhibit 10.VII	Pollution Notification/Investigation Request Form
Exhibit 10.VIII	Enforcement Flow Chart

Acronyms

303(d)	EPA List of Impaired Waters
ACL	Administrative Civil Liability
ACO	Administrative Compliance Order
AI	Authorized Inspector
APWA	American Public Works Association
AMAL	Average Monthly Action Level
ASBS	Area of Special Biological Significance
AQMD	Air Quality Management District
BAT	Best Available Technology
BCT	Best Conventional Technology
BIA	Building Industry Association
BMP	Best Management Practice
BPJ	Best Professional Judgement
Basin Plan	Water Quality Control Plan for the San Diego Basin
CAP	Household Hazardous Waste Community Awareness Program
CAR	Critical Aquatic Resources
CASC	Countywide Areas Spill Control Program
CASQA	California Stormwater Quality Association
CC&Rs	Covenants, Codes & Restrictions
CDFW	California Department of Fish & Wildlife
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second
CGP	Construction General Permit
CHP	California Highway Patrol
CIA	Common Interest Areas
CUPA	Certified Unified Program Agency
CWA	Clean Water Act
CWC	Clean Water Code
CZARA	Coastal Zone Act Reauthorization Amendments of 1990
DA	District Attorney
DAMP	Drainage Area Management Plan
DCIA	Directly Connected Impervious Area
DHS	Department of Health Services
DMV	Department of Motor Vehicles
DOT	Department of Transportation
DTSC	Department of Toxic Substance Control
EA	Enforcing Attorney
ECG	Enforcement Consistency Guide
EHS	Environmental Health Services
EOC	Emergency Operations Center
EMC	Event Mean Concentration
EPA	Environmental Protection Agency
EPR	Environmental Performance Reporting
ERP	Enforcement Response Plan

Acronyms

ESA	Environmentally Sensitive Area
FC	Fecal Coliform
FIM	Fecal Indicator Bacteria
GIS	Geographic Information System
GPM	Gallons per Minute
GPS	Global Positioning System
GRBOD	Geomorphically-referenced Basis Of Design
HAZMAT	Hazardous Materials
HCA	Health Care Agency
HHW	Household Hazardous Waste
HMI	Hazardous Materials Incident
HOA	Homeowner's Association
HPWQC	Highest Priority Water Quality Conditions
HSA	Hydrologic Sub Area
HU	Hydrologic Unit
HWI	Hazardous Waste Inspector
IBI	Index of Biological Integrity
IC	Incident Commander
IDDE	Illicit Discharge Detection and Elimination
ID/IC	Illegal Discharge/Illicit Connection
IPM	Integrated Pest Management
IRWD	Irvine Ranch Water District
IRWMP	Integrated Regional Water Management Plan
IWMD	Integrated Waste Management Department
JPA	Joint Powers Authorities
JRMP	Jurisdictional Runoff Management Plan
LID	Low Impact Development
LIP	Local Implementation Plan
LC	LIP Coordinator
MDAL	Maximum Daily Action Level
MEP	Maximum Extent Practicable
MOU	Memorandum of Understanding
MPN	Most Probable Number
MRP	Monitoring and Reporting Programs
MS4	Municipal Separate Storm Sewer System
NAL	Non-Stormwater Action Level
NAICS	North America Industry Classification System
NEPA	National Environmental Policy Act
NNC	Notice of Non-compliance
NCCP	Natural Community Conservation Planning Program
NOA	Notice Of Applicability
NOI	Notice of Intent
NOT	Notice of Termination
NPDES	National Pollutant Discharge Elimination System
NSE	Natural Source Exclusion
OC	Orange County

Acronyms

OCC	Orange County Code
OCFA	Orange County Fire Authority
OCFCD	Orange County Flood Control District
OCP	OC Planning
OCPW	OC Public Works
OCSD	Orange County Sanitation District
OCTA	Orange County Transportation Authority
OES	Office of Emergency Services
O&M	Operations & Maintenance
OWTS	On-site Waterwater Treatment System
PDSD	Planning & Development Services Department
PEA	Program Effectiveness Assessment
PNIR	Pollution Notification/Investigation Request
PPE	Personal Protective Equipment
PWQC	Priority Water Quality Conditions
QA/QC	Quality Assurance/Quality Control
RAA	Reasonable Assurance Analysis
RCRA	Resource Conservation and Recovery Act
RMV	Rancho Mission Viejo
ROMP	Runoff Management Plan
ROWD	Report of Waste Discharge
RP	Responsible Party
SAL	Stormwater Action Level
SAR	Santa Ana Region
SAMP	Special Area Management Plan
SBPAT	Structural BMP Prioritization and Analysis Tool
SCAG	Southern California Association of Governments
SCCWRP	Southern California Coastal Water Research Project
SDR	San Diego Region
SDRWQCB	San Diego Regional Water Quality Control Board
SEEP	SmarTimer Edgescape Evaluation Project
SIC	Standard Industrial Classification Code
SOC	South Orange County
SOCWA	South Orange County Wastewater Authority
SOCWMA	South Orange County Watershed Management Area
SR	Spill Responder
SSMP	Sewer System Management Plans
SSO	Sanitary Sewer Overflow
SUSMP	Standard Urban Storm Water Mitigation Plan
SWPPP	Stormwater Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TAC	Technical Advisory Committee
TDS	Total Dissolved Solids
TLR	Target Load Reduction
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids

Acronyms

UCI	University of California, Irvine
UHWM	Uniform Hazardous Waste Manifest
USEPA	United States Environmental Protection Agency
WAP	Watershed Action Plan (Formerly Watershed Urban Runoff Management Plan)
WDR	Waste Discharge Requirement
WDID	Waste Discharge Identification Number
WDR	Waste Discharge Requirements
WLA	Water Load Allocation
WMA	Watershed Management Area
WMAA	Watershed Management Area Analysis
WQBEL	Water Quality Based Effluent Limitation
WQIP	Water Quality Improvement Plan
WQMP	Water Quality Management Plan
WQO	Water Quality Objective
WSPA	Western States Petroleum Association
WY	Water Year

Glossary

Best Management Practice (BMP)

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.

Clean Water Act and Amendments

The Federal Pollution Control Act (Public Law 92-500), as amended (33 U.S.C. 1251 et seq.). Federal regulation mandating a National Pollutant Discharge Elimination System permit for discharges into the Waters of the United States. The goals of the act are to restore and maintain the chemical, physical and biological integrity of the nation's waters.

Construction General Permit

The NPDES general permit for stormwater discharges associated with construction activity. SWRCB Order No. 2009-0009-DWQ DWQ, NPDES General Permit No. CAS000002 or its subsequent replacement.

Control Measures

Major groupings of the specific BMPs that are developed and implemented for a program element. There are typically several control measures for each program element.

Effectiveness Assessment

The process that is used to evaluate if the programs are resulting in desired Outcomes.

First Term Permits

The Regional Boards issued Municipal Stormwater Permits No. CA 8000180 and No. CA 0108740 to the Permittees in 1991 for the period from 1990 – 1996.

Fifth Term Permit

The Regional Board re-issued the Municipal NPDES Stormwater Permit as San Diego Region Order No. R9-2013-0001 as amended by Order Nos. R9-2015-0001 and R9-2015-0100, NPDES Permit No. CAS0109266

Fourth Term Permit

The Regional Board re-issued the Municipal NPDES Stormwater Permit in 2009 as San Diego Region Order No. R9-2009-0002

General Industrial Permit

The NPDES general permit for stormwater discharges associated with industrial activity. SWRCB Order No. 2014-0057-DWQ, NPDES General Permit No. CAS000001 or its subsequent replacement.

Glossary

General Permittee Committee

The committee made up of a representative from each of the Permittees that provides the overall guidance for the NPDES Stormwater Program.

Headline Indicator

A sub-set of measures that reflect, in simple terms, how a stormwater program is progressing towards its goals and are easily understandable.

Hydromodification

Hydromodification is the alteration of natural flow characteristics.

Illegal Discharge

Any discharge to a municipal separate storm sewer that is not composed entirely of stormwater and that is not covered by an NPDES permit or identified in the NPDES Stormwater permit as an allowed discharge.

Illicit Connection

Any man-made conveyance or drainage system, pipeline, conduit, inlet or outlet, through which the discharge of any pollutant to the stormwater drainage system occurs or may occur.

Implementation Agreement

The agreement underpinning County and city cooperation which establishes the responsibilities of each Permittee and a funding mechanism for the shared costs of the Program.

Implementation Assessment

The analysis of the effectiveness of a program element or control measure at meeting desired programmatic Outcomes or goals.

Integrated Assessment

The process of evaluating whether stormwater program implementation is resulting in the protection or improvement of water quality.

Iterative Approach

A stormwater program is developed, implemented, and assessed in repeated cycles. In each cycle the program is implemented and then refined based on the effectiveness assessment results.

Local Implementation Plan (LIP)/Jurisdictional Runoff Management Plan (JRMP)

The Permittee specific document that details how the stormwater programs within the DAMP are implemented within their local jurisdictions (synonymously referred to as a LIP in the Santa Ana Region and a JRMP within the San Diego Region).

Low Impact Development (LID)

LID is an approach to land development (or re-development) that works with nature to manage storm water as close to its source as possible by using

structural and non-structural best management practices to reduce environmental impacts.

Orange County Stormwater Program

The program designed by the Orange County Permittees for compliance with the NPDES permits.

Outcomes

Outcomes are the results of implementing a stormwater control measure, program element or overall program. Outcomes defined by the California Stormwater Quality Association are categorized in terms of six Outcome Levels, which can have implementation or water quality endpoints.

Outcome Levels

Outcome Levels help to categorize and describe the desired results or goals of programs and control measures.

National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater Permit

A provision of the CWA, section 402, that identifies municipal stormwater as a point source subject to regulation under the NPDES Permits.

Permittees

The cities of Aliso Viejo, Dana Point, Laguna Beach, Laguna Hills, Laguna Niguel, Laguna Woods, Lake Forest, Mission Viejo, Rancho Santa Margarita, San Clemente, San Juan Capistrano; the County of Orange; and the Orange County Flood Control District and any subsequently incorporated cities that become subject to the NPDES permit. Each Permittee is individually responsible for the implementation of the program elements within its jurisdiction.

Point Source

Any discernable, confined, and discrete conveyance, including any conduit pipe, ditch, channel, sewer, tunnel, vessel, or other floating craft from which pollutants are or may be discharged.

Principal Permittee

The County of Orange is the Permittee designated with the responsibility to manage the NPDES Municipal Stormwater Program on behalf of the Permittees.

Regional Water Quality Control Boards

The Santa Ana and San Diego Regional Water Quality Control Boards are agencies that implement and enforce Clean Water Act Section 402(p) NPDES permit requirements, and are issuers and administrators of these permits on behalf of EPA within Orange County.

Glossary

Report of Waste Discharge (ROWD)

Constitutes the application to the RWQCB for the NPDES permit. The ROWD presents the compilation of data from the current and previous permit terms and describes the proposed plan for future activities.

San Diego Regional Board

The Regional Board that issues the NPDES Municipal Stormwater Permit for Orange County from approximately El Toro Road down southward to the San Diego County border. The Permittees in the San Diego Regional Water Quality Control Board jurisdiction include the County of Orange, the Orange County Flood Control District and the eleven (11) incorporated cities of Aliso Viejo, Dana Point, Laguna Beach, Laguna Hills, Laguna Niguel, Laguna Woods, Lake Forest, Mission Viejo, Rancho Santa Margarita, San Clemente, and San Juan Capistrano.

Second Term Permits

The Regional Boards re-issued the Municipal NPDES Stormwater Permits in 1996, San Diego Region CAS618030, which covered the time period from 1996-2002.

State Water Resources Control Board

State agency that sets statewide policy for the nine Regional Water Quality Control Boards.

Total Maximum Daily Loads (TMDL)

A written, quantitative analysis and plan for attaining and maintaining water quality standards in all seasons for a specific waterbody and pollutant.

Third Term Permits

The Regional Boards re-issued the Municipal NPDES Stormwater Permits in 2002, San Diego Region Order No. R9-2002-0002, which covers the time period from 2002-2007.

Water Quality Assessment

The use of environmental data and related information to characterize the quality of stormwater discharges and the water bodies that receive these discharges.

Water Quality Planning Process

Systematic and detailed evaluation of the impacts of urban water quality on beneficial uses to determine or validate that actual impairments exist that warrant corrective action.

1.0 INTRODUCTION

This document constitutes the City of Laguna Niguel's Local Implementation Plan (LIP) prepared as part of a compliance program pursuant to the California Regional Water Quality Control Board, San Diego Region Order No. R9-2013-0001 as amended by Order Nos. R9-2015-0001 and R9-2015-0100, NPDES Permit No. CAS0109266 (termed *Fifth Term Permit* or *Permit)*. The LIP contains all the information specified for the Jurisdictional Runoff Management Plan (JRMP) and should, for purposes of compliance is considered to be a JRMP as defined by the Permit.

This plan describes the activities that the City is undertaking to meet the requirements of the Fifth Term Permit and to protect and improve the quality of the creeks, streams and coastal waters within the urban areas of San Juan Hydrologic Unit, also referred to as the South Orange County Watershed Management Area (WMA) to which the city contributes runoff. Although the LIP is intended to serve as the basis for City compliance during the entire period of the Permit, the LIP is subject to modifications and updates as the City determines necessary, or as directed by the Regional Board.

1.1 BACKGROUND

The City's urban runoff control programs have been undertaken since 1990 in cooperation with the County of Orange and with other cities in Orange County under the jurisdiction of the San Diego Regional Water Quality Control Board (RWQCB), to comply with the requirements of National Pollutant Discharge Elimination System (NPDES) Permits issued by the Board. Under the guidance and structure of a County-wide Drainage Area Management Plan (DAMP), the City of Laguna Niguel has prepared this LIP in compliance with the Fifth Term Permit. The LIP describes the programs and activities that the City is implementing to meet Permit requirements, with the goal of making meaningful improvement in urban water quality.

This plan addresses the impacts to creeks, rivers, streams and coastal waters that can arise from the imprint of urban development on the landscape. Urbanization creates impervious surfaces such as rooftops, driveways, roads and parking lots which can (1) increase the timing and volume of rainfall runoff (compared to pre-development conditions) and (2) provide a source of pollutants that are flushed or leached by rainfall runoff or dry weather runoff into surface water systems.

The environmental consequences of urban area runoff can be loss or impairment of aquatic beneficial uses due to:

- Water quality degradation from increased loadings of sediment, nutrients, metals hydrocarbons, pesticides, and bacteria;
- Reduced biotic richness, with increased dominance of tolerant species;
- Changes in channel morphology and habitat loss from increased severity and frequency of runoff events;
- Loss of groundwater recharge, and
- Increased water temperatures from solar energy absorption by urban surfaces and

elimination of riparian shading.

These impacts have been referred to as the symptoms of "urban stream syndrome[1]" and while these impacts are often mostly attributed to urban stormwater runoff delivered to streams by constructed drainage systems, other stressors, including sanitary sewer overflows, unauthorized wastewater discharges, and legacy pollutants can also be important determinants of urban stream syndrome conditions.

The stormwater pollution control effort, of which this LIP is a part, is the result of four decades of legislative effort beginning with the 1972 Federal Water Pollution Control Act, subsequently known as the Clean Water Act (CWA). In 1987 the Water Quality Act brought stormwater discharges into the NPDES program and USEPA subsequently issued implementing regulations on November 16, 1990.

In response to these regulations, the City of Laguna Niguel, County of Orange, the Orange County Flood Control District and the other incorporated cities of Orange County (collectively referred to as Permittees[2]) have obtained, renewed and complied with NPDES permits issued by the RWQCB. Each permit renewal has required the Permittees to continue to implement stormwater quality management programs and update and develop additional programs at the countywide and watershed scales to control pollutants in dry and wet weather urban runoff.

The City's stormwater quality management program reduces pollutant discharges through the implementation of a variety of measures commonly referred to as Best Management Practices (BMPs). BMPs are integral to the city's construction and maintenance of its urban municipal drainage system. Regulatory oversight ensures BMP implementation at locations of commerce, public facilities, and construction activities while public education and outreach encourages adoption of practices in residential areas to prevent water waste and to adopt approaches that are protective of stormwater quality. The City established a program to address land development or redevelopment activities through the preparation of a Water Quality Management Plan (WQMP) when the projects meet the criteria for a Priority Development Project (PDP).

Since 1990, the City has cooperated with the County of Orange, the Orange County Flood Control District and the other cities in Orange County in a region wide stormwater quality program (collectively the Orange County Stormwater Program or "Program"). The result of this cooperation has been the development of a series of model stormwater program elements that comprise the county-wide DAMP. In developing this LIP, the City of Laguna Niguel, has used the DAMP as the foundation for its program development which in combination with a watershed management plan (see discussion in Section 1.2 regarding Water Quality Improvement Plan), in effect, act as companion parts of the City's compliance program.

[1] Christopher J. Walsh,1,* Allison H. Roy,2,† Jack W. Feminella,3,‡ Peter D. Cottingham,4,§ Peter M. Groffman,5, // and Raymond P. Morgan II6,#, "The urban stream syndrome: current knowledge and the search for a cure," Journal of the North American Benthological Society 24, no. 3 (September 2005): 706-723.

[2] The terms Copermittee and Permittee are synonymous. Permittee is used for countywide consistency

1.2 REGULATORY REQUIREMENTS

Section 402(p) of the CWA, as amended by the Water Quality Act of 1987, requires that municipal NPDES Permits include:

1. A requirement to effectively prohibit non-storm water discharges into municipal storm sewers; and

2. Controls to reduce the discharge of pollutants from municipal storm drains to the maximum extent practicable, including management practices, control techniques and system, design and engineering methods, and such other provisions as the Administrator or the State determines appropriate for the control of such pollutants.

Regulations promulgated by EPA on November 16, 1990 (40 CFR 122.26 (d)(2)(iv)) require municipal NPDES permit applicants to develop a management program to effectively address these requirements. According to these regulations the management program, "*shall include a comprehensive planning process which involves public participation and where necessary intergovernmental coordination, to reduce the discharge of pollutants to the maximum extent practicable using management practices, control techniques and system, design and engineering methods, and such other provisions which are appropriate*."

The Fifth Term Permit retains the prescribed program elements of the prior permits and places additional regulatory emphasis on watershed planning with new requirements for the development and implementation of a Water Quality Improvement Plan (WQIP). This plan is intended to guide jurisdictional efforts toward achieving the outcome of improved water quality in discharges and receiving waters by enabling management resources to be directed toward priority water quality constituents of concern and/or underlying priority water quality conditions thereby providing a regulatory basis for addressing both the symptoms and underlying causes of urban stream syndrome.

Currently, some of the Copermittees including the City are pursuing a subvention of funds from the State to pay for certain activities required by Order No. R9-2009-0002 (Fourth Term Permit) and the Fifth Term Permit, including some of the activities in the LIP. Nothing in this LIP should be viewed as a waiver of those claims or as a waiver of the rights of the City to pursue a subvention of funds from the State to pay for certain activities required by the Fourth and Fifth Term Permits, including the implementation of certain activities in this LIP. In addition, several Copermittees, including the City, have filed petitions with the State Water Resources Control Board (SWRCB) challenging some of the requirements of the Fifth Term Permit. Nothing in this LIP should be viewed as a waiver of those claims. Because the SWRCB has not issued a stay of the Fifth Term Permit, Copermittees must comply with the Fifth Term Permit's requirements while the SWRCB process is pending.

1.3 OBJECTIVES OF THE LOCAL IMPLEMENTATION PLAN

The main objective of this LIP is to fulfill the commitment of the City to present a plan that satisfies the requirements of the Fifth Term Permit. This document outlines all of the strategies the City will implement to reduce the discharge of pollutants from its storm drain system in accordance with the Permit and therefore identifies both LIP and WQIP strategies.

1. LIP strategies – These strategies are the baseline programs developed on a Countywide or regional basis and which are focused on reducing pollutant discharges from the municipal storm drain system to the MEP.

2. WQIP strategies – These strategies go beyond the City's baseline strategies and represent a focus on south Orange County's highest priority water quality conditions.

This LIP includes the following programs in subsequent sections:

1. Introduction, including descriptions of the City and its surface water concerns (Section 1)

2. Framework for program management activities, including internal and external coordination, fiscal information and reporting (Section 2)

3. Jurisdictional Work Plan, including the City's approach to iterative improvement to its program and WQIP strategies and Best Management Practices (BMPs) (Section 3)

4. Legal authority for prohibiting unpermitted discharges to the storm drain system and for requiring BMPs in new development and significant redevelopment (Section 4)

5. Municipal activities for pollution prevention and treatment to further reduce the amount of pollutants entering the storm drain system (Section 5)

6. Training and public educational programs to communicate with the public, businesses, and City staff about urban stormwater and non-stormwater pollution and obtain their support in implementing pollution prevention BMPs (Section 6)

7. Development planning to incorporate appropriate and required post construction nonstructural and structural BMPs into the environmental planning and development review process (Section 7)

8. Construction site controls that address appropriate and required practices for erosion and sediment control and on-site hazardous materials and waste management (Section 8)

9. Existing development programs to prioritize, inspect and implement programs for industrial, and commercial facilities and residential management areas (Section 9), and

10. Illegal discharges/illicit connections (ID/IC) program to detect and eliminate unpermitted discharges and unauthorized connections to the municipal storm drain system (Section 10).

1.4 PERMITTEE COMMITMENTS

The Permittees are committed to maintaining the integrity of the receiving waters and their ability to sustain beneficial uses. As such, the Permittees have designed and implemented a countywide baseline stormwater management program in order to be able to periodically re-

assess the conditions of the waters within Orange County and help determine the impact, if any, of urban stormwater discharges to the beneficial uses of those waters.

This baseline effort is complemented by the WQIP, which focuses resources on the highest priority water quality constituents and conditions. The Highest Priority Water Quality Conditions (HPWQC) are: pathogen health risk in dry weather, unnatural water balance in dry weather and the geomorphic instability of the channel system. The list of strategies the City will implement to address the HPWQC identified in the WQIP and meet numeric goals is provided in Exhibit 3.I of this LIP. These strategies include the City's baseline programs as well as the additional commitments necessary to meet the goals within the timelines specified in the WQIP. The LIP is the City's primary mechanism for WQIP strategy implementation and Fifth Term Permit compliance.

1.5 DESCRIPTION OF DRAINAGE AREA AND CLIMATE

1.5.1 Geography and Climate

Figure 1.2 illustrates the regional location of the City of Laguna Niguel within the jurisdictional area of RWQCB. The City covers an area of approximately 14.8 square miles and has a population of approximately 67,000 people. The City is topographically composed of moderate to steep slopes situated within the coastal foothill region, from one to five miles inland from the Pacific Ocean.

Laguna Niguel is underlain geologically by marine sedimentary and volcanic rock of the Capistrano and Monterey Formations. These formations tend to have high salinity, phosphorus and metals (notably cadmium, nickel, zinc, selenium and manganese). Both native and manufactured slopes have historically demonstrated high risk of landslides and surficial failures. Native soils formed from these geologic formations are typically expansive clay to clay loam in texture with a low infiltration rate. Narrow canyon bottomland areas are characterized by high groundwater levels; natural seeps are common. The groundwaters and springs are naturally high in TDS, with some springs high in sulfur and low in pH, precluding beneficial use of groundwater for municipal purposes.

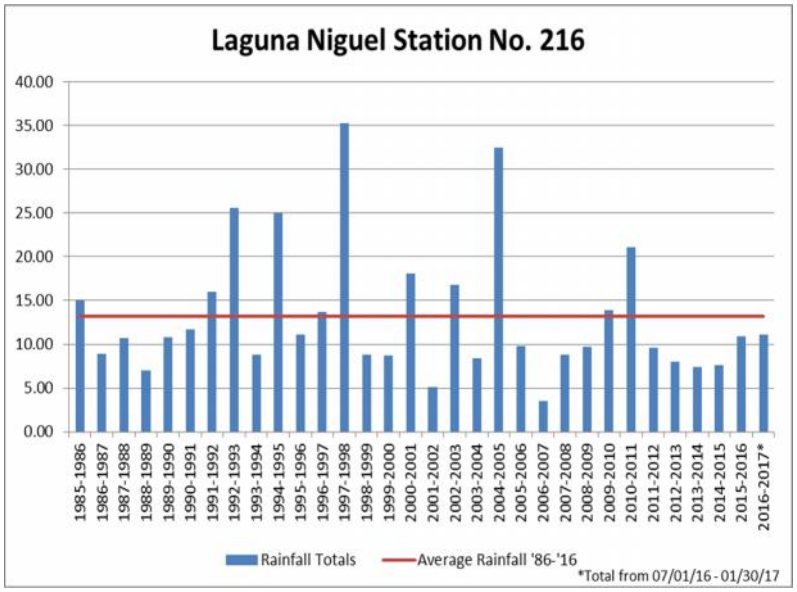


Figure 1.1 Rainfall Measured in Inches at Laguna Niguel Station No. 216 for Each Water Year From 1985

Orange County's climate has hot, dry summers and mild winters. Nearly all the annual precipitation falls in only a few storm events between October and April. On average, Orange County only receives 12 to 13 inches of rain per year (Figure 1.1). Beginning in 2011-12 Orange

County received below average rainfall for five straight years. Conditions were similar across the State prompting the governor to declare a drought in 2014 and enact new regulations to curtail water use especially for landscape irrigation. The drought was the most prolonged and extreme in the southern and central parts of California, affecting Orange County. More recently, in late 2016 and early 2017 several large storms have brought significant rain and snow pack to the State suggesting that the drought may soon be over. At present water use restrictions and required reductions are still in place and are imposed by the Moulton Niguel Water District, the local water purveyor to the City.

1.5.2 Watersheds

Laguna Niguel drains into three major watersheds within the County's South Orange County Watershed Management Area: Sulphur Creek in the northerly part of the City, which is tributary to Aliso Creek and considered part of the Aliso Creek Watershed Management Area; Salt Creek, in the southerly part of the City and within the Dana Point Coastal Streams Watershed Management Area; and Oso Creek in the easterly part of the City, which is tributary to San Juan Creek and is part of the San Juan Creek Watershed Management Area. The individual watersheds are shown in Figure 1.2.

Sulphur Creek within Laguna Niguel is mostly modified and vegetated soft-bottomed channel. Oso Creek is mostly a lined channel, while Salt Creek is mostly natural. Sulphur Creek Reservoir, constructed in the County-operated Laguna Niguel Regional Park in the 1965, serves flood control and recreational functions.

1.5.3 Land Use

Land use in the City of Laguna Niguel are predominantly hillside residential, scattered with commercial centers, parks and institutional uses in flatter areas. Substantial swaths of landscaped slopes and undeveloped brush-covered open space slopes are interspersed. The majority of residential and landscaped slope areas, as well as a substantial number of streets, are managed by private Homeowners Associations. The 73 Toll Road, operated and maintained by Caltrans, cuts across the northern part of the City. A railroad line, Metrolink Station, and Interstate 5 are on the City's eastern border.

There are currently no identified private industrial land uses in the City. There is one sewage treatment plant, also producing recycled water, which is operated by the South Orange County Wastewater Authority (SOCWA) and is a separate entity from the City government. The City's water supply and wastewater collection systems are operated by the Moulton Niguel Water District, which is a member agency of SOCWA and whose service area also includes portions of five surrounding cities.

The City is essentially fully built-out, with most development occurring in the 1980s and 1990s prior to the imposition of more aggressive urban runoff controls in the Third and Fourth Term NPDES Permits. The City of Laguna Niguel was not incorporated until 1989. A map of land uses is included Exhibit 1.I of this LIP.

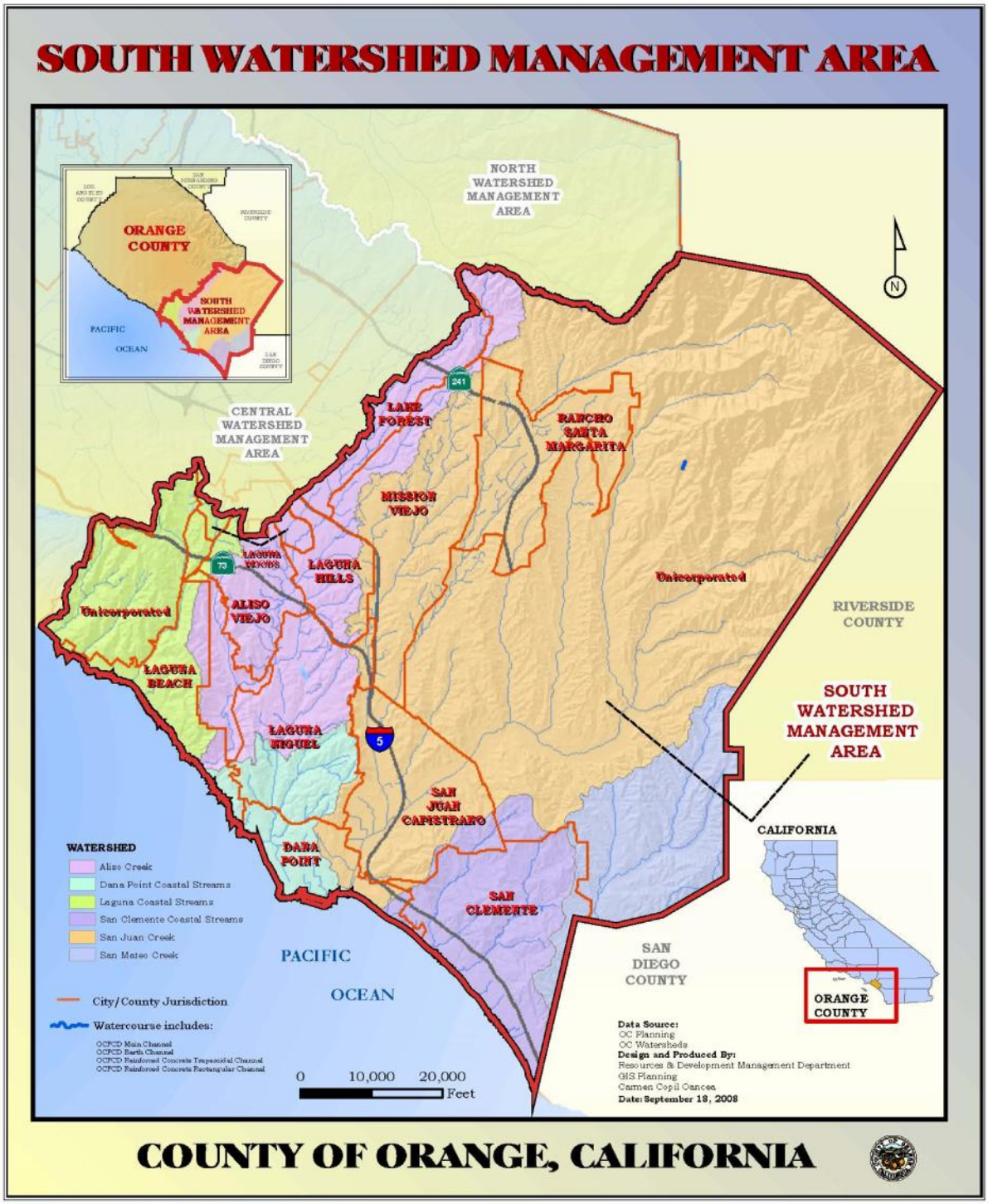


Figure 1.2 Regional Location Map – South Orange County Watershed Management Area Showing City Boundaries and Watersheds

1.5.4 Beneficial Uses and Impaired Waters/Environmentally Sensitive Areas (ESAs)

Beneficial uses of all the City's inland surface waters, as defined in the San Diego Region Basin Plan, include agriculture (AGR), passive recreation (REC2), warm-water habitat (WARM, and wildlife (WILD). Oso Creek are also designated for industrial (IND), active recreation (REC1), and coldwater habitat (COLD). Aliso and Salt Creeks are designated for "potential" REC1 use. All 3 creeks are exempt from municipal (MUN) use.

The RWQCB defines Environmentally Sensitive Areas (ESAs, shown in Exhibit 1.II) as those areas that include, but are not limited to:

- All Clean Water Act (CWA) Section 303(d) impaired waters (see below)
- Areas designated as Areas of Special Biological Significance by the SWRCB in the Water Quality Control Plan for the San Diego Region (a.k.a. the Basin Plan).
- State Water Quality Protected Areas
- Water bodies designated with the RARE Beneficial Use category by the SWRCB in the Basin Plan (RARE)
- Areas designated as preserves or their equivalent under the Natural Communities Conservation Planning Program (NCCP)
- Any other ESAs identified by the City.

The ESAs identified in the City are listed in Tables 1.1 and 1.2.

CWA Section 303(d) Water Quality Limited Segments of Receiving Waters

Under Section 303(d) of the CWA, states are required to develop lists of water quality limited segments of receiving waters (impaired waters). These impaired waters do not meet water quality standards or support designated water uses. The 2010 303(d) list of water quality limited segments potentially affected by activities in the City of Laguna Niguel is provided in Table 1.1.

Table 1.1
303(d) Listed Waterbodies Potentially Affected By Activities in the City of Laguna Niguel

Hydrologic Unit	ESA	303(d) Pollutant / Stressor
Aliso Creek	Aliso Creek	Indicator Bacteria, Phosphorous, Selenium, Total Nitrogen as N, Toxicity
Aliso Creek	Aliso Creek mouth (estuary)	Indicator Bacteria
Aliso Creek	Pacific Ocean Shoreline at Aliso Creek Mouth	Total Coliform[1], Fecal Coliform & Enterococcus
Aliso Creek	Pacific Ocean Shoreline at Aliso Beach - Middle	Total Coliform[1], Enterococcus
Aliso Creek	Sulphur Creek	Indicator Bacteria

Hydrologic Unit	ESA	303(d) Pollutant / Stressor
Dana Point	Pacific Ocean Shoreline at Salt Creek Outlet at Monarch Beach	Total Coliform[1]
San Juan Creek	Lower San Juan Creek (approx. 1 mile of stream beginning at shoreline)	DDE, Indicator Bacteria, Phosphorous, Selenium, Total Nitrogen as N, Toxicity
San Juan Creek	Oso Creek (lower 4 miles)	Selenium, Toxicity
San Juan Creek	Arroyo Trabuco Creek	Diazinon, Phosphorus, Total Nitrogen as N & Toxicity
San Juan Creek	San Juan Creek mouth (estuary)	Indicator Bacteria
San Juan Creek	Pacific Ocean Shoreline at North Beach Creek	Total Coliform[1], Fecal Coliform & Enterococcus
San Juan Creek	Pacific Ocean Shoreline at San Juan Creek	Total Coliform[1], Fecal Coliform & Enterococcus
San Juan Creek	Pacific Ocean Shoreline at North Doheny State Beach Campground	Total Coliform[1] & Enterococcus
San Juan Creek	Pacific Ocean Shoreline at South Doheny State Beach Campground	Enterococcus

[1] 303(d) listing is for shellfish harvesting Total Coliform objective and not for water contact recreation.

Other ESAs identified in the City are shown in Table 1.2 and are included in the map in Exhibit 1.II, along with the 303(d) listed impaired waters.

Table 1.2
Other Environmentally Sensitive Areas Potentially Affected By Activities in the City of Laguna Niguel

Name	Hydrologic Unit	Reason for listing as ESA
NCCP Coastal/buffer zone	Dana Point	NCCP area
NCCP Coastal/buffer zone	Aliso Creek	NCCP area
NCCP Coastal/buffer zone	San Juan Creek	NCCP area

1.6 PROGRAM ASSESSMENT AND MODIFICATION

The Program Effectiveness Assessment is the foundation for the Annual Progress Report that is submitted each year to the RWQCB. This report presents an evaluation of this LIP which is used to determine where modifications within the program may be necessary. It also ensures that an adaptive management process is applied to each of the program components and is used as an effective management tool (See Section 3.0).

EXHIBIT 1.I

LAND USE MAP

ZONING CODE DISTRICTS

- RS-1: RURAL RESIDENTIAL DISTRICT
- RS-2: RESIDENTIAL ESTATE DISTRICT
- RS-4: SINGLE-FAMILY DISTRICT 4
- RP: PLANNED RESIDENTIAL DISTRICT
- RA: ATTACHED RESIDENTIAL DISTRICT
- RM: MULTI-FAMILY DISTRICT
- SP: SPECIFIC PLAN
- CC: COMMUNITY COMMERCIAL DISTRICT
- BP: BUSINESS PARK DISTRICT
- PI: PUBLIC/INSTUTIONAL DISTRICT
- PR: PARK & RECREATION DISTICT
- OS: OPEN SPACE DISTRICT
- WATER
- PI/RA/PR/MC: PUBLIC/INSTITUTIONAL; RESIDENTIAL ATTACHED; PARKS AND RECREATION; MANAGED CARE OVERLAY DISTRICT
- MC: MANAGED CARE OVERLAY DISTRICT
- FP: FLOODPLAIN OVERLAY DISTRICT (See Separate Map)

Special Zoning Symbols

Zoning District ## --- Denotes Zoning District Over Maximum Building/Structure Height

Zoning District : # --- Denotes Zoning District Followed by Minimum Lot Size

GATEWAY SPECIFIC PLAN

- GATEWAY SPECIFIC PLAN BOUNDRY

GWSP

- RC *Retail Commercial*
- BP *Business Park*
- CS *Community Service (Auto, Office, Retail)*
- MU *Mixed Use*
- OS *Open Space*

CASE NO.	NAME	ORDINANCE NO.	DATE	OLD	NEW
ZC 15-01	Agora	Proposed		CC	CC/RM
ZC 12-02	Map Cleanup Multiple Parcels	2012-172	10/2/2012	Various	Various
ZC 02-02*	Sunset Clause Reversion	2002-122	12/31/2011	OS	RS-3 RM
ZC 11-01	Gateway Specific Plan	2011-166	12/6/2011		
ZC 07-01	CUSD at Paseo De Colinas	2007-145	4/3/2007	PI	PI/RA/PR
ZC 04-02	Bear Branch Ranch 16 Morning Dove	2005-138	2/1/2005	RD	OS
ZC 04-01	Cornerstone at San Joaquin Hills	2004-137	9/21/2004	RM	RP
ZC 02-02*	Niguel Summit/ Crown Cove	2002-122	10/15/2002	RS-3 RM	OS
ZC 01-01	Del Prado Annexation (Pre-Zone)	2001-118	2/20/2001	County Zoning	OS RP
ZC 99-01	Shapell B3 San Joaquin Hills	99-112	8/3/1999	RD	PR
ZC 98-01	Gateway Specific Plan	99-111	6/1/1999		
----	Zoning Code Adoption	99-107	2/2/1999		

Aliso Creek
Local Costal Program
(Aliso Creek Planning Unit)
Excluding the Aliso Viejo Segment

South Laguna
Specific Plan /
Local Coastal Program

ALISO VIEJO

MISSION VIEJO

SAN JUAN CAPISTRANO

LAGUNA BEACH

DANA POINT

Pacific Ocean

City of Laguna Niguel Official Zoning Code Map

1,000 0 1,000 Feet

January 17, 2017

EXHIBIT 1.II

ENVIRONMENTALLY SENSITIVE AREAS

Environmentally Sensitive Areas

303d Listed Water Body (200' Buffer)

Natural Community Conservation Planning Area (NCCP - 200' Buffer)

General Map Information

Watershed Boundaries

Oso Creek

Sulphur Creek

Aliso Creek

Arroyo Trabuco Creek

Pacific Ocean Shoreline at Salt Creek

Pacific Ocean Shoreline at Aliso Creek Mouth

Aliso Creek mouth (estuary)

Pacific Ocean Shoreline at Aliso Beach - Middle

Lower San Juan Creek

San Juan Creek mouth (estuary)

Pacific Ocean Shoreline at North Beach Creek

Pacific Ocean Shoreline at San Juan Creek

Pacific Ocean Shoreline N Doheny State Beach Camp

Pacific Ocean Shoreline S Doheny State Beach Camp

EXHIBIT 1.II

Environmentally Sensitive Areas

: 03/15/2017

D:\GISProjects\NPDES\NDSPermit MXDs\esa.mxd

2.0 PROGRAM MANAGEMENT

2.1 INTRODUCTION

Program management activities conducted by the City to implement the LIP involve the following activities:

- Coordination with the Principal Permittee and other Permittees on program development through the DAMP; common program implementation (such as monitoring, public education and watershed programs); fiscal resources for shared budgets under the Implementation Agreement; and overall program direction.
- Coordination with the Principal Permittee and other Permittees on program development through the WQIP.
- Coordination with internal City departments, City subcontractors and with local outside agencies to implement the LIP.
- Fiscal analysis in preparing, approving and tracking shared cost budgets prepared by the Principal Permittee and individual cost budgets prepared by the City (Provision E.8).
- Data management and compliance reporting based on common practices specified in the DAMP and WQIP.

2.2 COUNTYWIDE COORDINATION

Both the Public Works Department and the Community Development Department participate with the County of Orange, Orange County Flood Control District, and other Orange County cities in the countywide stormwater program. An Implementation Agreement among the 36 Copermittees in the County (including cities in the Santa Ana Regional Board jurisdiction in northern Orange County, as well as in the San Diego Region jurisdiction in southern Orange County) defines the roles, responsibilities, and cost sharing formulas governing the countywide program. The City executed the cooperative agreement originally in December 1990; it was subsequently revised in 2002. Under the Cooperative Agreement, the City participates in planning efforts and operates its program in a manner generally consistent with the countywide approach; while the County provides overall guidance as well as technical support with regional monitoring, inspection/enforcement protocols, and assistance with emergency services.

Management of the countywide program is performed by means of a committee structure with responsibilities and chairing assigned selectively to the Principal Permittee and the Permittees. These are as follows:

- City Manager's Water Quality Committee: provides budget and overall program review and governance direction; comprised of several City Managers and is attended by County staff.

- City Engineer's Technical Advisory Committee (TAC)/ Planning Advisory Committee (PAC): serves in a program advisory role to the Permittees and implements policy previously established by the permittees. The TAC is comprised of a City Engineer, or selected representative, from one city in each of the County Supervisorial Districts and a representative from the County of Orange. The PAC is comprised of Planning Directors, from one city in each of the County Supervisorial Districts and a representative from the County of Orange.

- General Permittee meetings: provide a regional forum to update and involve designated representatives from each Permittee on program development.

- WQIP Committee: provides a watershed management area forum to engage Permittees in WQIP development, implementation, assessment, and adaptive management.

- Sub-Committees/Task Forces/Advisory Groups:

    - Legal/Regulatory Authority Task Force
    - LIP/Performance Effectiveness Assessment Committee and related sub-committees
    - Public Education Sub-Committee
    - Trash and Debris Task Force
    - Authorized Inspectors Sub-Committee
    - Water Quality Ordinance Authorized Inspectors Sub-Committee

- Other Committees including Aliso Creek/ San Juan Creek Watershed TMDL Committee and South Orange County Watershed Management Area Group.

The City participates in these committees through the representatives shown in Table 2.1:

Table 2.1
City Participation in Countywide Program

Committee/Task Force	City Department/Division
City Manager Water Quality Committee	City Manager
TAC	Public Works
TAC/PAC	Public Works/Community Development
General Permittee Committee	Public Works
WQIP Committee	Public Works/Community Development
Legal/Regulatory Authority Task Force	Public Works/Community Development
LIP/PEA Sub-Committee	Public Works/Community Development
Public Education Sub-Committee	Public Works
Authorized Inspectors Sub-Committee	Community Development
Trash and Debris Task Force	Public Works

2.3 CITY INTERNAL COORDINATION/ IMPLEMENTATION

The responsibilities of the City departments for the internal coordination of LIP activities are shown in Table 2.2. A City organization chart is attached as Exhibit 2.I.**Table 2.2**
City of Laguna Niguel Internal Implementation of the LIP

Program Element	Department	Activity	Responsibility
Section 2 Program Management	Public Works	Serves as City LIP manager	Prepares annual compliance reports
			Reviews shared budgets and prepared internal City budgets
			Coordinates with Principal Permittee and other Permittees for development and implementation of countywide program
			Coordinates/ensures implementation of LIP by City departments; administers program
			Responds to phone, e-mail, and other input to the City on water quality issues and dispatches appropriate personnel; records responses
Section 3 Jurisdictional Work Plan	Public Works	Oversees development of new DAMP/WQIP programs	Follows up on problems with City compliance
Section 4 Legal Authority	City Attorney	Certification of adequate legal authority	Reviews legal authority/modifications of ordinances/ legal certification
Section 5 Municipal Activities	Public Works	Manages storm drain inventory/atlas	Updates or provides Geographic Information System (GIS) with updates to storm drain atlas
	Public Works	Operates and maintains storm drains and flood	Implements applicable model BMPs, reports actions taken to LIP Management

Program Element	Department	Activity	Responsibility
		control facilities	Reports to LIP Manager with changes in flood control maintenance program and facilities
	Public Works	Operates and maintains corporate/municipal yards	Implements applicable model BMPs, reports actions taken to LIP Management
			Reports to LIP Manager with changes in corporate/municipal yards
	Public Works	Maintains catch basin stenciling program	Implements stenciling program, reports actions taken to LIP Management
			Reports to LIP Manager with changes in stenciling program
	Orange County Fire Authority	Generates emergency and non-emergency fire fighting discharges	Implements applicable model BMPs, reports actions taken to LIP Management
		Operates and maintains fire stations	Implements applicable model BMPs, reports actions taken to LIP Management
			Reports to LIP Manager with changes in fire facilities operated
	Public Works	Operates parks, community centers, and recreational facilities	Implements applicable model BMPs, reports actions taken to LIP Management operated
			Reports to LIP Manager with changes in parks facilities
	Orange County Sheriff's Department	Operates and maintains police facilities	Implements applicable model BMPs, reports actions taken to LIP Management
			Updates LIP Manager with changes in police facilities operated
	Public Works	Operates and maintains parking lots	Implements applicable model BMPs, reports actions taken to LIP Management

Program Element	Department	Activity	Responsibility
	South Orange County Wastewater Authority	Operates wastewater facilities	Implements applicable model BMPs, reports actions taken to LIP Management
			Updates LIP Management with changes in wastewater facilities operated
	Moulton Niguel Water District	Operates water facilities	Implements applicable model BMPs, reports actions taken to LIP Management
			Updates LIP Management with changes in water facilities operated
	Public Works	Maintains city facilities	Implements applicable model BMPs, reports actions taken to LIP Management
			Updates LIP Management with changes to City-owned facilities
	Public Works	Manages and maintains city vehicle programs	Implements applicable model BMPs, reports actions taken to LIP Management
			Updates LIP Management with changes to city vehicle programs
	Public Works	Manages and implements street sweeping	Implements applicable model BMPs, reports actions taken to LIP Management
			Updates LIP Management with changes to street sweeping
	Public Works	Manages and implements IPM Policy	Implements IPM Policy, reports actions taken to LIP Management
			Updates LIP Management with changes to pesticide and fertilizer programs for conformance with IPM Policy
	Public Works	Manages and implements landscape maintenance programs	Implements applicable model BMPs, reports actions taken to LIP Management

Program Element	Department	Activity	Responsibility
		including lakes	Updates LIP Management with changes to landscape maintenance programs
	Public Works	Manages and implements waste recycling and litter control programs	Implements applicable model BMPs, reports actions taken to LIP Management
			Updates LIP Management with changes to waste recycling and litter control programs
Section 6 Public Education	Public Works	Manages education/outreach program	Attends public meetings
			Provides training and guidance materials to private developers, public, and City staff
			Disseminates information in the City
			Develops City versions of countywide education materials as appropriate
			Participates in one City event per year
	Public Works, Community Development Parks and Recreation	Distribution of public education materials	Provides information to public at City counters
Section 7 New Development/ Significant Redevelopment	Community Development	Manages General Plan	Reviews the General Plan for water quality protection
	Community Development	Manages environmental planning review	Implements use of CEQA checklist to review water quality issues on proposed projects
			Reviews development for water quality issues
	Community Development	Processes building/grading permits	Advises applicants of water quality requirements
			Verifies plan compliance with water quality requirements

Program Element	Department	Activity	Responsibility
			Coordinates with building and safety inspectors for project tracking and inspection of water quality requirements
	Public Works	Interacts with public	Provides information to permit applicants on water quality requirements
	Public Works	Manages public works projects	Verifies plan compliance with water quality requirements in public works projects
			Coordinates with public works inspectors for project tracking and inspection of water quality requirements in public works projects
Section 8 Construction	Community Development	Processes building/grading permits	Advises applicants of water quality requirements
			Verifies plan and NOI compliance with water quality requirements, reports actions taken to LIP Management
	Community Development	Manages oversight of construction inspection inventory, prioritization and inspection program	Inventories, prioritizes and maps construction sites
			Implement inspections, requires corrective actions to be taken, reports actions taken to LIP Management
	Public Works	Manages Public works projects and Capital Improvement Project (CIP) projects	Verifies plan compliance with water quality requirements in public works projects and CIPs
			Coordinates with public works inspectors for project tracking and inspection of water quality requirements in public works projects and CIPs, reports actions taken to LIP Management

Program Element	Department	Activity	Responsibility
Section 9 Existing Development	Community Development	Manages oversight of the commercial, industrial, residential inspection program	Inventories, prioritizes and maps facilities
			Implement inspections, require corrective actions to be taken, report actions taken to LIP management
			Provides commercial and industrial information for the inventory to LIP Manager
	Community Development	Interacts with businesses and the public	Provides information to industrial and commercial businesses and the public
Section 10 ID/IC	Public Works	Operates Parks field activities	Reports dumped materials and/or undocumented connections
	Public Works, Community Development	Manages education/outreach program	Distributes public education materials to encourage the reporting of problems
	Public Works, Community Development	Implements construction site inspections	Reports violations of and/or enforce the water quality ordinance
	Community Development	Implements the existing development inspections	Report violations of and/or enforces the water quality ordinance
	Community Development	Processes notifications/response requests for water pollution problems	Detects and eliminates illegal discharges and illicit connections
	Community Development	Responds to water pollution complaints, assesses site, makes notifications, oversees clean-up operations and enforces water quality ordinance	Responds to water pollution complaints in a timely manner and enforce all applicable ordinances
	Public Works	Manage water quality data received from countywide program	Initiates source investigations through ID/IC program for problems identified through the water quality monitoring program

Program Element	Department	Activity	Responsibility
	City Attorney	Assists with the enforcement of violations of applicable ordinances	Enforces against violators of stormwater related ordinances

As shown in Table 2.2, implementation of the LIP related programs and WQIP strategies is overseen by the Public Works Department, which coordinates the development, implementation and administration of the stormwater program for the City overall. In addition to managing internal implementation, the Public Works Department also participates with the County of Orange, Orange County Flood Control District, and other Orange County cities in the Program. The Community Development Department takes the lead for those functions relating to Development Planning, Construction, and Existing Development and the City Attorney and City Administrative Departments provide policy, legal and fiscal direction. Training and oversight for compliance with the Fifth Term Permit is managed by the Environmental Programs Manager in Public Works.

All City municipal construction, physical maintenance functions and certain inspection functions are contracted out to private contractors that report to contractor administrators in Public Works or Community Development, as applicable. Public landscape and building maintenance is provided by several separate contractors for parks, streetscapes, habitat areas, and municipal and school facilities. Other recycling services are provided by small contractors in partnership with local businesses. Certain other services are also provided by outside local agencies, as noted in Section 2.4.

2.4 EXTERNAL PARTNERSHIPS

The City's Environmental Programs Manager in Public Works is the point of contact for all correspondence/interaction with outside local, regional and State agencies regarding the implementation of the program. Key local agencies include:

- California Department of Transportation: Provides operations and maintenance services of State Road 73.
- Moulton Niguel Water District: Provides water and sewer distribution system operation, inspection, maintenance, water conservation administration and enforcement services and primary emergency response
- Orange County Sherriff department: Provide law enforcement services to the City
- Orange County Fire Authority: Provide fire protection and related activities services to the City, including Hazardous Material related matters

- Orange County Health Care agency: Provides the City with food facilities inspections, in addition to their regular operations/services provided to all cities. The agency also provides management of the City's Used Oil Program and is the CUPA for the City and inspects all hazardous waste generators.

- Orange County Flood Control District provides maintenance for the flood control channels within the City that are within their right of way.

- South Orange County Wastewater Authority (SOCWA): SOCWA is a part of the Joint Powers Authority that operates the Coastal Treatment Plant located in the lower Aliso and Woods Canyon Regional Park and the Regional Treatment Plan located on La Paz Road between Crown Valley Park and Rancho Niguel Road.

2.5 FISCAL ANALYSIS

The stormwater program funding needs are principally driven by:

- The Fifth Term Permit, including the baseline requirements of Provision E and the WQIP requirements of Provision B

- The Bacteria TMDL which is incorporated in to the Fifth Term Permit and which is addressed in the WQIP

The activities necessary to comply with these requirements are described in this LIP. Examples include, but are not limited to, street sweeping, storm drain cleaning, development processing and inspections of facilities used for commerce and business. The City uses Exhibit 2.II to report on costs (capital, operations and maintenance) and funding sources for these activities.

Since the adoption of the First Term NPDES Permit, the City has provided funding for the countywide shared-cost budget and has appropriated funds annually for internal compliance activities. The City uses the countywide standardized reporting format shown in Exhibit 2.II, to report to the RWQCB on capital, operations and maintenance expenditures and funding sources.

As part of the normal annual budgeting process, each department manager is required to submit a draft budget to the City Manager to be included in a comprehensive City-wide budget for City Council review and approval. The City's Environmental Programs Manager collects data from the various relevant departments to be incorporated into the City's urban runoff program budget, and compiles expenditure data for the annual progress report, with assistance from the Finance Department.

Because the City does not operate or generate revenue from water, sewer, sanitation or power supply utilities, the City uses mostly General Funds to pay for its urban runoff programs, occasionally supplemented by grants for capital improvements. In order to assess stormwater fees or create a stormwater utility, a Proposition 218 process would be required. This process historically has not been considered politically viable locally.

Additional funding sources for compliance with the permit may include:

- Solid waste franchise fees.
- Recycling fees.
- Volunteers and private sponsorships.
- Developer fees.

2.6 DATA MANAGEMENT AND PERMIT REPORTING REQUIREMENTS

The City maintains hardcopy documentation and/or electronic records, spreadsheets, and databases as needed for program implementation, and for the generation of the individual JRMP Annual Report, which is submitted to the RWQCB as a summary of the City's program implementation activities during the past annual reporting/fiscal year period. The City also submits its individual JRMP Annual Report to the Principal Copermittee for County-wide compilation into a Unified Program Effectiveness Assessment report. The City retains its backup and reporting records for at least five years.

The annual reporting process includes the following activities:

(1) Permittees: The City completes a JRMP Annual Report Forms (**Exhibit 2.III**) covering implementation of its jurisdictional activities during the annual reporting period. Each Annual Report verifies and documents compliance with the Fifth Term Permit. The reporting period for these annual reports must be the previous fiscal year. For example, the report submitted September 30, 2017 must cover the reporting period July 1, 2016 to June 30, 2017.

(2) Principal Permittee: The Principal Permittee is responsible for preparing the WQIP Annual Report which is due annually on January 31st. This report will include:

1. The receiving water and MS4 outfall discharge monitoring;

2. The progress of the special studies and the findings, interpretations and conclusions of a special study, or each phase of a special study, upon its completion;

3. The findings, interpretations and conclusions from the assessments required pursuant to Provision D.4;

4. The progress of implementing the WQIP, including, but not limited to, the following:

    - The progress toward achieving the interim and final numeric goals for the highest water quality priorities for the Watershed Management Area;

    - The water quality improvement strategies that were implemented and/or no longer implemented by each of the Permittees during the reporting period and previous reporting periods;

    - The water quality improvement strategies planned for implementation during the next reporting period;

- Proposed modifications to the water quality improvement strategies, the public comments received and the supporting rationale for the proposed modifications;

- Previous modifications or updates incorporated into the WQIP and/or each Permittee's LIP/JRMP document and implemented by the Permittees in the Watershed Management Area; and

- Proposed modifications or updates to the WQIP and/or each Permittee's jurisdictional runoff management program document;

2.7 NPDES PERMIT RESPONSIBILITIES

The responsibilities of the County of Orange as the Principal Permittee and Permittees as a whole are defined within the Implementation Agreement, the Fifth Term Permit, or as otherwise identified within separate fundin2-13g agreements.

The County of Orange as Principal Permittee is responsible for:

1. Serving as liaison between the Copermittees in the Watershed Management Area and the San Diego Water Board on general permit issues, and when necessary and appropriate, representing the Permittees in the Watershed Management Area before the RWQCB;

2. Facilitating the development of the WQIP in accordance with the requirements of Provision B of the Fifth Term Permit;

3. Coordinating the submittal of the deliverables required by Provisions F.1, F.2, F.3.a, and F.3.b of the Fifth Term Permit; and

4. Coordinating and developing, with the other Principal Watershed Permittees, the requirements of Provisions F.3.c, F.4, and F.5.b of the Fifth Term Permit.

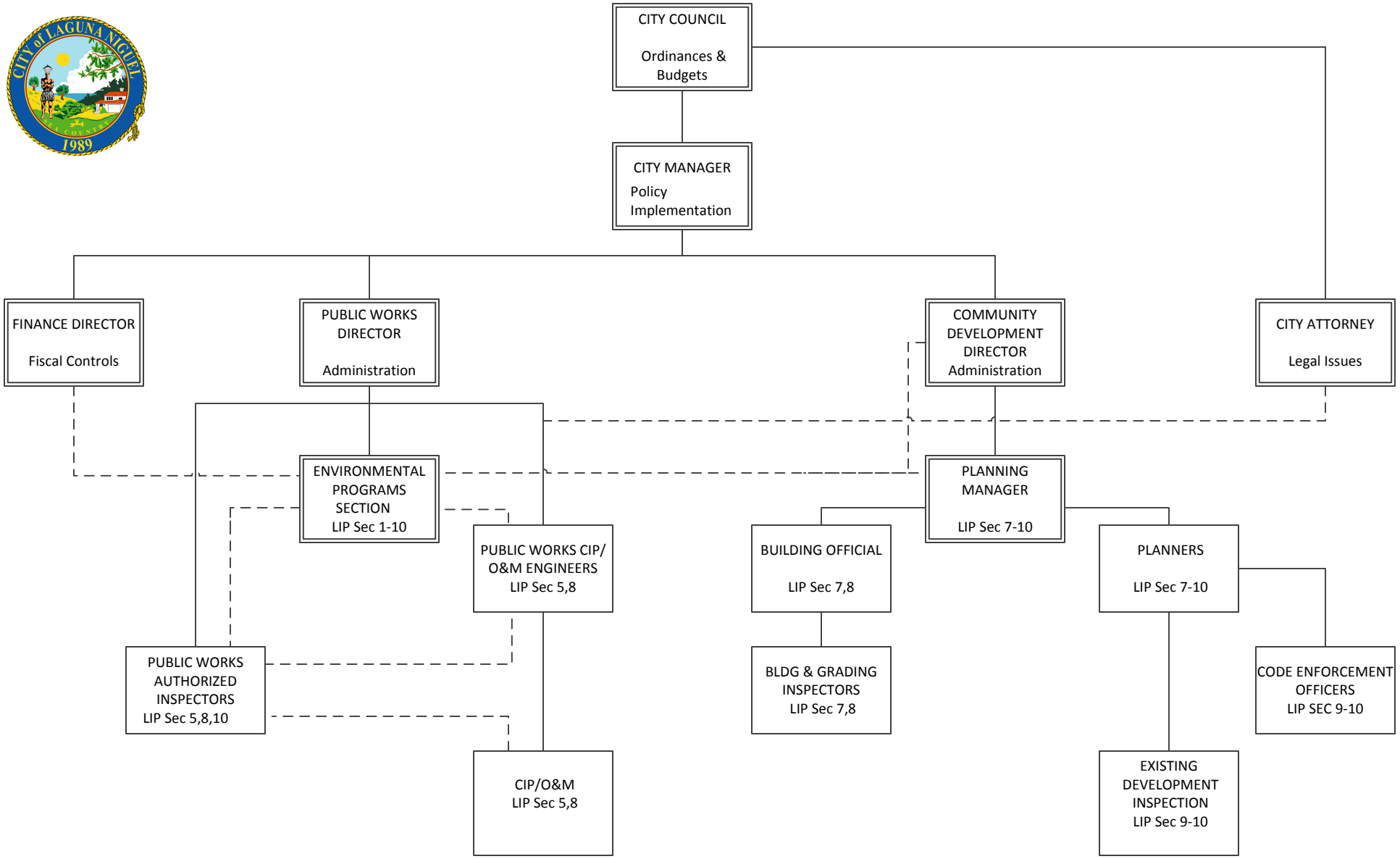
The Principal Permittee is not responsible for ensuring that the other Permittees within the Watershed Management Area are in compliance with the requirements of the Fifth Term Permit.

2.8 PROGRAM REPRESENTATION

The Principal Permittee represents the Permittees on the California Stormwater Quality Association (CASQA), the Stormwater Monitoring Coalition, Southern California Coastal Water Research Project (SCCWRP), and other stormwater forums.

EXHIBIT 2.I

RUNOFF MANAGEMENT PROGRAM ORGANIZATIONAL CHART



CITY OF LAGUNA NIGUEL
STORMWATER COMPLIANCE AND LIP IMPLEMENTATION
ORGANIZATION CHART
4/1/2017

EXHIBIT 2.II

FISCAL REPORTING TEMPLATE

Exhibit 2.II
Fiscal Analysis Template

Capital Costs

LIP Program Elements	Preceding Period Costs	Current Reporting Period Costs	Projected Costs - Draft
Public Project BMPs			
Construction BMPs for Public Construction Projects		*	
Other Capital Projects/Major Equipment Purchases	0	0	
Totals	**0**	**0**	**0**

Operation & Maintenance Costs

LIP Program Elements	Preceding Period Costs	Current Reporting Period Costs	Projected Costs - Draft
Supportive of Program Administration (LIP Section 2.0)			
Municipal Activities Trash and Debris Controls (LIP Section 5.0)			
Municipal Activities (LIP Section 5.0) Drainage Facility Maintenance			
Municipal Activities (LIP Section 5.0) Street Sweeping			
Municipal Activities (LIP Section 5.0) Environmental Performance (BMP Implementation)			
Municipal Activities (LIP Section 5.0) Pesticide & Fertilizer Management			
Public Information (LIP Section 6.0) Nonpoint Source Pollution Awareness			
Public Information (LIP Section 6.0) Household Hazardous Waste Collection			
Requiring New Development BMPs(Supportive of Planning, etc) (LIP Section 7.0)			
Requiring Construction BMPs(Supportive of Plan Check & Inspection) (LIP Section 8.0)			
Existing Development (LIP Section 9.0) Industrial/Comm./HOA Inspections			
Illicit Connections/Discharge Ident. & Elimination Facility Inspection			
Agency Contribution to Regional Programs			
Totals			**0**

Funding Sources

FUNDING SOURCES	Preceding Period FY2008-09 Costs	Current Reporting Period FY 2009-10 Costs	Projected FY 2010-11 Costs - Draft
General Fund			
Other: grants			
Other:			
Other:			
Other:			
TOTALS	**100%**	**100%**	

YES NO

Are there any legal resitrictions on the use of any of the above funds?
If yes, plese explain:

Was there a 25% or greater annual change for any of the budget line items?
If yes, plese explain:

EXHIBIT 2.III

JRMP ANNUAL REPORT FORMS

EXHIBIT 2.III
JURISDICTIONAL RUNOFF MANAGEMENT PROGRAM
ANNUAL REPORT FORM

I. COPERMITTEE INFORMATION			
Copermittee Name:			
Copermittee Primary Contact Name:			
Copermittee Primary Contact Information: Address:			
City:	County: Orange	State: CA	Zip:
Telephone:	Fax:	Email:	

II. LEGAL AUTHORITY	
Has the Copermittee established adequate legal authority within its jurisdiction to control pollutant discharges into and from its MS4 that complies with Order No. R9-2013-0001, as amended by Order Nos. R9-2015-0001 and R9-2015-0100?	YES ☐ NO ☐
A Principal Executive Officer, Ranking Elected Official, or Duly Authorized Representative has certified that the Copermittee obtained and maintains adequate legal authority?	YES ☐ NO ☐

III. JURISDICTIONAL RUNOFF MANAGEMENT PROGRAM DOCUMENT UPDATES	
Was an update of the jurisdictional runoff management program document required or recommended by the San Diego Regional Water Board?	YES ☐ NO ☐
If YES to the question above, did the Copermittee update its jurisdictional runoff management program document and make it available on the Regional Clearinghouse?	YES ☐ NO ☐

IV. ILLICIT DISCHARGE DETECTION AND ELIMNATION PROGRAM	
Has the Copermitee implemented a program to actively detect and eliminate illicit discharges and connections to its MS4 that complies with Order No. R9-2013-0001, as amended by Order Nos. R9-2015-0001 and R9-2015-0100	YES ☐ NO ☐
Number of non-storm water discharges reported by the public	
Number of non-storm water discharges detected by Copermittee staff or contractors	
Number of non-storm water discharges investigated by the Copermittee	
Number of sources of non-storm water discharges identified	
Number of non-storm water discharges eliminated	
Number of sources of illicit discharges or connections identified	
Number of illicit discharges or connections eliminated	
Number of enforcement actions issued	
Number of escalated enforcement actions issued	

V. DEVELOPMENT PLANNING PROGRAM	
Has the Copermittee implemented a development planning program that complies with Order No. R9-2013-0001, as amended by Order Nos. R9-2015-0001 and R9-2015-0100?	YES ☐ NO ☐
Was an update to the BMP Design Manual required or recommended by the San Diego Water Board?	YES ☐ NO ☐
If YES to the quest above, did the Copermittee update its BMP Design Manual and make it available on the Regional Clearinghouse?	YES ☐ NO ☐
Number of proposed development projects in review	
Number of Priority Development Projects in review	
Number of Priority Development Projects approved	
Number of approved Priority Development Projects exempt from any BMP requirements	
Number of approved Priority Development Projects allowed alternative compliance	
Number of Priority Development Projects granted occupancy	
Number of completed Priority Development projects in inventory	
Number of high priority Priority Development Project structural BMP inspections	
Number of Priority Development Project structural BMP violations	
Number of enforcement actions issued	
Number of escalated enforcement actions issued	

EXHIBIT 2.III
JURISDICTIONAL RUNOFF MANAGEMENT PROGRAM
ANNUAL REPORT FORM

VI. CONSTRUCTION	
Has the Copermittee implemented a construction management program that complies with Order No. R9-2013-0001, as amended by Order Nos. R9-2015-0001 and R9-2015-0100?	YES ☐ NO ☐
Number of construction sites in inventory	
Number of active construction sites in inventory	
Number of inactive construction sites in inventory	
Number of construction sites closed/completed during reporting period	
Number of construction site inspections	
Number of construction site violations	
Number of enforcement actions issued	
Number of escalated enforcement actions issued	

VII. EXISTING DEVELOPMENT MANAGEMENT PROGRAM	
Has the Copermittee implemented an existing development management program that complies with Order No. R9-2013-0001, as amended by Order Nos. R9-2015-0001 and R9-2015-0100?	YES ☐ NO ☐

	Municipal	Commercial	Industrial	Residential
Number of facilities or areas in inventory				
Number of existing development inspections				
Number of follow-up inspections				
Number of violations				
Number of enforcement actions issued				
Number of escalated enforcement actions issued				

VIII. PUBLIC EDUCATION AND PARTICIPATION	
Has the Copermitee implemented a public education program component that complies with Order No. R9-2013-0001, as amended by Order Nos. R9-2015-0001 and R9-2015-0100?	YES ☐ NO ☐
Has the Copermitee implemented a public participation program component that complies with Order No. R9-2013-0001, as amended by Order Nos. R9-2015-0001 and R9-2015-0100?	YES ☐ NO ☐

IX. FISCAL ANALYSIS	
Has the Copermittee attached to this form a summary of its fiscal analysis that complies with Order No. R9-2013-0001, as amended by Order Nos. R9-2015-0001 and R9-2015-0100?	YES ☐ NO ☐

X. CERTIFICATION

I [☐ Principal Executive Officer ☐ Ranking Elected Official ☐ Duly Authorized Representative] certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Signature _____ Date _____

Print Name _____ Title _____

Telephone Number _____ Email _____

3.0 JURISDICTIONAL WORK PLAN

3.1 INTRODUCTION

The section describes the approach taken by the City in developing and updating the Local Implementation Plan (LIP) to maintain a responsive program in compliance with the Fifth Term Permit. Program updates are informed by an adaptive management process focused on addressing high priority water quality issues by revising, adding or deleting BMPs and activities in response to performance assessment and research. This feedback loop forms the framework for revision and improvement of the Program and its documentation.

3.2 DAMP, LIP, AND WATERSHED WORK PLANS

The Principal Permittee, in conjunction with the City and the other Co-permittees, have developed a comprehensive framework for storm water management, described in the Drainage Area Management Plan (DAMP) and Water Quality Improvement Plan (WQIP), which are updated as appropriate in conjunction with the Report of Waste Discharge and each new Municipal Permit's findings and requirements. There is now a programmatic County-wide approach for urban stormwater management on two levels:

- Implementing a baseline set of source control BMPs and activities that are considered proven and cost-effective, and are recommended for inclusion or reference in the Co-permittees' LIPs at *the local jurisdictional MS4 level*. The LIP primarily addresses non-structural and pollution prevention controls applicable to on-site or in the MS4, as well as localized structural BMPs, as required by Provision E of the Fifth Term Permit and as further determined appropriate by the City.

- A framework for collective action at the *multi-jurisdictional/regional watershed level*, focusing on solving the highest priority water quality issues and conditions, and documenting issues and progress through the WQIP compiled by the Principal/Lead Permittee with input by the Copermittees.

3.3 FRAMEWORK FOR PROGRAM ASSESSMENT

BMP effectiveness assessment is characterized based upon the framework defined in the 2015 California Stormwater Quality Association (CASQA) guidance document, *A Strategic Approach to Planning For and Assessing the Effectiveness of Stormwater Programs*. The approach presents a hierarchy of potential outcomes at six levels:

- Outcome Level 6: Receiving Water Conditions
- Outcome Level 5: MS4 Contributions
- Outcome Level 4: Source Conditions
- Outcome Level 3: Target Audience Actions
- Outcome Level 2: Barriers & Bridges to Action
- Outcome Level 1: Stormwater Program Activities

Sections 5 through 10 of the LIP establish the City's baseline BMPs to reduce, eliminate or mitigate pollutant impacts. These measures may be adapted or modified over the Permit term to improve their usefulness and assessment findings are reported annually. Any modifications to the program or to programmatic assessment methods are also reported annually, with corresponding revisions made to the LIP as appropriate.

3.4 FRAMEWORK FOR BMP SELECTION AND EFFECTIVENESS ASSESSMENT

The WQIP provides the framework for collective action at the multi-jurisdictional watershed level, focusing on solving the highest priority water quality issues and conditions. In order to assure that resources for pollution prevention and removal BMPs are strategically expended, the City typically evaluates any potential new structural or preventative BMP technologies or practices on a limited scale, or consults evaluations conducted by others, before considering broader-scale implementation. Implementation is pursued in a prioritized manner on a schedule consistent with available resources. After pilot and/or broader implementation, local effectiveness is assessed to determine if further adjustments or modifications are needed to the BMP implementation or program priorities. These iterative efforts are discussed and reported in the Annual Jurisdictional Work Plan progress updates submitted with the WQIP Annual Report.

The BMP selection and effectiveness assessment process may include, but is not limited to, input from the following factors and information sources, as available and applicable:

- A review of technical literature (such as the ASCE/EPA databases)
- A review of existing control programs
- Demonstration or research projects by City or other entities
- Input from vendors, consulting firms, other municipalities, or other agencies
- Water quality and flow data and modeling,
- User and operational/maintenance staff feedback
- Opinion surveys
- Beneficial Use assessment
- Cost and cost/benefit
- Technical feasibility
- Acceptability by the community
- Ease or difficulty of implementation
- Maintenance requirements
- Pollutant prevention/removal performance
- Multiple resource benefits or impacts

3.5 WATER QUALITY MONITORING

3.5.1 WQIP Monitoring and Assessment Program

Through the annual cost-share agreement described in Section 2, the City participates financially to support the implementation of the following WQIP monitoring and assessment programs:

- *The High Priority Water Quality Condition Monitoring Program* monitors the effectiveness of strategies, and progress towards goals and schedules associated with the WQIP identified highest priority water quality conditions (HPWQCs);

- The *Receiving Water Monitoring Program* is intended to measure the long-term health of the watersheds;

- The *MS4 Outfall Monitoring Program* monitors the discharges from the MS4 outfalls in order to assess the effectiveness of Copermittee LIPs at prohibiting non-storm water discharges into the MS4 and reducing pollutants in storm water discharges.

- *TMDL Monitoring Program* monitors progress toward achieving compliance with interim and final numeric targets specified in the Twenty Beaches and Creeks Bacteria Total Maximum Daily Loads (TMDLs).

- *Special Studies* address pollutant and/or stressor data gaps and/or develop information necessary to more effectively address the pollutants and/or stressors that cause or contribute to the HPWQCs.

The data collected as part of the WQIP monitoring programs and special studies is then evaluated annually by the Copermittees in conjunction with information collected during the implementation of the LIP programs in order to assess the progress of water quality improvement strategies. A detailed description of the WQIP Monitoring and Assessment Program can be found in Section 4 of the WQIP which can be found on the City's website at http://www.cityoflagunaniguel.org/index.aspx?nid=27.

3.6 WATER QUALITY IMPROVEMENT STRATEGIES

3.6.1 DAMP/LIP Strategies

Sections 5 through 10 of the LIP identify the City's baseline BMPs modeled after the countywide DAMP and are focused on reducing pollutant discharges from the MS4 to the maximum extent practicable (MEP). Exhibit 3.I further identifies the WQIP HPWQCs (pathogen health risk, channel erosion/geomorphic impacts, and unnatural water balance/flow regime) and target pollutants that are addressed through these strategies.

3.6.2 WQIP Strategies

Beyond the City's baseline DAMP/LIP Strategies, WQIP strategies include non-structural programs and special studies and structural BMPs focused on the WQIP identified HPWQCs. These efforts can be divided into multi-jurisdictional regional WQIP strategies implemented through the Principal Permittee (see Exhibit 3.I and Section 3 of WQIP) and jurisdictional WQIP strategies implemented by the City through the LIP. City jurisdictional WQIP strategies include:

Jurisdictional Non-Structural WQIP Strategies

- Recreational Vehicle Waste Disposal Education Program - Recreational vehicles are a unique source of pollutants because they are mobile sources that are largely unregulated. To address discharges from recreational vehicles the City implements an illicit discharge detection and elimination program that includes public outreach, a water pollution hotline, staff training, and clean-up of illegal discharges. The Principal Permittee is also planning to develop a BMP factsheet on proper recreational vehicle waste disposal which will be distributed by the City. The program's goal is to address the HPWQC of pathogen health risk.

- Permitted Discharge and Water Impoundment Inventory - The City will utilize available information and requests specific information from the RWQCB to prepare an inventory of permitted dischargers and water impoundments within the City. The purpose of this inventory is to characterize the potential contribution of these sources to flows at MS4 outfalls as part of addressing the HPWQC of unnatural water balance/flow regime.

- Unauthorized Encampment Waste Management Program - In areas where unauthorized encampments are determined to present a significant pollutant source, the City will seek to implement measures to mitigate their negative impact on water quality. Possible measures may include establishing new ordinances to reduce encampments, enhancing programs to reduce the number of people in encampments, and enforcing new and existing laws. Other options may include leveraging and partnering with existing social programs to address unauthorized encampments and with environmental volunteer programs to address a common concern. The program's goal is to address the HPWQC of pathogen health risk.

Jurisdictional Structural WQIP Strategies

- Wetlands/Channel Restoration - Wetland treatment systems have shown proven reductions in bacteria, metals and other pollutants and channel restoration enhances a stream's natural capacity to absorb pollutant loads. Wetland and channel restoration projects target the HPWQCs of pathogen health risk and unnatural water balance/flow regime. City wetland and channel restoration projects include (see Exhibit 3.I for project descriptions):
  - Wetlands Capture and Treatment @ J03P02
  - Upper Sulphur Creek Restoration
  - Middle Sulphur Creek Restoration

- o J03P01 Stream Channel Restoration
- o Narco Channel Restoration
- o Crown Valley Park Master Plan Implementation – J03P01 Channel Entry Improvements Project

- J Landscape Retrofits – Examples include weather-based irrigation controllers (aka SmarTimers), edgescaping where existing irrigated lawn area along the edge of a sidewalk, street curb, driveway, etc. is replaced with lower impact landscaping and permeable ground covering, and other irrigation improvements to improve water efficiency and reduce runoff. Landscape retrofits target the HPWQCs of pathogen health risk, channel erosion/geomorphic impacts and unnatural water balance/flow regime. City landscape retrofit projects include (see Exhibit 3.I for project descriptions):
  - o Sulphur Solution "GreenBack" Water Conservation and Pollution Prevention Project
  - o SmarTimer Edgescape Evaluation Project (SEEP) – Laguna Niguel Sites
  - o Crown Valley Parkway Median Retrofit
  - o Crown Valley Parkway Landscaped Median Retrofits, Phase V
  - o Water District "Smart Landscape" Rebate Programs

- J Catch Basin Retrofits – Examples of catch basin retrofits include debris gates and in line baskets and filters. Debris gates are designed to keep trash out of storm drains and within reach of street sweepers. In line baskets capture and retain trash pollutants for later removal while catch basin filters screen out finer pollutants such as metals, silt/sediment, and hydrocarbons. Catch basin retrofits target the HPWQCs of pathogen health risk. City catch basin retrofit projects include (see Exhibit 3.I for project descriptions):
  - o Sulphur Solution "Control" Subproject
  - o Catch Basin Debris Gates (M2 Tier 1 Project)

3.7 REPORTING

Annual progress updates to the Jurisdictional Work Plan are submitted with the WQIP Annual Report to summarize BMP and programmatic adaptations and anticipated schedules, in compliance with the Fifth Term Permit. Program assessment and iterative BMP findings, as well as any modifications to the program or to programmatic assessment methods, are reported, along with any corresponding revisions made to the LIP, as appropriate.

EXHIBIT 3.I

SUMMARY OF WATER QUALITY IMPROVEMENT STRATEGIES CITY OF LAGUNA NIGUEL

Exhibit 3.I
Summary of Jurisdictional and Watershed Strategies – City of Laguna Niguel

Strategy		High Priority Water Quality Conditions (HPWQC) Targeted	Target Pollutants	Geographic Extent of Implementation	Location in LIP or WQIP
DAMP/LIP Strategies					
Municipal Activities	Trash and Debris Control	•Pathogen Health Risk •Unnatural Water Balance/Flow Regime	WQIP Priority Pollutants •Bacteria/Pathogens •Non-stormwater discharges •Nutrients •Trash •Pesticides •Turbidity •Toxicity Other Pollutants •Metals •Oil & Grease •Sediment	Citywide	LIP Section 5
	Drainage Facility Maintenance – MS4 Inspections/Cleaning				
	Street Sweeping				
	Structural BMP Maintenance at Municipal Projects				
	Pesticide & Fertilizer Management				
	Municipal Staff Training and Education				
Training and Public Education	Nonpoint Source Pollution Awareness	•Pathogen Health Risk •Unnatural Water Balance/Flow Regime •Channel Erosion/ Geomorphic Impacts	WQIP Priority Pollutants •Bacteria/Pathogens •Non-stormwater discharges •Nutrients •Trash •Pesticides •Turbidity •Toxicity Other Pollutants •Metals •Oil & Grease •Sediment	Citywide	LIP Section 6
	Household Hazardous Waste Collection				
	Absorbent Landscaping/Impervious Area Dispersion Incentive Program				

Strategy		High Priority Water Quality Conditions (HPWQC) Targeted	Target Pollutants	Geographic Extent of Implementation	Location in LIP or WQIP
Development Planning	Water Quality Management Plan Review & Post Construction BMP Inspection	•Pathogen Health Risk •Unnatural Water Balance/Flow Regime •Channel Erosion/ Geomorphic Impacts	<u>WQIP Priority Pollutants</u> •Bacteria/Pathogens •Non-stormwater discharges •Nutrients •Trash •Pesticides •Turbidity •Toxicity <u>Other Pollutants</u> •Metals •Oil & Grease •Sediment	Citywide	LIP Section 7
Construction	Construction BMPs – Plan Check & Inspection	•Pathogen Health Risk Unnatural Water Balance/Flow Regime •Channel Erosion/ Geomorphic Impacts	<u>WQIP Priority Pollutants</u> •Bacteria/Pathogens •Non-stormwater discharges •Nutrients •Trash •Turbidity <u>Other Pollutants</u> •Metals •Oil & Grease •Sediment	Citywide	LIP Section 8

Strategy		High Priority Water Quality Conditions (HPWQC) Targeted	Target Pollutants	Geographic Extent of Implementation	Location in LIP or WQIP
Existing Development	Industrial Facility Inspections	•Unnatural Water Balance/Flow Regime	<u>WQIP Priority Pollutants</u> •Non-stormwater discharges •Nutrients •Trash •Toxicity <u>Other Pollutants</u> •Metals •Oil & Grease	Not Applicable (There are currently no industrial facilities within the City)	LIP Section 9
	Commercial/Food Facility Inspections	•Pathogen Health Risk •Unnatural Water Balance/Flow Regime	<u>WQIP Priority Pollutants</u> •Bacteria/Pathogens •Non-stormwater discharges •Nutrients •Trash •Pesticides •Toxicity <u>Other Pollutants</u> •Metals •Oil & Grease	Commercial/ Food Facilities within the City	LIP Section 9
	Mobile Business Program	•Unnatural Water Balance/Flow Regime	<u>WQIP Priority Pollutants</u> •Non-stormwater discharges •Nutrients •Toxicity <u>Other Pollutants</u> •Metals •Oil & Grease	Citywide	LIP Section 9

Strategy		High Priority Water Quality Conditions (HPWQC) Targeted	Target Pollutants	Geographic Extent of Implementation	Location in LIP or WQIP
	Residential/HOA Inspections	•Pathogen Health Risk •Unnatural Water Balance/Flow Regime	<u>WQIP Priority Pollutants</u> •Bacteria/Pathogens •Non-stormwater discharges •Nutrients •Trash •Pesticides •Turbidity •Toxicity <u>Other Pollutants</u> •Metals •Oil & Grease •Sediment	City Residential Management Areas	LIP Section 9
Illegal Discharges/ Illicit Connections	Illicit Connection Inspections Illegal Discharge Investigations, Spill Response	•Pathogen Health Risk •Unnatural Water Balance/Flow Regime	<u>WQIP Priority Pollutants</u> •Bacteria/Pathogens •Non-stormwater discharges •Nutrients •Trash •Pesticides •Turbidity •Toxicity <u>Other Pollutants</u> •Metals •Oil & Grease •Sediment	Citywide	LIP Section 10
WQIP Strategies					

Strategy		High Priority Water Quality Conditions (HPWQC) Targeted	Target Pollutants	Geographic Extent of Implementation	Location in LIP or WQIP
Multi-Jurisdictional /Regional WQIP Strategies	Control Activities for Pathogen Health Risk •Comprehensive Human Waste Source Reduction Program	•Pathogen Health Risk	WQIP Priority Pollutants •Bacteria/Pathogens •Non-stormwater discharges •Nutrients	South Orange County Watershed Management Area	WQIP Chapter B.3
	Control Activities for Unnatural Water Balance •Expanded transitional monitoring observations •Detailed flow monitoring at priority outfalls •High-resolution imagery analysis •Flow regime characterization •Outfall prioritization •Outfall capture feasibility studies •Incentives for low water use landscaping and/or irrigation source controls	•Unnatural Water Balance/Flow Regime	WQIP Priority Pollutants •Bacteria/Pathogens •Non-stormwater discharges •Nutrients •Trash •Pesticides •Turbidity •Toxicity Other Pollutants •Metals •Oil & Grease •Sediment	South Orange County Watershed Management Area	WQIP Chapter B.3

Strategy		High Priority Water Quality Conditions (HPWQC) Targeted	Target Pollutants	Geographic Extent of Implementation	Location in LIP or WQIP
	Control Activities for Channel Erosion •Restoration Alternatives and Feasibility Studies •Finalize Conceptual Geomorphically-Referenced Basis of Design (GRBoD) Guidelines •Programmatic Permitting Framework for Geomorphically-Referenced Basis of Design Projects •LiDAR Data Acquisition and Analysis •Coordination with upland controls proposed for Pathogen Health Risk and Water Balance HPWQCs •Aliso Creek Mainstem Ecosystem Restoration Project •Watershed Management Area Analysis Coarse Sediment Supply Analysis	•Channel Erosion/ Geomorphic Impacts	WQIP Priority Pollutants •Bacteria/Pathogens •Nutrients •Turbidity •Toxicity Other Pollutants •Sediment	South Orange County Watershed Management Area	WQIP Chapter B.3
Jurisdictional Non-structural WQIP Strategies	Recreational Vehicle Waste Disposal Education Program	•Pathogen Health Risk	WQIP Priority Pollutants •Bacteria/Pathogens	Citywide	LIP Section 3
	Permitted Discharge and Water Impoundment Inventory	•Unnatural Water Balance/Flow Regime	WQIP Priority Pollutants •Non-stormwater discharges	Citywide	LIP Section 3

Strategy		High Priority Water Quality Conditions (HPWQC) Targeted	Target Pollutants	Geographic Extent of Implementation	Location in LIP or WQIP
	Unauthorized Encampment Program	• Pathogen Health Risk	WQIP Priority Pollutants • Bacteria/Pathogens • Trash	Citywide	LIP Section 3
Jurisdictional Structural WQIP Strategies	Wetland Capture and Treatment @ J03P02 Description: 3 treatment wetlands Drainage Area: 538 acre drainage area within the City of Laguna Niguel Construction Schedule: Completed 2002-2004 Construction Costs: $469,400	• Pathogen Health Risk • Unnatural Water Balance/Flow Regime	WQIP Priority Pollutants • Bacteria/Pathogens • Non-stormwater discharges • Nutrients • Pesticides • Turbidity • Toxicity Other Pollutants • Metals • Sediment	J03P02 Subwatershed (Aliso Creek Watershed)	LIP Section 3

Strategy		High Priority Water Quality Conditions (HPWQC) Targeted	Target Pollutants	Geographic Extent of Implementation	Location in LIP or WQIP
	Upper Sulphur Creek Restoration Description: 1.7 mile stream restoration on Home Owner Association properties (Crowne Royale, Niguel Ridge, Rancho Niguel Areas) Drainage Area: 1,149 acres (1,322 acres within City of Laguna Niguel and 114 within City of Laguna Hills) Construction Schedule: Completed in 2007 Construction Costs: $1.4 million	•Pathogen Health Risk •Unnatural Water Balance/Flow Regime	WQIP Priority Pollutants •Bacteria/Pathogens •Non-stormwater discharges •Nutrients •Pesticides •Turbidity •Toxicity Other Pollutants •Metals •Sediment	Sulphur Creek Subwatershed (Aliso Creek Watershed)	LIP Section 3
	Middle Sulphur Creek Restoration Description: 2,000 linear foot stream restoration project Drainage Area: 2,300 acres Construction Schedule: Phase I completed Spring 2006. Phase II work completed in Fall 2008. Construction Costs: $2 million	•Pathogen Health Risk •Unnatural Water Balance/Flow Regime	WQIP Priority Pollutants •Bacteria/Pathogens •Non-stormwater discharges •Nutrients •Pesticides •Turbidity •Toxicity Other Pollutants •Metals •Sediment	Sulphur Creek Subwatershed (Aliso Creek Watershed)	LIP Section 3

Strategy		High Priority Water Quality Conditions (HPWQC) Targeted	Target Pollutants	Geographic Extent of Implementation	Location in LIP or WQIP
	J03P01 Stream Channel Restoration Description: 700-foot channel restoration. Drainage Area: Drainage Area is 1,099 acres within the City of Laguna Niguel Construction Schedule: Completed in 2002 Construction Costs: $75,000	•Pathogen Health Risk •Unnatural Water Balance/Flow Regime	WQIP Priority Pollutants •Bacteria/Pathogens •Non-stormwater discharges •Nutrients •Pesticides •Turbidity •Toxicity Other Pollutants •Metals •Sediment	J03P01 Subwatershed (Aliso Creek Watershed)	LIP Section 3
	Narco Channel Restoration Description: 800-foot stream restoration of Narco Channel downstream of La Paz Road Drainage Area: Drainage Area is 517 acres within the City of Laguna Niguel Construction Schedule: Planting completed in September 2007 Construction Costs: $1 million	•Pathogen Health Risk •Unnatural Water Balance/Flow Regime	WQIP Priority Pollutants •Bacteria/Pathogens •Non-stormwater discharges •Nutrients •Pesticides •Turbidity •Toxicity Other Pollutants •Metals •Sediment	Narco Channel Subwatershed (Aliso Creek Watershed)	LIP Section 3

Strategy		High Priority Water Quality Conditions (HPWQC) Targeted	Target Pollutants	Geographic Extent of Implementation	Location in LIP or WQIP
	Crown Valley Park Master Plan Implementation – J03P01 Channel Entry Improvements Project Description: Treatment wetland receives water diverted from low-flow channel within J03P01 flood channel Drainage Area: 1,200 acres of mixed land uses, primarily residential, all draining to MS4 J03P01 system Construction Schedule: 2015-2016 Construction Costs: $3 million	• Pathogen Health Risk	WQIP Priority Pollutants • Bacteria/Pathogens • Non-stormwater discharges • Nutrients • Pesticides • Turbidity • Toxicity Other Pollutants • Metals • Sediment	J03P01 Subwatershed (Aliso Creek Watershed)	LIP Section 3
	Sulphur Solution "GreenBack" Water Conservation and Pollution Prevention Project Description: Implementation of pollution prevention low impact design projects on 16 acres. Drainage Area: 16 acres Construction Schedule: Completed September 2006	• Pathogen Health Risk • Unnatural Water Balance/Flow Regime	WQIP Priority Pollutants • Bacteria/Pathogens • Non-stormwater discharges • Nutrients Other Pollutants • Sediment	Aliso Creek Watershed	LIP Section 3

Strategy		High Priority Water Quality Conditions (HPWQC) Targeted	Target Pollutants	Geographic Extent of Implementation	Location in LIP or WQIP
	Construction Costs: $342,000				
	SmarTimer Edgescape Evaluation Project (SEEP) – Laguna Niguel Sites Description: BMP implementation at two neighborhoods LNH15 (Village Niguel) and LNH14 (Yosemite/El Acampo) within the City of Laguna Niguel Drainage Area: 1.36 acres retrofitted out of 16.6 irrigated acres within 43.6-acre total drainage area in Laguna Niguel Construction Schedule: Completed in April 2008 Construction Costs: Rebate $2,000/property = $46,000	•Pathogen Health Risk •Unnatural Water Balance/Flow Regime	WQIP Priority Pollutants •Bacteria/Pathogens •Non-stormwater discharges •Nutrients Other Pollutants •Sediment	Aliso Creek Watershed	LIP Section 3

Strategy		High Priority Water Quality Conditions (HPWQC) Targeted	Target Pollutants	Geographic Extent of Implementation	Location in LIP or WQIP
	Crown Valley Parkway Median Retrofit Description: Retrofitting five miles of street median areas with drought tolerant plants and low flow sprinklers Drainage Area: Affected area 0.4 acre in Aliso Creek Watershed and 0.2 acre in Dana Point Coastal Streams Watershed Construction Schedule: Fall 2012 Construction Costs: Construction cost $800,000	•Pathogen Health Risk •Unnatural Water Balance/Flow Regime	WQIP Priority Pollutants •Bacteria/Pathogens •Non-stormwater discharges •Nutrients Other Pollutants •Sediment	Aliso Creek Watershed and Dana Point Coastal Streams Watershed	LIP Section 3
	Crown Valley Parkway Landscaped Median Retrofits, Phase V Description: Retrofit low-precipitation irrigation and irrigation setback strips along 2000 lf of existing street median Drainage Area: 0.6 acres Construction Schedule: 2014 Construction Costs: $200,000	•Pathogen Health Risk •Unnatural Water Balance/Flow Regime	WQIP Priority Pollutants •Bacteria/Pathogens •Non-stormwater discharges •Nutrients Other Pollutants •Sediment	San Juan Creek Watershed	LIP Section 3

Strategy		High Priority Water Quality Conditions (HPWQC) Targeted	Target Pollutants	Geographic Extent of Implementation	Location in LIP or WQIP
	Water District "Smart Landscape" Rebate Programs Description: Continuation of voluntary Smart Landscape rebate programs on residential and commercial properties Drainage Area: Citywide Construction Schedule: Rebate offers planned to continue through 2021, subject to Metropolitan Water District funding Construction Costs: Typically rebated at $9 per residential irrigation valve, although program offerings vary	•Pathogen Health Risk •Unnatural Water Balance/Flow Regime	WQIP Priority Pollutants •Bacteria/Pathogens •Non-stormwater discharges •Nutrients Other Pollutants •Sediment	Citywide	LIP Section 3
	Sulphur Solution "Control" Subproject Description: 60 catch basins retrofitted within the Aliso Creek Watershed in Laguna Niguel Drainage Area: Approximately 2 acre/basin = 120 acres Construction Schedule: Completed 2008 Construction Costs: $1,500/site = $90,000	•Pathogen Health Risk	WQIP Priority Pollutants •Bacteria/Pathogens •Nutrients •Trash Other Pollutants •Metals •Oil & Grease •Sediment	Aliso Creek Watershed	LIP Section 3

Strategy		High Priority Water Quality Conditions (HPWQC) Targeted	Target Pollutants	Geographic Extent of Implementation	Location in LIP or WQIP
	Catch Basin Debris Gates (M2 Tier 1 Project) <u>Description:</u> Installation of debris gates at 48 locations in Aliso Creek Watershed <u>Drainage Area:</u> Average drainage area of 2 acres/catch basin (96 acre total drainage area) Construction Schedule: Spring 2012 <u>Construction Costs:</u> $72,000	• Pathogen Health Risk	<u>WQIP Priority Pollutants</u> • Bacteria/Pathogens • Nutrients • Trash <u>Other Pollutants</u> • Metals • Oil & Grease • Sediment	Aliso Creek Watershed and San Juan Creek Watershed	LIP Section 3

4.0 LEGAL AUTHORITY

4.1 INTRODUCTION

The City of Laguna Niguel establishes, maintains, and enforces adequate legal authority within its jurisdiction to control pollutant discharges into and from its storm drain system. Laguna Niguel Municipal Code (LNMC) Article 5, Section 6-3-400 through 6-3-599, include the City's Runoff Water Quality Regulations, which are the underpinning of the City's water quality/pollution prevention program. The updated ordinance was adopted on November 16, 2010 and is attached as Exhibit 4.I. The most current and up-to-date version of the Ordinance and the entire Laguna Niguel Municipal Code (LNMC) is also available online at www.cityoflagunaniguel.org.

4.2 REGULATORY REQUIREMENTS

The Fifth Term Permit, Provision E.1, requires the City to establish, maintain, and enforce adequate legal authority to control pollutant discharges into and from its MS4 through ordinance, statue, permit, contract or similar means.

4.3 AUTHORITY TO CONTROL POLLUTANT DISCHARGES

The City's Water Quality Ordinance is the principal legal foundation of the City's water quality/pollution prevention program. This legal authority enables the city to:

- Control the contribution of pollutants in discharges of runoff associated with industrial and construction sites;
- Prohibit all identified illicit discharges not otherwise allowed;
- Prohibit and eliminate illicit connections to the MS4;
- Control the discharge of spills, dumping or disposal of materials other than storm water into its MS4;
- Require compliance with conditions in City's ordinance, permits, contracts or orders;
- Utilize enforcement mechanisms to require compliance with storm water ordinances, permits, contracts, or orders;
- Control the contribution of pollutants from one portion of the shared MS4 to another portion of the MS4 through interagency agreements among Copermittees;
- Carry out all inspections, surveillance, and monitoring necessary to determine compliance and noncompliance with local ordinance and permits and with this Order, including the prohibition on illicit discharges to the MS4;
- Require the use of BMPs to prevent or reduce the discharge of pollutants into the MS4s from storm water to the maximum extent practicable (MEP); and

- Require documentation on the effectiveness of BMPs implemented to reduce the discharge of storm water pollutants to the MS4 to the Maximum Extent Practicable (MEP).

4.3.1 Other City of Laguna Niguel Pollution Prevention Codes / Ordinances

In addition to the City's water quality ordinance, other sections of the City's municipal code also address water quality protection and pollution prevention and contribute to a comprehensive water quality/pollution prevention program. These complementary codes include:

1. The City's Solid Waste Management Ordinance regulates where solid waste and liquid waste, including hazardous and industrial wastes, may and may not be deposited or discharged. This Ordinance was enacted as part of Ordinance No. 90-11 and is codified as Sections 6-3-17 through 6-3-137 of the Laguna Niguel Municipal Code.

2. The Uniform Fire Code, which has been adopted into the codified ordinances of the City and prohibits the discharge of any waste liquid containing crude petroleum or its products "into or upon" any drainage canal or ditch, storm drain, sewer, or upon the ground.

3. The California Vehicle Code, which has been adopted into the codified ordinances of the City and prohibits the throwing, depositing or dumping of wastes, dirt, or offensive matter onto highways or any portion of the highway right-of-way.

4. The City's General Plan, which provides policy guidance for City land use decisions, has been reviewed and amended as needed in conjunction with each new NPDES Permit to ensure that the policies provided therein reflect general water quality and watershed protection principles including implementation of effective water quality protection measures for all development projects.

5. The City's environmental review process includes use of the most recent California Environmental Quality Act (CEQA) initial study checklist, which requires thorough consideration and disclosure of potential water quality impacts prior to final discretionary approval of development projects.

6. The City's Building Code, which substantially conforms to the California Building Code, has been adopted into the codified ordinances of the LNMC, and provides authority to the Building Official to enforce building regulations, including those contained in the Grading and Excavation Code.

7. The City's Grading and Excavation Code regulates excavation, grading and construction; and establishes administrative requirements for the issuance of Grading Permits in accordance with the requirements in the California Building Code. This Code was enacted as part of Ordinance No. 90-11 and it is codified as Sections 8-1-800 through 8-1-845 of the Laguna Niguel Municipal Code. Project-specific grading permits include detailed conditions and requirements for erosion prevention, slope stabilization, seasonal restrictions, phasing of grading, and sediment/construction

waste management, as activities of concern specifically during the period of actual grading.

8. The City Zoning Code regulates site planning for development projects and requires City discretionary review and approval for significant development projects, to include review and approval of conceptual Water Quality Management Plans (referred to in the Permit as Standard Stormwater Mitigation Plans (SSMPs)). As part of the discretionary review process, and in addition to any Mitigation Requirements resulting from the City's environmental review process, the City imposes Standard Water Quality Conditions of Approval on proposed development projects. These conditions require approval of a final WQMP, including implementation and long-term maintenance of BMPs, and other water quality controls and management measures in accordance with Permit requirements.

9. The City's Landscape Water Use Efficiency Regulations and Guidelines, adopted as Ordinance 2016-180 in January 2016, to incorporate into the LNMC Article 3, Sections Sec. 6-5-40 through 6-5-45, new requirements for planning, design, installation and maintenance of water efficient landscapes for new construction and redevelopment, with runoff prevention as a focus. The City's ordinance requires that irrigation of all existing landscaped areas comply with the Water Waste Prohibitions in Moulton Niguel Water District's *Water Conservation and Drought Response Regulations* applicable to potable water, and to MNWD's *Design Standards and Regulations Governing Users of Recycled Water.* LNMC Article 2, Sections 7-1-56 through 7-1-57 make it unlawful for any person to place, track, deposit or allow the flood of clay, mud, oil, petroleum, irrigation water or other waste-water onto the street.The detection, elimination and enforcement activities undertaken by the City are described further in Section 10. In addition to prohibiting unpermitted discharges, the Water Quality Ordinance also provides the legal authority for requiring BMPs in new development and significant redevelopment, as described in Section 7.

4.3.2 Water/Sewer Agency Pollution Prevention Ordinances and Programs

In addition to City ordinances, the independent Moulton Niguel Water District (MNWD) and the South Orange County Wastewater Authority (SOCWA), that serve Laguna Niguel and parts of surrounding cities, have adopted enforceable ordinances and waste prohibition programs that prohibit irrigation runoff into the storm drains and help prevent sewage spills. It is important to note that the City does not own or operate the sanitary sewer system, and that the MNWD (which operates the sewage collection system) is the primary party responsible for responding to and for cleanup of sewer spills and the general sanitary sewer system operation and maintenance obligations, including the Fats, Oils and Grease program and other pre-treatment and source control programs. MNWD's ordinances and programs are summarized at www.mnwd.com. The City closely coordinates with MNWD on implementation of these programs.

4.3.3 Roles and Responsibilities Beyond City Jurisdiction

Although the City has a regulatory and enforceable framework in place, there are agencies, industries and programs that have either complementary and/or conflicting authorities that

extend beyond the authority of the City. Collaboration and cooperation with the following agencies, industries and programs is practiced by the City as necessary for a comprehensive and effective water quality program. The City is not responsible for discharges regulated under separate permits or under the jurisdiction of other agencies, industries or programs where the City has no authority. The following list is incomplete but includes agencies and programs that are beyond City authority that may affect receiving water quality:

- Reclaimed water use is regulated under a separate permit (Order 97-52) administered by the RWQCB.
- Hydrostatic Test & Potable Water is regulated under RWQCB Order R9-2009-0094.
- Caltrans is regulated by State and RWQCB under Order 2012-0011-DWQ.
- Phase II MS4s, such as Capistrano Unified School District is regulated by State and RWQCB under Order 2013-0001-DWQ.
- On-site disposal systems (OSDS), agricultural & nursery discharges, animal operations and aerially discharged wastes over land are each regulated under one of eleven (11) conditional "waivers" administered by RWQCB.
- Construction projects impacting one acre or greater are regulated by the General Construction Permit under Order 2009-0009-DWQ, which is administered by the State Resources Control Board.
- Discharges from utility vaults and underground structures are regulated under Order 2014-0174-DWQ, which is administered by the State Resources Control Board.
- Industrial sites are regulated under the Industrial Permit under Order 2014-0057-DWQ, which is administered by the State Resources Control Board.
- Pesticides used in the state are registered by the Department of Pesticide Regulation (DPR). DPR, SWRCB and RWCB have mandates and authorities bearing on pesticides and water quality. In order to promote cooperation to protect water quality from the adverse effects of pesticides, DPR and the SWRCB signed a Management Agency Agreement (MAA). The MAA, and its companion document, "The California Pesticide Management Plan for Water Quality," strive to coordinate interaction, facilitate communication, promote problem solving, and ultimately assure the protection of water quality.
- Air contaminants, including fugitive dust, are regulated by the Air Quality Management District (AQMD).
- Leaking Underground Storage Tanks (LUST), Landfills, regulations on water reuse, Restaurant Inspections, Ocean Water Protection - Beach Closures & Warnings Monitoring Program (per AB411), Used Oil Recycling, etc. are overseen by Orange County Health Care Agency.

- Hazardous Waste Inventory and Emergency Planning is regulated by the Orange County Fire Authority as the Administering Agency (AA).
- Hazardous Waste Transport, Treatment, Storage & Disposal are regulated by the State Department of Toxic Substances Control (DTSC).
- SOCWA's Aliso Creek sewer treatment outfall is regulated by RWQCB under Order R9-2012-0013.

4.4 ENFORCEMENT

The City's Water Quality Ordinance includes adequate legal authority, to the extent permitted by California and Federal Law and subject to the limitations on municipal action under the constitutions of California and the United States, to enter, inspect and gather evidence (pictures, videos, samples, documents, etc.) from industrial, construction and commercial establishments. Sanctions are in place to allow the City to progressively and decisively take enforcement actions against any violators of their Water Quality Ordinance. The City intends to use its Enforcement Response Plan (previously, Enforcement Consistency Guide For Water Quality Ordinance Implementation (DAMP Exhibit 4.I)) and follow the guidelines and procedures included therein. The City's Enforcement Response Plan is in Exhibit 4.III.

The detection, elimination and enforcement activities undertaken by the City are described further in Section 10.0. Authorized Inspector(s) (AI) are assigned to investigate compliance with and detect incidences of violations of the City's Water Quality Ordinance. In addition to prohibiting unpermitted discharges, the Water Quality Ordinance also provides the legal authority for requiring BMPs in new development and significant redevelopment found in Section 7.

The City of Laguna Niguel has key departments and staff responsible for overseeing, implementing, and enforcing City ordinances. These departments and staff members are identified in Section 2 Program Management, Table 2.2

4.5 ASSESSMENT

Provision E.1.b of the Fifth Term Permit requires each Copermittee to submit a Statement of Legal Authority that it has taken the necessary steps to obtain and maintain full authority within its jurisdiction to implement and enforce each of the requirements contained in the Permit. This statement is to be submitted with the first Water Quality Improvement Plan (WQIP) Annual Report and will then be included as Exhibit 4.II to the LIP.

4.6 REPORTING

Any modifications to the Runoff Water Quality Control ordinance or relevant portions of other ordinances, including any modifications to the prohibitions on dry-weather discharges are part of the Annual Jurisdictional Work Plan progress updates that are submitted with the WQIP Annual Report.

EXHIBIT 4.I

Runoff Water Quality Ordinance

ORDINANCE NO. 2010-161

ORDINANCE OF THE CITY COUNCIL OF THE CITY OF LAGUNA NIGUEL, CALIFORNIA, AMENDING THE STORM WATER QUALITY CONTROL ORDINANCE

The City Council of the City of Laguna Niguel does ordain as follows:

SECTION 1. RECITALS

1. The City Council adopted in 1994, and later amended in 2003, the Storm Water Quality Control Ordinance (Ordinance No. 94-79 & Ordinance No. 2003-133 respectively) to participate in the improvement of water quality and comply with federal requirements for the control of urban pollutants to runoff, which enters the network of storm drains throughout the County, as set forth in Section 6-3-400 and 6-3-401 of the City Municipal Code.

2. On December 16, 2009, the California Regional Water Quality Control Board, San Diego Region, issued Order No. R9-2009-002 (NPDES No. CAS 0108740) entitled "Waste Discharge Requirements for Discharges of Runoff from the Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds of the County of Orange, the Incorporated Cities of Orange County, and the Orange County Flood Control District within the Region" which is the fourth Permit issued to these permittees (the NPDES Permit).

3. The purpose of this ordinance is to amend the Storm Water Quality Control Ordinance to comply with the provisions of the current NPDES Permit and to make other changes to that ordinance as necessary to better reflect the current terminology and scope of runoff regulations.

SECTION 2. PROHIBITION OF NON-STORMWATER DISCHARGES INTO STORM SEWERS

Article 5, entitled "Prohibition of Non-Storm Water Discharges into Storm Sewers," of Division 3, entitled "Sewage and Solid Waste Disposal," of Title 6, entitled "Health and Sanitation," is hereby repealed and a new Article 5, entitled "Prohibition of Non-Stormwater Discharges into Storm Sewers," is added to Division 3, entitled "Sewage and Solid Waste Disposal," of Title 6, entitled "Health and Sanitation," to read as follows:

ARTICLE 5. PROHIBITION OF NON-STORMWATER DISCHARGES INTO STORM SEWERS

Sec. 6-3-400. Purpose.

The City Council determines that the purpose of this article is as follows:

(1) The United States Congress passed the Clean Water Act [33 USC §1251 et seq., as amended, including §402(p) therein] as a mandate, in part, that municipal separate storm sewer systems (MS4s), such as in Orange County, obtain permits to "effectively prohibit non-stormwater discharges into the storm sewers" and "require controls to reduce the discharge of pollutants to the maximum extent practicable..." This permitting authority has been delegated by the United States Environmental Protection Agency (EPA) to the State of California, which has authorized the State Water Resources Control Board and its local regulatory agencies, the Regional Water Quality Control Boards, to control non-point source discharges to California's waterways.

(2) The San Diego Regional Water Quality Control Board has addressed the obligation to implement the Clean Water Act by issuing Waste Discharge Requirements governing runoff for the County of Orange, Orange County Flood Control District and the Incorporated Cities of South Orange County. These requirements shall be referred to collectively herein as the National Pollution Discharge Elimination System (NPDES) Permit.

(3) The City of Laguna Niguel is a Co-Permittee under the NPDES Permit.

(4) Runoff, which includes both stormwater and non-stormwater, is one step in the cycle of water. However, human activities, such as agriculture, construction and the operation and maintenance of an urban infrastructure may result in undesirable discharges of pollutants and certain sediments, which may accumulate in local drainage channels and waterways and eventually may be deposited in the waters of the United States.

(5) The purpose of this article is to participate in the improvement of water quality and comply with federal requirements for the control of urban pollutants to runoff, which enters the network of storm drains throughout Orange County.

Sec. 6-3-401. - Recitals.

The City Council finds and declares that:

(1) The City of Laguna Niguel is authorized by Article XI, § 5 and § 7 of the State Constitution to exercise the police power of the State by adopting regulations promoting the public health, public safety and general prosperity.

(2) The City of Laguna Niguel has determined that a legitimate local purpose is present in complying with the provisions of the NPDES Permit.

(3) A reduction in stormwater borne pollution will promote the public health and protect the general welfare of the locality by reducing the level of artificial and naturally occurring constituents, which may improve the quality of the waters in this region.

(4) The land use authority exercised by the City of Laguna Niguel, pursuant to California Government Code § 65300 et seq., requires regional planning and the adoption of policies protecting the environment through the imposition of reasonable conditions on the use of land.

(5) This article conforms to the policies and goals of the General Plan adopted by the City of Laguna Niguel, pursuant to California Planning and Zoning Law, for the protection of the portions of watersheds located within Orange County by implementing measures to control erosion and prevent the pollution of streams and other waters.

(6) Certain provisions of this article may be coordinated with the Local Coastal Program for inclusion in Coastal Development Permits, pursuant to California Public Resources Code § 30607, as mitigation for the negative effects of grading, construction, re-construction, and changes to the intensity of use of land or water resources within the coastal zone.

(7) The Subdivision Map Act, California Government Code § 66411, authorizes the City of Laguna Niguel to regulate and control the design and improvement of subdivided lands and mitigate the burdens of proposed development by imposing reasonable conditions on map approval.

(8) California Constitution Article XI, § 7 and Government Code § 38660 authorize the City to establish appropriate conditions for the issuance of building permits, which require the installation of improvements reasonably related to the proposed use of property.

(9) Government Code § 38771 authorizes the City to declare as public nuisances undesirable acts which may injure health or cause interference with the comfortable enjoyment of life or property and to provide for the abatement of the same.

(10) The NPDES Permit requires that the City of Laguna Niguel: (i) develop and implement runoff management programs and implementation plans, (ii) enact legislation and ordinances as necessary to ensure compliance with the runoff management programs and implementation plans, (iii) pursue enforcement actions as necessary to ensure compliance with runoff management programs and implementation plans, (iv) prohibit illicit and illegal discharges from entering the stormwater conveyance systems, subject only to specific exceptions, (v) ensure adequate response to emergency situations, including spills, leaks, and illicit or illegal discharges, and (vi) develop and require implementation of Best Management Practices (BMPs) to ensure that pollution is reduced to the Maximum Extent Practicable (MEP).

(11) The City of Laguna Niguel may commence civil actions, pursuant to Federal Clean Water Act § 505(a), against any person or any governmental agency acting in violation of any condition of the NPDES permit.

(12) All industrial dischargers subject to the provisions of the State Industrial General Permit and State Construction General Permit (referred to collectively herein as the State General Permits) must comply with the lawful requirements of the City of Laguna Niguel, which regulates discharges of runoff to the storm drain system within its jurisdiction.

(13) All industrial dischargers subject to the provisions of the State General Permits are required to maintain Stormwater Pollution Prevention Plans on-site and make them available to the City of Laguna Niguel for inspection.

(14) All dischargers subject to the provisions of the State Construction General Permit may be required by the City of Laguna Niguel, with the concurrence of the San Diego Regional Water Board, to amend any Stormwater Pollution Prevention Plan.

(15) All industrial dischargers subject to the provisions of the State Industrial General Permit are required to maintain a description of the required monitoring program on-site and make it available to the City of Laguna Niguel for inspection.

(16) The City of Laguna Niguel has jurisdiction over certain stormwater facilities and other watercourses within the City of Laguna Niguel, and the water discharges into these facilities may be subject to the provisions of the State Industrial General Permit; accordingly, the City may certify (but is not required to certify) in writing that regulated dischargers have developed and implemented effective Stormwater Pollution Prevention Plans and should not be required to collect and analyze stormwater samples for pollutants.

(17) The City of Laguna Niguel has jurisdiction over certain stormwater facilities and other watercourses within the City of Laguna Niguel, and these facilities may receive runoff discharges from properties and activities regulated under the provisions of the State General Permits, and City may request that the regulated dischargers furnish information and records necessary to determine compliance with the State General Permits.

(18) The City of Laguna Niguel has jurisdiction over certain stormwater facilities and other watercourses within the City of Laguna Niguel, and these facilities may receive runoff discharges from properties and activities regulated under the provisions of the State General Permits, and City may, upon presentation of credentials and other documents required by law, (i) enter upon the discharger's premises where a regulated facility is located or where records must be kept under the conditions of the State General Permits, (ii) access and copy, at reasonable times, any records that must be kept under the conditions of the State General

Permits, (iii) inspect, at reasonable times, any facility or equipment related to or impacting runoff discharge, and (iv) sample or monitor for the purpose of ensuring compliance with the State General Permits.

(19) The enacting of this article is a condition of the NPDES Permit, the requirements of which are exempt from the California Environmental Quality Act (CEQA) pursuant to Public Resources Code § 21000, et seq., including but not limited to 21083 and 21084.

(20) This article is subject to CEQA categorical exemption classes 1 through 4, 6 through 9, 21 and 22, pursuant to the CEQA Guidelines, respectively, Title 14, California Code of Regulations Sections 15301, 15302, 15303, 15304, 15306, 15307, 15308, 15309, 15321 and 15322.

Sec. 6-3-402. - Short title.

This article shall be known and may be cited as the "Runoff Water Quality Control Ordinance."

Sec. 6-3-403. - Definitions.

(a) *Authorized Inspector* shall mean the City Director of Public Works/City Engineer and the City Director of Community Development, and persons designated by and under their instruction and supervision, who are assigned to investigate compliance with, detect violations of and/or take action pursuant to this article.

(b) *Best Management Practices (BMPs)* shall mean schedules of activities, pollution treatment practices or devices, prohibitions of practices, general good housekeeping practices, pollution prevention and educational practices, operation and maintenance procedures and other management practices or devices to prevent or reduce to the Maximum Extent Practicable (MEP) the Discharge of Pollutants directly or indirectly to stormwater, receiving waters or the Stormwater Drainage System. BMPs may be structural or non-structural, and include, but are not limited to, site design, source control, treatment control, and natural design methods. BMPs may include any type of Pollution prevention and control measure that can help to achieve compliance with this article.

(c) *City* shall mean the City of Laguna Niguel, Orange County, California.

(d) *Co-Permittee* shall mean the County of Orange, the Orange County Flood Control District, and/or any one of the municipalities, including the City of Laguna Niguel, which are responsible for compliance with the terms of the NPDES Permit.

(e) *Discharge* shall mean any release, spill, leak, pump, flow, escape, leaching (including subsurface migration or deposition to groundwater), dumping or disposal of any liquid, semi-solid or solid substance.

(f) *Discharge Exception* shall mean the group of activities not restricted or prohibited by this article, including only:

1. Discharges composed entirely of stormwater;

2. Discharges authorized by current EPA or Regional Water Quality Control Board issued NPDES Permits, State General Permits, or other waivers, permits, regulations or approvals granted by a government agency with jurisdiction over such Discharges;

3. Discharges to the Stormwater Drainage System from:

   a. Diverted stream flows;

   b. Rising ground waters;

   c. Infiltration to MS4s of groundwater not contaminated by sewage;

   d. Uncontaminated pumped groundwater;

   e. Foundation drains;

   f. Springs;

   g. Water from crawl space pumps;

   h. Footing drains;

   i. Air conditioning condensation;

   j. Flows from riparian habitats and wetlands;

   k. Water line flushing, except for fire suppression sprinkler system maintenance and testing discharges;

   l. Discharges from potable water sources;

   m. Individual residential car washing;

   n. Dechlorinated swimming pool Discharges;

   o. Emergency fire fighting activities;

4. Discharges authorized pursuant to federal or state laws or regulations.

The Discharges set forth above in Subsections 3(d)(e)(g) and (h) may require compliance with a State or Regional Water Quality Control Board Permit for groundwater extraction or similar Discharges to surface waters. The City authorizes this Discharge unless the Authorized Inspector determines the Discharge potentially causes, or threatens to cause, a condition of Pollution, contamination or nuisance.

The Discharges set forth above in Subsections 3(k) and (l) are exempt from the provisions of this article except to the extent that such Discharges are subject to, but not in compliance with, State or Regional Water Quality Control Board Permits or other local ordinances.

In any action taken to enforce this article, the burden shall be on the Person who is the subject of such action to establish that a Discharge was within the scope of this Discharge Exception.

(g) *Enforcing Attorney* shall mean the City Attorney or District Attorney acting as counsel to the City and his/her designee, which counsel is authorized to take enforcement action as described herein. For purposes of criminal prosecution, only the District Attorney and/or City Attorney shall act as the Enforcing Attorney.

(h) *EPA* shall mean the Environmental Protection Agency of the United States.

(i) *Hearing Officer* shall mean the City Director of Public Works/City Engineer or his/her designee, who shall preside at the administrative hearings authorized by this article and issue final decisions on the matters raised therein. In the alternative, it shall mean any appeals board established by separate resolution of the City Council, which shall preside at the administrative hearings authorized by this article and issue final decisions on the matters raised therein.

(j) *Invoice for Costs* shall mean the actual costs and expenses of the City, including but not limited to administrative overhead, salaries and other expenses recoverable under State law, incurred during any inspection conducted pursuant to Section 6-3-406 of this article, where a Notice of Noncompliance, Administrative Compliance Order or other enforcement option under Section 6-3-407 of this article is utilized to obtain compliance with this article.

(k) *Illicit Connection* shall mean any man-made conveyance or drainage system, pipeline, conduit, inlet or outlet through which the Discharge of any Pollutant to the Stormwater Drainage System occurs or may occur. The term Illicit Connection shall not include Legal Nonconforming Connections or connections to the Stormwater Drainage System that are hereinafter authorized by the agency with jurisdiction over the system at the location at which the connection is made.

(l) *Legal Nonconforming Connection* shall mean connections to the Stormwater Drainage System existing as of the adoption of this article that were in compliance with all federal, state and local rules, regulations, statutes and administrative

requirements in effect at the time the connection was established, including but not limited to any Discharge permitted pursuant to the terms and conditions of an individual discharge permit issued pursuant to the Industrial Waste Ordinance, City Ordinance No. 90-16.

(m) *Local Implementation Plan (LIP)* shall mean the City's adopted plan for local implementation of the NPDES Permit, including all appendices, as they may be amended or revised from time to time. The LIP is equivalent to the Jurisdictional Runoff Management Plan (JRMP) as defined in the NPDES Permit.

(n) *Maximum Extent Practicable (MEP)* shall mean the acceptability standard for BMPs established by Congress in Clean Water Act Section 402(p)(3)(B)(iii) that Discharges to MS4s must meet. MEP means using an effective set of BMPs that can be implemented and still remain practicable. A BMP is effective if it prevents, reduces or removes pollutants that would otherwise be present in the runoff due to human activity. A BMP is practicable if it complies with runoff and other regulations; is compatible with the area's land use, character, facilities and activities; is technically feasible (considering area soil, geography, water resources, and other resources available); is economically feasible; and provides benefits that are reasonable in relation to costs. MEP generally emphasizes Pollution prevention and source control BMPs (as the first line of defense) in combination with treatment methods serving as a backup (additional line of defense).

(o) *New Development* shall mean all public and private residential (whether single family, multi-unit or planned unit development), industrial, commercial, retail, and other non-residential construction projects, or mass grading for future construction, for which either a discretionary land use approval, grading permit, building permit or safety Permit is required.

(p) *NPDES Permit* shall mean the currently applicable municipal discharge permit issued by the California Regional Water Quality Control Board, San Diego Region, which permit establishes waste discharge requirements applicable to runoff in the City.

(q) *Person* shall mean any natural person as well as any corporation, partnership, government entity or subdivision, trust, estate, cooperative association, joint venture, business entity, or other similar entity, or the agent, employee or representative of any of the above.

(r) *Pollutant* shall mean any liquid, solid or semi-solid substances, or combination thereof, including and not limited to:

(1) Artificial materials (such as floatable plastics, wood products or metal shavings);

(2) Household waste (such as trash, paper and plastics; cleaning chemicals; yard wastes; animal fecal materials; used oil and fluids from vehicles, lawn mowers and other common household equipment);

(3) Metals and non-metals, including compounds of metals and non-metals (such as cadmium, lead, zinc, copper, silver, nickel, chromium, cyanide phosphorus and arsenic);

(4) Petroleum and related hydrocarbons (such as fuels, lubricants, surfactants, waste oils, solvents, coolants and grease);

(5) Animal wastes (such as Discharge from confinement facilities, kennels, pens and recreational facilities, including stables, show facilities, or polo fields);

(6) Substances having a pH less than 6.5 or greater than 8.6, or unusual coloration, turbidity or odor.;

(7) Waste materials and wastewater generated on construction sites and by construction activities (such as painting and staining; use of sealants and glues; use of lime; use of wood preservatives and solvents; disturbance of asbestos fibers, paint flakes or stucco fragments; application of oils, lubricants, hydraulic, radiator or battery fluids; construction equipment washing; concrete pouring and cleanup; use of concrete detergents; steam cleaning or sand blasting; use of chemical degreasing or diluting agents; and use of super chlorinated water for potable water line flushing);

(8) Materials causing an increase in biochemical oxygen demand, chemical oxygen demand or total organic carbon;

(9) Materials which contain base/neutral or acid extractable organic compounds;

(10) Those pollutants defined in § 1362(6) of the Federal Clean Water Act;

(11) Any other constituent or material, including but not limited to pesticides, herbicides, fertilizers, fecal coliform, fecal streptococcus or enterococcus, or eroded soils, sediment and particulate materials, in quantities that will interfere with or adversely affect the beneficial uses of the receiving waters, flora or fauna of the State.

(s) *Private Property* shall mean any real property, irrespective of ownership, which is not open to the general public.

(t) *Prohibited Discharge* shall mean any Discharge which contains any Pollutant, from public or private property to:

(1) The Stormwater Drainage System;

(2) Any upstream flow, which is tributary to the Stormwater Drainage System;

(3) Any groundwater, river, stream, creek, wash or dry weather arroyo, wetlands area, marsh, coastal slough; or

(4) Any coastal harbor, bay, or the Pacific Ocean.

The term Prohibited Discharge shall not include Discharges allowable under the Discharge Exception.

(u) *Responsible Party* shall mean the person(s) identified in and responsible for compliance with the provisions of a Water Quality Management Plan (WQMP) approved by the City.

(v) *Significant Redevelopment* means development that would create or add at least 5,000 square feet of impervious surfaces on an already developed site. Significant redevelopment includes, but is not limited to: the expansion of a building footprint; addition to or replacement of a structure; replacement of an impervious surface that is not part of a routine maintenance activity; and land disturbing activities related with structural or impervious surfaces. Replacement of impervious surfaces includes any activity that is not part of a routine maintenance activity where impervious material(s) are removed, exposing underlying soil during construction.

(w) *State General Permit* shall mean either the Waste Discharge Requirements for Discharges Of Storm Water Associated With Industrial Activities Excluding Construction Activities Permit (State Industrial General Permit) or the National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges Associated With Construction and Land Disturbance Activities (State Construction General Permit) and the terms and requirements of either or both. In the event the EPA revokes the in-lieu permitting authority of the State Water Resources Control Board, then the term State General Permit shall also refer to any EPA administered stormwater control program for industrial and construction activities.

(x) Stormwater *Drainage System* shall mean street gutter, channel, storm drain, constructed drain, lined diversion structure, wash area, inlet, outlet or other facility, which is a part of or tributary to the County-wide stormwater runoff system and owned, operated, maintained or controlled by the County of Orange, the Orange County Flood Control District or any Co-Permittee city, and used for the purpose of collecting, storing, transporting, or disposing of runoff.

(y) *Water Quality Management Plan (WQMP)* shall mean a plan, prepared in accordance with the LIP, to mitigate the impacts of runoff from development

projects. A WQMP is equivalent to a Standard Storm Water Mitigation Plan (SSMP) as defined in the NPDES Permit.

Sec. 6-3-404. - Prohibition on illicit connections and prohibited discharges.

(a) No person shall:

(1) Construct, maintain, operate and/or utilize any Illicit Connection.

(2) Cause, allow or facilitate any Prohibited Discharge.

(3) Act, cause, or permit any agent, employee, or independent contractor, to construct, maintain, operate or utilize any Illicit Connection, or cause, allow or facilitate any Prohibited Discharge.

(b) The prohibition against Illicit Connections shall apply irrespective of whether the Illicit Connection was established prior to the date of enactment of this article; however, Legal Nonconforming Connections shall not become Illicit Connections until the earlier of the following:

(1) For all structural improvements to property installed for the purpose of Discharge to the Stormwater Drainage System, the expiration of five (5) years from the adoption of this article.

(2) For all nonstructural improvements to property existing for the purpose of Discharge to the Stormwater Drainage System, the expiration of six (6) months following delivery of a notice to the owner or occupant of the property, which states a Legal Nonconforming Connection has been identified. The notice of a Legal Nonconforming Connection shall state the date of expiration of use under this article.

(c) A civil or administrative violation of Section 6-3-404(a) shall occur irrespective of the negligence or intent of the violator to construct, maintain, operate or utilize an Illicit Connection or to cause, allow or facilitate any Prohibited Discharge.

(d) If an Authorized Inspector reasonably determines that a Discharge, which is otherwise within the Discharge Exception, may adversely affect the beneficial uses of receiving waters, then the Authorized Inspector may give written notice to the owner of the property or facility that the Discharge Exception shall not apply to the subject Discharge following expiration of the 30-day period commencing upon delivery of the notice. Upon expiration of the 30-day period any such Discharge shall constitute a violation of Section 6-3-404(a).

(e) The owner or occupant of property on which a Legal Nonconforming Connection exists may request an administrative hearing, pursuant to the procedures set forth in Sections 6-3-407(a)(6-10), for an extension of the period

allowed for continued use of the connection. A reasonable extension of use may be authorized by the Director of Public Works/City Engineer upon consideration of the following factors:

(1) The potential adverse effects of the continued use of the connection upon the beneficial uses of receiving waters;

(2) The economic investment of the discharger in the Legal Nonconforming Connection; and

(3) The financial effect upon the discharger of a termination of the Legal Nonconforming Connection.

Sec. 6-3-405. - Control of runoff discharges.

(a) New Development and Significant Redevelopment.

(1) All New Development and Significant Redevelopment within the City shall be undertaken in accordance with:

a. When required by, and in accordance with the LIP, a WQMP; and

b. Any conditions and requirements established by the Community Development Department, which are reasonably related to the reduction or elimination of Pollutants in runoff from the project site.

(2) When required by the LIP, prior to the issuance by the City of a grading permit, building permit and/or safety permit for any New Development or Significant Redevelopment, the property owner shall submit to and obtain the approval of the Community Development Department of a WQMP. If the New Development or Significant Redevelopment will be approved without application for a grading permit, building permit or safety permit, the property owner shall submit to and obtain the approval of the Community Development Department of a WQMP prior to the issuance of a discretionary land use approval or, at the City's discretion, prior to recordation of a subdivision map.

(3) Notwithstanding the foregoing Sections 6-3-405(a)(1) and 6-3-405(a)(2), a WQMP shall not be required for construction of a (one) single-family detached residence unless the City Community Development Department determines that the construction may result in the Discharge of significant levels of a Pollutant into a tributary to the Stormwater Drainage System.

(4) Compliance with the conditions and requirements of a WQMP shall not exempt any Person from the requirement to independently comply with each provision of this article.

(5) If the City Community Development Department determines that the project will have a de minimis impact on the quality of runoff, then it may issue a written waiver of the requirement for preparation and approval of a WQMP.

(6) Each WQMP shall name a responsible party for the project.

(7) The owner of a New Development or Significant Redevelopment project, their successors and assigns, and each named responsible party, shall implement and adhere to the terms, conditions and requirements of the approved WQMP.

(8) Each failure by the owner of the property, their successors or assigns, or a named responsible party, to implement and adhere to the terms, conditions and requirements of an approved WQMP shall constitute a violation of this article.

(9) The City Community Development Department may require that the WQMP be recorded with the County Recorder's office by the property owner. The signature of the owner of the property, any successive owner or the named responsible party shall be sufficient for the recording of the plan or any revised plan and a signature on behalf of the City shall not be required for recordation.

(b) Cost Recovery. The costs and expenses of the City Community Development Department incurred in the review, approval, or revision of any WQMP shall be assessed to the property owner or responsible party and shall be due and payable to the City. The City Community Development Department may elect to require a deposit of estimated costs and expenses, and the actual costs and expenses shall be deducted from the deposit, and the balance, if any, refunded to the property owner or responsible party.

(c) Litter control. No Person shall discard any waste material, including but not limited to common household rubbish or garbage of any kind (whether generated or accumulated at a residence, business or other location), upon any public or private property, whether occupied, open or vacant, including but not limited to any street, sidewalk, alley, right-of-way, open area or point of entry to the Stormwater Drainage System.

Every Person occupying or having charge and control of private property on which a prohibited disposal of waste materials occurs shall cause the property collection and disposal of same.

A prohibited disposal of waste materials creates a danger to public health, safety and welfare, and otherwise threatens the environment, surface waters and groundwater; therefore, any owner or occupant of private property who fails to remove waste material within a reasonable time may be charged with creating a nuisance upon the property.

(d) Every Person owning property, conducting any activity or operation, or maintaining any facility shall comply with the applicable BMPs as identified in the LIP in order to prevent, to the MEP, pollutants from entering the Stormwater Drainage System.

Sec. 6-3-406. - Inspections.

(a) Right to Inspect. Prior to commencing any inspection as herein below authorized, the Authorized Inspector shall obtain either the consent of the owner or occupant of the private property or shall obtain an administrative inspection warrant or criminal search warrant.

(b) Entry to Inspect. The Authorized Inspector may enter private property to investigate the source of any Discharge to any public street, inlet, gutter, storm drain or the Stormwater Drainage System located within the jurisdiction of the City of Laguna Niguel.

(c) Compliance Assessments. The Authorized Inspector may inspect private property for the purpose of verifying compliance with this article, including but not limited to (i) identifying products produced, processes conducted, chemicals used and materials stored on or contained within the property, (ii) identifying point(s) of discharge of all wastewater, process water systems and Pollutants, (iii) investigating the natural slope at the location, including drainage patterns and man-made conveyance systems, (iv) establishing the location of all points of Discharge from the private property, whether by surface runoff or through a storm drain system, (v) locating any Illicit Connection or the source of Prohibited Discharge, (vi) evaluating compliance with any WQMP, and (vii) investigating the condition of any Legal Nonconforming Connection.

(d) Portable Equipment. For purposes of verifying compliance with this article, the Authorized Inspector may inspect any vehicle, truck, trailer, tank truck or other mobile equipment.

(e) Records Review. The Authorized Inspector may inspect all records of the owner or occupant of private property relating to chemicals or processes presently or previously occurring on-site, including material and/or chemical inventories, facilities maps or schematics and diagrams, material safety data sheets, hazardous waste manifests, business plans, pollution prevention plans, State General Permits, Stormwater Pollution Prevention Plans as required by a State General Permit, monitoring program plans and any other record(s) relating to Illicit Connections, Prohibited Discharges, a Legal Nonconforming Connection or any other source of contribution or potential contribution of Pollutants to the Stormwater Drainage System.

(f) Sample and Test. The Authorized Inspector may inspect, sample and test any area runoff, soils area (including groundwater testing), process discharge, materials

within any waste storage area (including any container contents), and/or treatment system Discharge for the purpose of determining the potential for contribution of Pollutants to the Stormwater Drainage System. The Authorized Inspector may investigate the integrity of all storm drain and sanitary sewer systems, any Legal Nonconforming Connection or other pipelines on the property using appropriate tests, including but not limited to smoke and dye tests or video surveys. The Authorized Inspector may take photographs or videotape, make measurements or drawings, and create any other record reasonably necessary to document conditions on the property.

(g) Monitoring. The Authorized Inspector may erect and maintain monitoring devices for the purpose of measuring any Discharge or potential source of Discharge to the Stormwater Drainage System.

(h) Test Results. The owner or occupant of property subject to inspection shall, on submission of a written request, receive copies of all monitoring and test results conducted by the Authorized Inspector.

Sec. 6-3-407. - Enforcement.

(a) Administrative Remedies.

(1) Notice of Noncompliance. The Authorized Inspector may deliver to the owner or occupant of any private property, or to any Person responsible for an Illicit Connection or Prohibited Discharge a Notice of Noncompliance. The Notice of Noncompliance shall be delivered in accordance with Section 6-3-407(a)(5) of this article.

(i) The Notice of Noncompliance shall identify the provision(s) of this article, the applicable WQMP or permit which has been violated. The Notice of Noncompliance shall state that continued noncompliance may result in additional enforcement actions against the owner, occupant and/or Person.

(ii) The Notice of Noncompliance shall state a compliance date that must be met by the owner, occupant and/or Person; provided, however, that the compliance date may not exceed 90 days unless the Authorized Inspector extends the compliance deadline an additional 90 days where good cause exists for the extension.

(2) Administrative Compliance Orders.

(i) The Authorized Inspector may issue an Administrative Compliance Order. The Administrative Compliance Order shall be delivered in accordance with Section 6-3-407(a)(5) of this article. The Administrative Compliance Order may be issued to:

a. The owner or occupant of any private property requiring abatement of conditions on the property that cause or may cause a Prohibited Discharge or an Illicit Connection in violation of this article;

b. The owner of private property or a responsible party subject to the requirements of any WQMP to ensure implementation of and adherence to the terms, conditions and requirements of the plan;

c. Any Person responsible for an Illicit Connection or Prohibited Discharge.

(ii) The Administrative Compliance Order may include the following terms and requirements:

a. Specific steps and time schedules for compliance as reasonably necessary to prevent the imminent threat of Prohibited Discharge, including but not limited to Prohibited Discharge from any pond, pit, well, surface impoundment, holding or storage area;

b. Specific steps and time schedules for compliance as reasonably necessary to discontinue any Illicit Connection;

c. Specific requirements for containment, cleanup, removal, storage, installation of overhead covering, or proper disposal of any pollutant having the potential to contact runoff;

d. Any other terms or requirements reasonably calculated to prevent the imminent threat of or continuing violations of this article, including, but not limited to requirements for compliance with BMPs and guidance documents promulgated by any federal, State of California or regional agency;

e. Any other terms or requirements reasonably calculated to achieve full compliance with the terms, conditions and requirements of any WQMP, or permit issued by the City.

(3) Cease and Desist Orders.

(i) The Authorized Inspector may issue a Cease and Desist Order. A Cease and Desist Order shall be delivered in accordance with Section 6-3-407(a)(5) of this article. A Cease and Desist Order may direct the owner or occupant of any private property and/or other Person responsible for a violation of this article to:

a. Immediately discontinue any Illicit Connection or Prohibited Discharge to the Stormwater Drainage System;

b. Immediately contain or divert any flow of water off the property, where the flow is occurring in violation of any provision of this article;

c. Immediately discontinue any other violation of this article;

d. Clean up the area affected by the violation.

(ii) The Authorized Inspector may direct by Cease and Desist Order that the owner of any private property, the responsible party subject to the terms and conditions of any WQMP, or any Permittee under any permit issued by the Cityimmediately cease any activity not in compliance with the terms, conditions and requirements of the applicable WQMP or permit.

(4) Recovery of Costs. The Authorized Inspector may deliver to the owner or occupant of any private property, any Permittee or any responsible party, or any other Person who becomes subject to a Notice of Noncompliance or Administrative Compliance Order, an Invoice for Costs. An Invoice for Costs shall be delivered in accordance with Section 6-3-407(a)(5) of this article. An Invoice for Costs shall be immediately due and payable to the City for the actual costs incurred by the City in issuing and enforcing any notice or order.

If any owner or occupant, Permittee or responsible party, or any other Person fails to either pay the Invoice for Costs or appeal successfully the Invoice for Costs in accordance with Section 6-3-407(a)(6), then the Enforcing Attorney may institute collection proceedings.

(5) Delivery of Notice. Any Notice of Noncompliance, Administrative Compliance Order, Cease and Desist Order or Invoice of Costs to be delivered pursuant to the requirements of this article shall be subject to the following:

(i) The notice shall state that the recipient has a right to appeal the matter as set forth in Sections 6-3-407(a)(6) through Section 6-3-407(a)(10) of this article.

(ii) Delivery shall be deemed complete upon (a) personal service to the recipient; (b) deposit in the U.S. mail, postage pre-paid for first class delivery; or (c) facsimile service with confirmation of receipt.

(iii) Where the recipient of notice is the owner of the property, the address for notice shall be the address from the most recently issued equalized assessment roll for the property or as otherwise appears in the current records of the City.

(iv) Where the owner or occupant of any private property cannot be located after the reasonable efforts of the Authorized Inspector, a Notice of Noncompliance or Cease and Desist Order shall be deemed delivered after posting on the property for a period of ten (10) business days.

(6) Administrative Hearing for Notices of Noncompliance Administrative Compliance Orders, Invoices for Costs and Adverse Determinations. Except as set forth in Section 6-3-407(a)(8), any Person receiving a Notice of Noncompliance, Administrative Compliance Order, a Notice of Legal Nonconforming Connection, an Invoice for Costs, or any Person who is subject to any adverse determination made pursuant to this article, may appeal the matter by requesting an administrative hearing. Notwithstanding the foregoing, these administrative appeal procedures shall not apply to criminal proceedings initiated to enforce this article.

(7) Request for Administrative Hearing. Any Person appealing a Notice of Noncompliance, an Administrative Compliance Order, a Notice of Legal Nonconforming Connection, an Invoice for Costs or an adverse determination shall, within 30 days of receipt thereof, file a written request for an administrative hearing, accompanied by an administrative hearing fee as established by separate resolution, with the office of the City Clerk, with a copy of the request for administrative hearing mailed on the date of filing to the Director of Public Works/City Engineer. Thereafter, a hearing on the matter shall be held before the Hearing Officer within 45 business days of the date of filing of the written request unless, in the reasonable discretion of the Hearing Officer and pursuant to a written request by the appealing party, a continuance of the hearing is granted.

(8) Administrative Hearing for Cease and Desist Orders and Emergency Abatement Actions. An administrative hearing on the issuance of a Cease and Desist Order or following an emergency abatement action shall be held within five (5) business days following the issuance of the order or the action of abatement, unless the hearing (or the time requirement for the hearing) is waived in writing by the party subject to the Cease and Desist Order or the emergency abatement. A request for an administrative hearing shall not be required from the Person subject to the Cease and Desist Order or the emergency abatement action.

(9) Hearing Proceedings. The Authorized Inspector shall appear in support of the notice, order, determination, Invoice for Costs or emergency abatement action, and the appealing party shall appear in support of withdrawal of the notice, order, determination, Invoice for Costs, or in opposition to the emergency abatement action. The City shall have the burden of supporting any enforcement or other action by a preponderance of the evidence. Each party shall have the right to present testimony and other documentary evidence as necessary for explanation of the case.

(10) Final Decision and Appeal. The final decision of the Hearing Officer shall issue within ten (10) business days of the conclusion of the hearing and shall be delivered by first-class mail, postage prepaid, to the appealing party. The final decision shall include notice that any legal challenge to the final decision shall be made pursuant to the provisions of Code of Civil Procedure §§ 1094.5 and

1094.6 and shall be commenced within 90 days following issuance of the final decision.

Notwithstanding this Section 6-3-407(a)(10), the final decision of the Hearing Officer in any preceding determining the validity of a Cease and Desist order or following an emergency abatement action shall be mailed within five (5) business days following the conclusion of the hearing.

(11) City Abatement. In the event the owner of private property, the operator of a facility, a Permittee, a responsible party, or any other Person fails to comply with any provision of a compliance schedule issued pursuant to this article, the Authorized Inspector may request the Enforcing Attorney to obtain an abatement warrant or other appropriate judicial authorization to enter the property, abate the condition and restore the area. Any costs incurred by the City in obtaining and carrying out an abatement warrant or other judicial authorization may be recovered pursuant to Section 6-3-407(b)(4).

(b) Nuisance. Any condition in violation of the prohibitions of this article, including but not limited to the maintenance or use of any Illicit Connection or the occurrence of any Prohibited Discharge, shall constitute a threat to the public health, safety and welfare, and is declared and deemed a nuisance pursuant to Government Code § 38771.

(1) Court Order to Enjoin or Abatement. At the request of the City Manager, the Enforcing Attorney may seek a court order to enjoin and/or abate the nuisance.

(2) Notice to Owner and Occupant. Prior to seeking any court order to enjoin or abate a nuisance or threatened nuisance, the City Manager shall provide notice of the proposed injunction or abatement to the owner and occupant, if any, of the property where the nuisance or threatened nuisance is occurring.

(3) Emergency Abatement. In the event the nuisance constitutes an imminent danger to public safety or the environment, the Authorized Inspector may enter the property from which the nuisance emanates, abate the nuisance and restore any property affected by the nuisance. To the extent reasonably practicable, informal notice shall be provided to the owner or occupant prior to abatement. If necessary to protect the public safety or the environment, abatement may proceed without prior notice to or consent from the owner or occupant thereof and without judicial warrant.

(i) An imminent danger shall include, but is not limited to, exigent circumstances created by the dispersal of Pollutants, where the same presents a significant and immediate threat to the public safety or the environment.

(ii) Notwithstanding the authority of the City to conduct an emergency abatement action, an administrative hearing pursuant to Section 6-3-407(a)(8) hereinabove shall follow the abatement action.

(4) Reimbursement of Costs. All costs incurred by the City in responding to any nuisance, all administrative expenses and all other expenses recoverable under State law, shall be recoverable from the Person(s) creating, causing, committing or maintaining the nuisance.

(5) Nuisance Lien. All costs shall become a lien against the property from which the nuisance emanated and a personal obligation against the owner thereof in accordance with Government Code § 38773.1 and § 38773.5. The owner of record of the property subject to any lien shall be given notice of the lien prior to recording as required by Government Code § 38773.1.

At the direction of the City Manager, the Enforcing Attorney is authorized to collect nuisance abatement costs or enforce a nuisance lien in an action brought for a money judgment or by delivery to the County Assessor of a special assessment against the property in accord with the conditions and requirements of Government Code § 38773.5.

(c) Criminal Sanctions.

(1) Prosecutor. The Enforcing Attorney may act on the request of the City Manager to pursue enforcement actions in accordance with the provisions of this article.

(2) Infractions. Any Person who may otherwise be charged with a misdemeanor under this article may be charged, at the discretion of the Enforcing Attorney, with an infraction punishable by a fine of not more than $100.00 for a first violation, $200.00 for a second violation, and a fine not exceeding $500.00 for each additional violation occurring within one (1) year.

(3) Misdemeanors. Any Person who negligently or knowingly violates any provision of this article, undertakes to conceal any violation of this article, continues any violation of this article after notice thereof, or violates the terms, conditions and requirements of any WQMP or permit, shall be guilty of a misdemeanor punishable by a fine of not more than $1,000.00 or by imprisonment for a period of not more than six (6) months, or both.

(d) Consecutive Violations. Each day in which a violation occurs and each separate failure to comply with either a separate provision of this article, an Administrative Compliance Order, a Cease and Desist Order, an applicable WQMP, or a permit issued by the City, shall constitute a separate violation of this article punishable by fines or sentences issued in accordance herewith.

(e) Non-exclusive Remedies. Each and every remedy available for the enforcement of this article shall be non-exclusive and it is within the discretion of the Authorized Inspector or Enforcing Attorney to seek cumulative remedies, except that multiple monetary fines or penalties shall not be available for any single violation of this article.

(f) Citations. Pursuant to Penal Code § 836.5, the Authorized Inspector shall have the authority to cause the arrest of any Person committing a violation of this article. The Person shall be released and issued a citation to appear before a magistrate in accordance with Penal Code § 853.5, § 853.6, and § 853.9, unless the Person demands to be taken before a magistrate. Following issuance of any citation the Authorized Inspector shall refer the matter to the Enforcing Attorney.
Each citation to appear shall state the name and address of the violator, the provisions of this article violated, and the time and place of appearance before the court, which shall be at least ten (10) business days after the date of violation. The Person cited shall sign the citation giving his or her written promise to appear as stated therein. If the Person cited fails to appear, the Enforcing Attorney may request issuance of a warrant for the arrest of the Person cited.

(g) Violations of Other Laws. Any Person acting in violation of this article also may be acting in violation of the Federal Clean Water Act or the State Porter-Cologne Act and other laws and also may be subject to sanctions including civil liability. Accordingly, the Enforcing Attorney is authorized to file a citizen suit pursuant to Federal Clean Water Act § 505(a), seeking penalties, damages, and orders compelling compliance, and other appropriate relief. The Enforcing Attorney may notify EPA Region IX, the San Diego Regional Water Quality Control Board, or any other appropriate state or local agency, of any alleged violation of this article.

(h) Injunctions. At the request of the City Manager, the Enforcing Attorney may cause the filing in a court of competent jurisdiction, of a civil action seeking an injunction against any threatened or continuing noncompliance with the provisions of this article.

(1) Order for Reimbursement. Any temporary, preliminary or permanent injunction issued pursuant hereto may include an order for reimbursement to the City of all costs incurred in enforcing this article, including costs of inspection, investigation and monitoring, the costs of abatement undertaken at the expense of the city, costs relating to restoration of the environment and all other expenses as authorized by law.

(i) Other Civil Remedies.

(1) The City Manager may cause the Enforcing Attorney to file an action for civil damages in a court of competent jurisdiction seeking recovery of (i) all costs incurred in enforcement of this article, including but not limited to costs relating to investigation, sampling, monitoring, inspection, administrative expenses, all other

expenses as authorized by law, and consequential damages, (ii) all costs incurred in mitigating harm to the environment or reducing the threat to human health, and (iii) damages for irreparable harm to the environment.

(2) The Enforcing Attorney is authorized to file actions for civil damages resulting from any trespass or nuisance occurring on public land or to the Stormwater Drainage System from any violation of this article where the same has caused damage, contamination or harm to the environment, public property or the Stormwater Drainage System.

(3) The remedies available to the City pursuant to the provisions of this article shall not limit the right of the City to seek any other remedy that may be available by law.

Sec. 6-3-408. - Reserved.

Editor's note—

Ord. No. 2003-133, § 4, adopted December 2, 2003, amended the Code by repealing former § 6-3-408 in its entirety. Former § 6-3-408 pertained to permits, and derived from Ord. No. 94-79, adopted December 20, 1994.

Sec. 6-3-409. - Interagency cooperation.

(a) The City intends to cooperate with other agencies with jurisdiction over runoff Discharges to ensure that the regulatory purposes underlying runoff regulations promulgated pursuant to the Clean Water Act (33 USC § 1251 et seq.) are met.

(b) The City may, to the extent authorized by law, elect to contract for the services of any public agency or private enterprise to carry out the planning approvals, inspections, permits and enforcement authorized by this article.

Sec. 6-3-409.1. Compliance Disclaimer

Full compliance by any Person or entity with the provisions of this article shall not preclude the need to comply with other local, state or federal statutory or regulatory requirements, which may be required for the control of the Discharge of Pollutants into runoff and/or the protection of runoff quality.

Sec. 6-3-410. - Judicial review.

The provisions of § 1094.5 and § 1094.6 of the Code of Civil Procedure set forth the procedure for judicial review of any act taken pursuant to this article. Parties seeking judicial review of any action taken pursuant to this article shall file such action within 90 days of the occurrence of the event for which review is sought.

Secs. 6-3-411—6-3-599. - Reserved.

SECTION 3. EFFECTIVE DATE

This Ordinance shall go into effect and be in full force and operation from and after thirty (30) days after its final passage and adoption.

SECTION 4. SEVERABILITY

If any section, subsection, subdivision, sentence, clause, phrase, or portion of this ordinance, is for any reason held to be invalid or unconstitutional by the decision of any court or competent jurisdiction, such decision shall not affect the validity of the remaining portions of this ordinance. The City Council hereby declares that it would have adopted this ordinance, and each section, subsection, subdivision, sentence, clause, phrases, or portion thereof, irrespective of the fact that any one or more sections, subsections, subdivisions, sentences, clauses, phrases, or portions thereof, be declared invalid or unconstitutional.

SECTION 5. CITY CLERK'S CERTIFICATION

The City Clerk shall certify to the adoption of this Ordinance and cause the same to be posted at the duty designated posting places within the City and published once within fifteen (15) days after passage and adoption as required by law; or, in the alternative, the City Clerk may cause to be published a summary of this Ordinance in the Office of the City Clerk five (5) days prior to the date of adoption of this Ordinance, and, within fifteen (15) days after adoption, the City Clerk shall cause to be published the aforementioned summary and shall post a certified copy of this Ordinance, together with the vote for and against the same, in the Office of the City Clerk.

PASSED, APPROVED, AND ADOPTED this 16th day of November, 2010.

Linda Lindholm, Mayor

ATTEST:

Pam Lawrence
Deputy City Manager/Acting City Clerk

CERTIFICATION

STATE OF CALIFORNIA)
COUNTY OF ORANGE)SS
CITY OF LAGUNA NIGUEL)

I, Pamela Lawrence, Acting City Clerk of the City of Laguna Niguel, California, do hereby certify that the foregoing is Ordinance No. 2010-161 which was adopted at a regular meeting of the City Council of the City of Laguna Niguel, California, held November 16, 2010 by the following vote:

AYES:	Council Members Brown, Glaab, Ming, Mayor Pro Tem Capata and Mayor Lindholm
NOES:	None
ABSTENTIONS:	None
ABSENT:	None

Pam Lawrence
Deputy City Manager/Acting City Clerk

EXHIBIT 4.II

LETTER OF LEGAL AUTHORITY

EXHIBIT 4.II
STATEMENT OF LEGAL AUTHORITY

PLACEHOLDER
TO BE ADDED UPON SUBMITTAL WITH FIRST WQIP ANNUAL REPORT

EXHIBIT 4.III

ENFORCEMENT RESPONSE PLAN

Exhibit 4.III

Storm Water Management and Urban Runoff

Enforcement Response Plan

CITY OF LAGUNA NIGUEL

STORM WATER MANAGEMENT AND URBAN RUNOFF

ENFORCEMENT RESPONSE PLAN

I. INTRODUCTION

The City of Laguna Niguel (City) controls pollutant discharges into and from its storm drain system within its jurisdiction through enforcement of its Water Quality Ordinance, which is Article 5 of Division 3 of Title 6 of the Laguna Niguel Municipal Code (Sections 6-3-400 through 6-3-410, inclusive), its Grading Ordinance, which is Article 8 of Division 1 of Title 8 of the Laguna Niguel Municipal Code (Sections 8-1-800 through 8-1-845, inclusive), and certain other complimentary Municipal Code provisions identified in Section 4 of the City's Jurisdictional Urban Runoff Plan/Local Implementation Plan (referred to collectively as the City ordinances).

Unless otherwise defined in this Enforcement Response Plan (ERP), all capitalized terms used in this ERP are defined in the Water Quality Ordinance or the LIP.

This ERP works in conjunction with the City's Ordinances as part of the City's efforts to effectively administer the storm water quality control programs described in the Drainage Area Management Plan (DAMP), the LIP, and the South Orange County Water Quality Improvement Plan (WQIP), and is intended to be consistent with these programmatic documents.

This ERP describes the applicable approaches and options the City takes to investigate and enforce violations of the City's Ordinances in order to achieve compliance with the requirements of the National Pollutant Discharge Elimination System (NPDES) Permit (Permit) with respect to Illicit Discharge Detection and Elimination, Development Planning, Construction Management, and Existing Development. It is intended to provide guidance to Authorized Inspectors, Enforcing Attorneys, and other City personnel responsible for implementing the Water Quality Ordinance and the City's storm water quality control programs in order to assist them to take appropriate, adequate, consistent, and timely enforcement actions for the protection of the environment and public health, safety and welfare.

This ERP was developed in support of the City's Ordinances, and is not intended to support the enforcement of requirements under the State General Industrial and General Construction Permit Programs, which are subject to enforcement by other state and regional authorities.

II. OVERVIEW OF ENFORCEMENT OPTIONS AND APPROACHES TO RESPONDING TO NONCOMPLIANCE

The goals of the City's enforcement program include the following:

- To educate the regulated community.
- To achieve compliance with the laws and regulations within the regulated community.

- To return violators to compliance in a timely manner and eliminate any threats due to noncompliance.
- To initiate and conclude enforcement activities in a timely manner.
- To provide consistency in responding to violations.

In selecting enforcement options, the City strives to ensure that violations of a similar nature are subjected to similar-types of enforcement remedies. Nonetheless, a more severe enforcement option may be selected when a violator has either a history of noncompliance or has failed to take good faith actions to eliminate continuing violations or to meet a previously imposed compliance schedule. Authorized Inspectors should review enforcement options with the Enforcing Attorney to insure that evidence is collected and delivered in a timely fashion.

The City typically employs a tiered, escalating enforcement system. However, the City reserves the right to use whatever tools it deems most appropriate for a given situation, as dictated by the specifics of each case. The use of a progressively more severe enforcement option is referred to in this ERP as "Escalated Enforcement." Whether a particular method of enforcement constitutes "Escalated Enforcement" is specified below.

A. Criteria for Determining Appropriate Response to Noncompliance

The enforcement approach taken by the City in response to a specific incident of noncompliance is determined on a case-by-case basis and depends on a variety of factors, including the severity of the violation and the knowledge or intent, level of cooperation, and compliance history of the responsible party.

1. Severity of the Violation

Violations are evaluated against the severity of the noncompliance and the potential or actual threat to public health or the environment created by the noncompliance. The severity of a violation is generally the most important factor in determining the appropriate level of enforcement response. The severity of a violation will depend on a number of factors, including the duration and frequency of the event, the type and amount of the pollutants discharged, and the impact on public health and the environment. Violations that do not pose an immediate or significant threat to public health or the environment, are isolated or infrequent, and/or are short in duration will typically be addressed initially through lower level enforcement actions, such as Verbal Warnings, Notices of Violation (also referred as Notices of Noncompliance), or Administrative Compliance Orders. However, higher level Escalated Enforcement responses will be utilized for violations that pose an immediate and significant threat to human health or the environment or which are continuous, frequent, and/or of a long duration.

2. Knowledge or Intent of the Responsible Party

The responsible party's knowledge of a violation or regulations being violated are also taken into account when evaluating the appropriate enforcement approach to take. Where a violation is not severe and has occurred unknowingly, the initial enforcement response will typically consist of an Education Letter, Verbal Warning, or Notice of Noncompliance. However, negligent or willful

noncompliance will warrant higher level administrative or civil Escalated Enforcement action or Criminal Enforcement.

3. Level of Cooperation

A responsible party's willingness to cooperate and to undertake good faith efforts to maintain compliance or eliminate noncompliance may also be considered when determining the appropriate enforcement response. "Good faith" means that the responsible party has an honest intention to remedy its noncompliance, coupled with actions that give support to this intention. While a responsible party's good faith and willingness to cooperate may be taken into account in determining the appropriate type of enforcement response, it does not eliminate the need for enforcement action, and should not be used to mitigate an enforcement response to such an extent as to permit actual or threatened harm to public health or the environment.

4. Compliance History

When evaluating the level of enforcement action to be taken for a violation, the City reviews and considers the compliance history of the responsible party. If a pattern of recurring violations is observed, or if a responsible party has failed to correct violations noted in a prior enforcement action, the City will use Escalated Enforcement.

B. Initial Methods of Achieving Voluntary Compliance

1. Education Letters

In certain limited circumstances, the City will issue an Educational Letter advising a property owner, business, or resident of their legal obligations prior to, or in lieu of, pursuing administrative, civil, or criminal enforcement. An Educational Letter provides information regarding the requirements of City's Ordinances and the steps that need to be taken to comply with them. An Educational Letter may be appropriate under the following circumstances:

- Where an Authorized Inspector receives a complaint or information concerning noncompliance that the Authorized inspector believes to be valid, but the Authorized Inspector does not have sufficient evidence to substantiate that a violation of the City's Ordinances has occurred.
- Where a violation has been caused by a contractor hired by a property owner, business, or resident without the knowledge or consent of the property owner, business, or resident, and the City may pursue enforcement against the contractor.

In these circumstances, the Authorized Inspector will document that the Educational Letter has been provided, and this documentation can be used as evidence to support enforcement action in the event of continued or future similar violations at the same site.

2. Verbal Warnings

A Verbal Warning is often the initial method used by the City to request corrective action and enforce compliance with the City's Ordinances. A Verbal Warning may be utilized where there is no history of

noncompliance and the violation or noncompliance is relatively minor and can be quickly and easily corrected. In such cases, a Verbal Warning may be sufficient to achieve immediate correction of a violation. Where an Authorized Inspector issues a Verbal Warning, he/she will document the violation and the name and position of the person(s) notified in the inspection file. A specific time frame for correcting the problem and a follow-up inspection date will also be documented by the Authorized Inspector. In cases, where the issue is immediately abated while the Authorized Inspector is present on site, a case may not be created as no follow-up will be necessary. In other instances, where the issue was observed as part of a designated inspection, and the issue was immediately addressed, the issue and abatement actions will be noted as part of the inspection, and a separate case will not be created.

C. Administrative Enforcement Responses

1. Notice of Noncompliance/Notice of Violation

After a verbal warning, the Notice of Noncompliance/Notice of Violation is the least severe administrative enforcement response utilized by the City for violations of the Water Quality Ordinance. A Notice of Noncompliance/Notice of Violation constitutes a basic written request that a contractor, facility operator, property owner, or resident rectify a condition causing or threatening to cause noncompliance with the City's Ordinances. A Notice of Noncompliance/Notice of Violation is the appropriate enforcement tool in the following circumstances:

- The violation or threat is insignificant and short in duration.
- The violation or threat is an isolated incident.
- The violation or threat does not affect and will not harm human health or the environment.
- The responsible party is cooperative and has indicated a willingness to readily correct the violation.
- The violation occurred unknowingly.
- A prior Verbal Warning was given, but the deficiency that was noted in a prior Verbal Warning has not been corrected within the specified timeframe or by the next inspection.

A Notice of Noncompliance/Notice of Violation (a) identifies the provision(s) of the City's Ordinances and/or relevant permit that has been violated, (b) describes the violation/deficiency to be corrected and corrective action(s) required, (c) includes a compliance date by which the violation must be corrected, (d) sets a date for a follow-up inspection (if applicable), and (e) states that continued noncompliance may result in additional enforcement actions.

A responsible party may appeal a Notice of Noncompliance/Notice of Violation and request an administrative hearing before a hearing officer in accordance with the procedures set forth in the Water Quality Ordinance.

Generally, a Notice of Noncompliance/Notice of Violation will be given to a responsible party prior to the use of other progressively severe enforcement options. However, a Notice of Noncompliance/Notice of Violation will not be the first enforcement method used if egregious or unusual circumstances indicate that a stronger enforcement tool is needed.

2. Administrative Compliance Order

An Administrative Compliance Order is a progressively more severe enforcement response than a Notice of Noncompliance/Notice of Violation. The Administrative Compliance Order is an appropriate enforcement tool in the following circumstances:

- The violation or threat is not significant and short in duration.
- The violation or threat is infrequent.
- The violation does not pose an immediate threat to human health or the environment.
- An actual condition of noncompliance exists, but the condition cannot be remedied within a relatively short period of time.
- The responsible party has indicated willingness to come into compliance by meeting milestones established in a reasonable schedule.
- The violation is not willful.
- A prior Verbal Warning and/or Notice of Noncompliance/Notice of Violation has been insufficient to achieve compliance.

An Administrative Compliance Order may include the following terms and requirements:

- Specific steps and time schedules for compliance as reasonably necessary to eliminate an existing prohibited discharge or prevent the imminent threat of a prohibited discharge;
- Specific steps and time schedules for compliance as reasonably necessary to discontinue any illicit connection;
- Specific requirements for containment, cleanup, removal, storage, installation of overhead covering, or proper disposal of any pollutant having the potential to contact stormwater runoff; and
- Any other terms or requirements reasonable calculated to prevent imminent threat of or continuing violations, including, but not limited to, requirements for implementation of, and compliance with, appropriate BMPs.

An Administrative Compliance Order may constitute Escalated Enforcement in those instances where a previously issued Verbal Warning or Notice of Noncompliance/Notice of Violation has failed to achieve compliance.

3. Cease and Desist Order

A Cease and Desist Order may be issued to obtain immediate compliance with the Water Quality Ordinance and may order immediate cessation of any Illegal Discharge, Illicit Connection, or other violation; immediate containment or diversion of any impermissible flow of water off the property; and/or immediate cleanup of any area affected by a violation. The Cease and Desist order may also be appropriately issued as a first step in ordering the removal of nuisance conditions that threaten to cause an unauthorized discharge of Pollutants if exposed to rain or surface water runoff. The Cease and Desist Order is an appropriate enforcement tool in the following circumstances:

- The violation or threat is immediate in nature and may require an emergency spill response or immediate nuisance abatement if left unattended.
- The violation or threat exhibits a potential situation that may harm human health or the environment.
- The Authorized Inspector's contacts with the responsible party indicate that further authority of the City may need to be demonstrated before remedial action is forthcoming.
- The Authorized Inspector's prior enforcement actions have not obtained a favorable response.

A person issued a Cease and Desist Order is entitled to an administrative hearing before a hearing officer within 5 business days in accordance with the procedures set forth in the Water Quality Ordinance.

A Cease and Desist Order constitutes Escalated Enforcement in those instances where a previously issued Notice of Noncompliance/Notice of Violation and/or Administrative Compliance Order has failed to achieve compliance.

4. Administrative Nuisance Abatement

In instances where Escalated Enforcement actions fail to achieve compliance and there is a continuing threat to water quality, the City may itself enter the property, abate the condition(s) causing the violation, and restore the area. Before pursuing Administrative Nuisance Abatement, the City will notify the property owner and/or occupant and seek their consent. Where consent is not given or cannot be obtained, the City generally must obtain an inspection / abatement warrant from a court in accordance with State law before entering private property. However, where a nuisance condition on private property constitutes imminent danger to public safety or the environment and deemed a nuisance pursuant to Government Code Section 38771, the City is authorized to take any and all enforcement action to abate said nuisance.

Administrative Nuisance Abatement constitutes Escalated Enforcement.

5. Invoice For Costs

The Water Quality Ordinance authorizes an Authorized Inspector to deliver an Invoice for Costs to any responsible party for the actual costs incurred by the City in issuing and enforcing any Notice of Noncompliance/Notice of Violation, Administrative Compliance Order, Cease and Desist Order, or Administrative Abatement order. A responsible party may appeal an Invoice for Costs and request an

administrative hearing before a hearing officer in accordance with the procedures set forth in the Water Quality Ordinance. If the responsible party fails to either pay or successfully appeal the Invoice for Costs, then the Enforcing Attorney may institute collection proceedings in accordance with State law.

Delivery of an Invoice for Costs does not constitute Escalated Enforcement.

6. Stop Work Orders

A Stop Work Order is an Escalated Enforcement tool for active land development projects. A Stop Work Order is a written order prohibiting further construction or site development activity until compliance has been achieved. The Stop Work Order is an appropriate enforcement tool in any of the following circumstances:

- If prior written notices or orders have failed to result in compliance or correction of identified violations.
- If the developer/contractor has not complied with the requirements of their building and/or grading permit.
- If an observed violation poses a significant threat to water quality (such as a failure of BMPs resulting in a significant release of sediment or other pollutants off site).

A Stop Work Order will be issued by the inspector or the appropriate official. Stop work orders prohibit further construction activity until the problem is resolved and provide a time frame for correcting the problem.

The Stop Work Order will describe the violation and specify what corrective action must be taken. A copy of the Stop Work Order will be given to the contractor's project supervisor and placed in the active inspection file. For a private construction project, a copy of the Stop Work Order will also be sent to the owner/developer. To restart work once a Stop Work Order has been issued, the contractor's project supervisor must request the City's inspector to re-inspect the project and verify that the deficiencies have been satisfactorily corrected. If the City inspector is satisfied with the corrections, the inspector may sign off on that phase of the project, and work may proceed.

A Stop Work Order constitutes Escalated Enforcement.

7. Permit Revocation or Denial

Violations of the City's Ordinances may be grounds for the suspension or revocation of City issued permits, licenses or other approvals after notice and an opportunity for hearing. For instance, in severe cases of noncompliance, or significant discharges relating to development and/or construction activities, the City revoke grading and/or building permits or other approvals for a development project that a contractor/developer is working under for the project or deny future permits on the project. The responsible party would then have to re-apply for permits and meet any requirements that the City may place on the project. Suspension or revocation of permits or other approvals must be conducted in accordance with the procedures described in the City's Municipal Code. City Staff should consult with the Enforcing Attorney before proceeding with the suspension, revocation or denial of a permit or development approval.

Suspension or revocation of a permit constitutes Escalated Enforcement.

8. Enforcement of Contracts

If a contractor is performing work for the City, then the City may use the provisions within the contract for enforcement of noncompliance. Such contract provisions may allow the City to withhold payment(s), require bonds, apply monetary penalties, order work stopped (without time penalties), or terminate the contract if the contractor performing the work does not comply with all appropriate permits, laws, regulations and ordinances.

Enforcement of Contracts constitutes Escalated Enforcement.

9. Administrative Citations

The City's authorized enforcement staff may issue administrative citations imposing administrative fines for specified violations of the City's Ordinances in accordance with Article 2 of Division 3 of Title 1 of the City's Municipal Code. The fine amount for an initial violation may be relatively small for a first offense, but repeated violations of the same type will result in escalated fines, up to a maximum of $500 per violation per day. When an Administrative Citation is issued, the responsible party may request a hearing to contest the determination that a violation has occurred in accordance with Chapter 1.3-20 of the City's Municipal Code.

D. Criminal Enforcement

In addition to the administrative enforcement actions described above, the Enforcing Attorney is authorized to file criminal actions to enforce the City's Ordinances. Criminal prosecution is generally the last step taken to stop a condition of noncompliance; however, in some limited cases, criminal enforcement may be appropriate as a first step in enforcement if the facts indicate that the violation is severe, willful and egregious. Criminal prosecution will be appropriate if information or events indicate that noncompliance is (i) willful, (ii) fails to comply with the best management practices imposed on a New Development or Significant Redevelopment project, (iii) continues after notice of noncompliance is received, or (iv) is a direct attempt to conceal a violation of the City's Ordinances. Criminal prosecution may also be utilized for egregious violations which are the result of negligent rather than willful conduct.

Circumstances indicating that criminal, rather than administrative, enforcement measures should be considered include the following:

- There is strong evidence that the responsible party has willfully violated the City's Ordinances and/or has intentionally disregarded legal requirements.
- There is a significant threat of environmental harm as a result of the violation.
- There is actual sustained environmental harm as a result of the violation.
- The discharge or event of noncompliance is continuing or has been long in duration.
- No immediate remedy for the violation is available.
- There have been numerous previous violations by the same responsible party.

Where it is determined that the available facts warrant criminal enforcement in a particular case, additional evidence will often need to be collected to support a criminal prosecution, and the City may need to obtain a criminal inspection warrant from a court. City staff should consult with the Enforcing Attorney early in the process to ensure proper procedures are followed. Where criminal enforcement is indicated, authorized City personnel may cause issuance of a criminal citation to the offending party pursuant to Penal Code §853.5, §853.6, and §853.9. The citation shall include: (i) the name and address of the violator; (ii) the provisions of the City's Ordinances violated; and (iii) the time and place of required appearance before a magistrate. The responsible party must sign the citation thereby promising to appear. If the cited party refuses to sign the citation, the enforcement official may cause the arrest of the discharger with the assistance of law enforcement personnel, or may refer the matter to the Enforcing Attorney for issuance of a warrant for arrest.

At the discretion of the Enforcing Attorney, criminal violations of the City's Ordinances may be charged as either misdemeanors or infractions. Factors that the Enforcing Attorney may use in determining whether the misdemeanor is more appropriately treated as an infraction, rather than a misdemeanor, may include:

- The duration of the violation or threatened violation.
- The compliance history of the person, business or entity.
- The effort made to comply with an established compliance schedule.
- The existence of prior enforcement actions.
- The actual harm to human health or the environment from the violation.

Criminal Enforcement constitutes Escalated Enforcement.

E. Civil Judicial Enforcement

In addition to the administrative and criminal enforcement options discussed above, the City may also pursue civil judicial enforcement of violations where appropriate.

1. Civil Injunction/Nuisance Abatement Action

Violations of the City's Ordinances that constitute a threat to the public health, safety and welfare are deemed a public nuisance, and the Enforcing Attorney may file a civil judicial action seeking preliminary or permanent injunctive relief to enjoin and/or abate a nuisance or other threatened or continuing noncompliance. Such an action may be appropriate where a continuing or emergency nuisance exists, and administrative and/or criminal enforcement options are insufficient to remedy the nuisance condition. In any such action, the City may seek recovery of its actual enforcement and abatement costs.

A Civil Injunction / Nuisance Abatement Action constitutes Escalated Enforcement.

2. Civil Damages Action

Pursuant to the Water Quality Ordinance, the City may bring an action for civil damages against a responsible party to recover (i) enforcement costs incurred by the City; (ii) costs incurred by the City in mitigating harm to the environment or reducing the threat to human health; (iii) damages for irreparable harm to the environment; and/or (iv) damages resulting from any trespass or nuisance occurring on public land or to the Stormwater Drainage System as a result of a violation of the Water Quality Ordinance.

III. Illicit Discharge Detection and Elimination Enforcement Component

This Section of the ERP describes the City's approaches to investigating, responding to, and enforcing noncompliance with the City's Ordinances related to Illegal Discharges and Illicit Connections.

A. Overview

The City's Water Quality Ordinance expressly prohibits Illegal Discharges and Illicit Connections (ID/ICs), and the City implements a comprehensive program for actively detecting, responding to, investigating and eliminating ID/ICs in an efficient and timely manner (ID/IC Program). The City's ID/IC Program is described in more detail in LIP Section 10.

An Illicit Connection is an undocumented and/or unpermitted physical connection from a facility to the Stormwater Drainage System. Illicit Connections are often associated with Illegal Discharges. Constructed (i.e., man-made) Illicit Connections include pipelines, conduits, inlets or outlets, connected impervious areas, channels or swales. Practical examples of constructed Illicit Connections include: (i) pipes that discharge onto adjacent property or into a water runoff area; (ii) facilities constructed adjacent to construction areas that allow dewatering runoff to flow to the storm water drainage system; or (iii) storm drain inlets that drain from outside wash areas directly into the Stormwater Drainage System.

An Illegal Discharge (or "Prohibited Discharge") is any discharge to the Stormwater Drainage System that is not composed entirely of stormwater and that is not covered by an NPDES permit. An Illegal Discharge refers to the disposal of non-stormwater materials such as paint or waste oil into the storm drain or the discharge of waste streams containing pollutants to the storm drain. Illegal Discharges typically are generated from poorly managed on-site operations, illegal dumping, contaminated stormwater discharges, and/or sewage or other materials spills.

Various site operations may produce Illegal Discharges, including releases of (i) process waters such as boiler blow down, rinse water, or chlorinated pool discharges; (ii) waste materials such as manufactured floatable materials, animal wastes from kennels or riding stables, or vehicle fluids (oils, coolants, etc.); and (iii) sand/gravel, cement, fertilizers, or pesticides from raw materials unloading and storage areas. Practical examples of problematic site operations include: (i) pressurized washing and steam cleaning areas; (ii) auto repair shops where operations occur out of doors in unprotected areas and no provision is made for preventing contamination from leaving the site; (iii) non-retail fueling areas where vehicle washing also occurs and runoff flows to storm drain areas; (iv) manufacturing storage yards for concrete materials where materials are uncovered and wash off flows directly to the storm drain; (v) construction locations where debris, materials, and silt flows off the construction site; and (vi) trauma scene clean-up.

Illegal dumping activities include intentional dumping of: (i) household wastes such as home, garden or yard debris, trash or rubbish, or household hazardous wastes; (ii) commercial wastes such as landscape

debris or soil, trash or rubbish, or hazardous wastes in drums or canisters; and (iii) animal or agricultural wastes such as manure, stock wastes, fruit and vegetable materials and animal carcasses. Practical Examples of illegal dumping activities could include: (i) home/yard debris dumped near a curb inlet to the stormwater drainage system; (ii) trash, drums or discarded materials left on creek or wash area banks; (iii) used oil dumped on the ground or into storm drains; and (iv) paint waste dumped on the ground or into storm drains.

Stormwater pollution can also occur as rain water is contaminated running off of impervious surfaces. Though the runoff is due to storm events, Illegal Discharges can occur from the following:

- Construction work on an exposed site where soils are being tracked onto the street and washed down the gutter.
- Construction or work on an exposed site where materials, such as sand, are migrating into the street gutter area either through non-concentrated exposure to water, such as sprinkler systems, or by actual contact with other runoff water.
- Petroleum contained soils in equipment servicing areas, which are exposed to gutter areas through tracking.
- Uncovered areas of stockpiled construction demolition materials.
- Outside storage of unsealed paint and solvent containers.
- Exposed truck loading docks with uncovered materials.
- Equipment storage yards without runoff controls.

Sewage spills may be the result of an accidental or irregular discharges of sewage from a sanitary sewer system or from private property tributary to a public sewerage system. Pursuant to the Statewide General Waste Discharge Requirements for Sanitary Sewer Systems (State Water Resources Control Board, Order No. 2006-0003) and San Diego Regional Board Order No. R9-2007-0005, Moulton Niguel Water District is responsible for responding to, containing, and cleaning up sewage spills/incidents originating from their wastewater and sanitary systems, including systems that collect and convey wastewater to publicly owned treatment facilities. It is this agenciy's standard operating policy to respond to all sewage spills/incidents from private systems as well. MNWD has implemented an overflow emergency response plan that is used during sewage spills/incidents.

In addition, the City's Plumbing and Building Codes and Ordinances require that private sewer laterals and septic systems be designed and operated in accordance with industry standards and require the proper maintenance of these facilities in order to minimize possible spills, breakages, and failures. The City enforces these requirements if a sewage spill from private property or another private source is, or cannot be, effectively remedied by the owner or other responsible party. The City may also issue enforcement actions pursuant to this ERP to any party responsible for a prohibited discharge into the City's MS4.

B. Investigating and Responding to Noncompliance

The City may become aware of potential Illegal Discharges or Illicit Connections through field observations, facility or construction site inspections, Water Quality Monitoring Program results, or complaints. The protocols the City follows for investigating, documenting, and responding to Illegal Discharges and Illicit Connections are described in more detail in Section 10 of the LIP.

If a complaint or information is received that indicates a potential ID/IC, an Authorized Inspector will conduct a field investigation. If evidence of an actual or threatened ID/IC is found as a result of an inspection, every effort is made to identify the responsible party and resolve the situation quickly.

Any Illicit Connection identified by the City during routine inspections is investigated. Appropriate actions are then taken to either approve undocumented connections by permit procedure or to pursue removal of those connections that are determined to be Illicit Connections and not permissible. If evidence of an Illegal Discharge is detected and the source does not appear to be evident, a source investigation may be conducted to determine if the discharge is being conveyed through an Illicit Connection.

Parties found to be responsible for an Illegal Discharge are required to clean up and remove Pollutants to the maximum extent practicable. Where a responsible party is cooperative and responds in a timely manner, lower level enforcement actions may be sufficient to ensure compliance. The failure of a responsible party to cooperate and/or perform required clean-up will result in immediate Escalated Enforcement action.

Sewage spills and spills of other types of harmful Pollutants may require immediate remedial action. In cases where a spill presents an immediate threat to the Stormwater Drainage System or to human health or the environment, and the City knows who the responsible party is, the City will direct the responsible party to immediately contain and commence clean-up of the spill. For all sewer spills, the City will contact the appropriate sewering agency to respond. For spills other than sewer spills, where the City is unable to identify the responsible party, or the responsible party is able to effectively respond to contain and clean-up the spill immediately, the City will respond through Control One and the Water Implementation Agreement to secure resources to ensure the spill is contained and mitigated, and will conduct a source investigation to identify the responsible party.

C. Enforcement Response Approaches

The nature of the City's enforcement response approach for ID/ICs is determined on a case-by-case basis and is based on factors such as severity of the violation or threat to human health or the environment, site-specific circumstances, and past compliance history. If the situation is determined to pose an immediate risk to public health or the environment, higher level Escalated Enforcement responses may be used immediately and, if needed, the City will respond itself to ensure the threat is eliminated in a timely and efficient manner.

If a non-sewage spill, illegal dumping, or other Illegal Discharge is determined to pose a threat to human or environmental health, the City will report this information to the Regional Board by phone or e-mail within 24 hours of the discovery followed by a written report within 5 days, as required by the NPDES Permit. The sewering agency will do all reporting relating to sewage spills, including to the Orange County Health Care Agency in accordance with California Health and Safety Code Section 5411.5, and reports all sewage spills of 1,000 gallons or more from a public sewer system to the State Office of Emergency Services pursuant to California Water Code Section 13271 and the 23 CCR § 2250.

The City seeks to abate actual Illegal Discharges and hazardous materials spills as soon as reasonably possible. As required by the NPDES Permit, the City seeks to resolve all incidents of observed noncompliance within at least 30 calendar days, or prior to the next rain event, whichever is sooner. In cases where more than 30 days are required to resolve a violation and achieve compliance, the reasons why additional time is needed is documented and kept on file. If Escalated Enforcement is not used when compliance is not achieved within the required compliance period, the rationale for why Escalated Enforcement actions were not used will also be documented.

The following table provides a general overview of the City's enforcement response approach for ID/ICs. The descriptions in the Table as to when specific enforcement responses are used and appropriate timeframes for compliance are intended to be illustrative in nature and to provide general guidance to City enforcement staff, and are not intended to be exclusive or exhaustive. The City reserves the right to use whatever tools deemed most appropriate for a given situation, as dictated by the specifics of each case, and taking into account the factors described in Section II.A of this ERP.

Illicit Discharge Detection and Elimination Enforcement Approach

Enforcement Action	Use	Time Schedule to Achieve Compliance
Education Letter	) If suspect noncompliance, but lack sufficient evidence to substantiate it.) Use for business/resident where violation is by contractor and there is no history of noncompliance by business/resident.	Goal is to correct the situation and behavior.
Verbal Warning	) Use for threatened Illegal Discharges from poorly managed on-site operations, illegal dumping, contaminated water runoff, or spilled materials where there is no history of noncompliance and the violation is relatively minor and can be quickly and easily corrected.	Goal is to correct the violation immediately, if possible. If not, the compliance timeframe should be short and will depend on the nature of the potential threat to water quality. At a minimum, violation should be corrected within 30 calendar days or before the follow-up inspection or next predicted rain event, whichever is sooner.

Enforcement Action	Use	Time Schedule to Achieve Compliance
Notice of Noncompliance/Notice of Violation	) Use where a prior Verbal Warning was given, but the deficiency that was noted in a prior Verbal Warning has not been corrected within the specified timeframe or by the next inspection.) Use for threatened Illegal Discharges from Illicit Connections, poorly managed on-site operations, illegal dumping, contaminated water runoff, or spilled materials where the threat level is insignificant, there is no environmental harm, and the responsible party is cooperative and has already corrected, or is willing to readily correct, the condition causing the violation.) Use to order correction of conditions causing or contributing to an actual Illegal Discharge that has already ceased where the discharge occurred unknowingly, was an isolated incident, and was short in duration; the threat level is insignificant; there was no environmental harm; and the responsible party is cooperative and has shown a good faith effort to correct the condition causing the violation and to come into compliance.	Require immediate containment of spilled materials or Illegal Discharges, with a goal of completion of correction/cleanup within 24 hours. Conditions causing or contributing to an actual or threatened Illegal Discharge should be corrected within 30 calendar days or before the follow-up inspection or next predicted rain event, whichever is sooner. If more than 30 days is required to achieve compliance, then a written rationale must be documented and kept on file.

Enforcement Action	Use	Time Schedule to Achieve Compliance
Administrative Compliance Order	) Use where a prior Verbal Warning and/or Notice of Noncompliance has been insufficient to achieve compliance.) Use for threatened Illegal Discharges from Illicit Connections, poorly managed on-site operations, illegal dumping, contaminated water runoff, or spilled materials where the violations are not willful, the threat level is not significant, there is no immediate threat of environmental harm, and the responsible party has shown a good faith willingness to correct the condition causing the violation.) Use to order correction of conditions causing or contributing to an actual Illegal Discharge that has already ceased where there is no immediate threat to human health or the environment; the discharge was not willful, was not significant, and was infrequent or short in duration; the conditions causing or contributing to the Illegal Discharge cannot be remedied within a relatively short period of time; and the responsible party has indicated willingness to come into compliance by meeting milestones established in a reasonable schedule.	Require immediate containment of spilled materials or Illegal Discharges, with a goal of completion of correction/cleanup within 24 hours. Conditions causing or contributing to an actual or threatened Illegal Discharge should be corrected within 30 calendar days or before the follow-up inspection or next predicted rain event, whichever is sooner. If more than 30 days is required to achieve compliance, then a written rationale must be documented and kept on file.

Enforcement Action	Use	Time Schedule to Achieve Compliance
Cease and Desist Order	) Use to order immediate cessation of an Illegal Discharge or Illicit Connection.) Use to order immediate containment or diversion of any impermissible flow of water off of a site that poses a significant and/or immediate threat to water quality.) Use to order immediate cleanup of an area affected by an Illegal Discharge, sewage or materials spill, illegal dumping, or other violation.) Use to order immediate removal of nuisance conditions on property that threaten to cause an Illegal Discharge of Pollutants if exposed to rain or surface water runoff.) Use where lower level enforcement actions have not resulted in compliance and/or available information indicates that further authority of the City may need to be demonstrated before remedial action is forthcoming.) Use for recurring violations.	Generally, immediate. Where used other than to order immediate cessation of an actual or threatened ID/IC, the time schedule for compliance will vary based on the severity of the violation and will be determined on a case-by-case basis. In these circumstances, noncompliance should be corrected within 30 calendar days or before follow-up inspection or next predicted rain event, whichever is sooner. If more than 30 days is required to achieve compliance, then a written rationale must be documented and kept on file.
Nuisance Abatement / Spill Response	) Use for sewage or hazardous materials spills where there is a significant and immediate threat to human health or the environment.) Use where the responsible party has continually failed to comply with a previously issued compliance schedule.	Goal is immediate containment of spilled materials or Illegal Discharges, with a goal of completion of correction/cleanup within 24 hours.

Enforcement Action	Use	Time Schedule to Achieve Compliance
Administrative Citation	) May be used in addition to an Administrative Compliance Order or Cease and Desist Order where monetary sanctions will deter future violations.) May be used in lieu of an Administrative Compliance Order or Cease and Desist Order where a compliance schedule is unnecessary and will help deter future violations.) Use where an actual Illegal Discharge occurred, but ceased prior to other enforcement action.) Use where a prior Verbal Warning, Notice of Noncompliance, and/or Administrative Compliance Order has been insufficient to achieve compliance.) Use for recurring violations.	Time schedule for compliance will vary based on the severity of the violation and will be determined on a case-by-case basis. Conditions causing or contributing to an actual or threatened Illegal Discharge should be corrected within 30 calendar days or before the follow-up inspection or next predicted rain event, whichever is sooner. If more than 30 days is required to achieve compliance, then a written rationale must be documented and kept on file.
Enforcement of Contracts	) Use to address actual or threatened Illegal Discharges or Illicit Connections caused by City contractors.	Time schedule for compliance will be determined on a case-by-case basis.
Stop Work Order	) Use to order immediate cessation of construction or development activities where prior written notices or orders have failed to result in compliance or correction of identified violations.) Use to order immediate cessation of construction or development activities where a developer/contractor has not complied with the requirements of its building and/or grading permit.) Use to order immediate cessation of construction or development activities where if an observed violation at the site poses a significant threat to water quality (such as a failure of BMPs resulting in a significant release of sediment or other pollutants off site).	Effective immediately, all work, except work to remedy non-compliant situation, must cease.

Enforcement Action	Use	Time Schedule to Achieve Compliance
Permit Revocation / Denial	) Use in severe cases of noncompliance or significant Illegal Discharges relating to development and/or construction activities.	NA
Civil Action	) Use for violations that cause significant harm.) Use when response to administrative enforcement actions is inadequate or the responsible party fails to respond.	Time schedule for compliance will vary based on the severity of the violation and will be determined on a case-by-case basis.
Criminal Action	) Use in cases where the actual or threatened environmental harm from the violation is significant and there is strong evidence of willfulness or intentional disregard for legal requirements.) Use in cases where an Illegal Discharge, Illicit Connection, or related violation is frequent, ongoing, or long in duration and the responsible party has failed to respond to administrative enforcement actions.) Use where there is a history of repeated prior violations by the same responsible party.) Use where there has been a direct attempt to conceal an Illegal Discharge, Illicit Connection, or related violation.	Consult with Enforcing Attorney
Referrals	) Sites that fail to obtain state industrial or construction permits.) Sites that fail to comply with City enforcement actions.) Sites that discharge waste or hazardous wastes to receiving waters.	NA

IV. Development Planning Enforcement Component

This Section of the ERP describes the City's approaches to investigating, responding to, and enforcing noncompliance with permanent BMP implementation, operation and maintenance obligations associated with New Development and Significant Redevelopment.

A. Overview

The Water Quality Ordinance requires all New Development and Significant Redevelopment to be undertaken in accordance with the DAMP, the LIP, the City's New Development / Significant Redevelopment Program. In conjunction with the New Development / Significant Redevelopment Program, the City has established design standards for new development and significant redevelopment projects that require installation and implementation of permanent (post-construction) BMPs, including Low Impact Development (LID) techniques, hydromodification controls, source controls and treatment controls, to address the quality and quantity of stormwater runoff. These required BMPs are described in project-specific Water Quality Management Plans (Project WQMPs) and Non-Priority Project Water Quality Checklists (WQCs), which may be recorded, and which describe long-term BMP operation and maintenance requirements and identify the persons or entities responsible for funding and implementing ongoing BMP operation and maintenance. The New Development / Significant Redevelopment Program is more fully described in Section 7 of the LIP.

This Development Planning Enforcement Component describes the enforcement response approaches the City takes to ensure that required permanent BMPs are properly installed and implemented during construction and thereafter appropriately operated and maintained.

B. Investigating and Responding to Noncompliance

The City verifies required permanent BMPs are included in project designs through its development review and plan check process. All permanent structural BMPs must be shown on the grading and/or building plans, and building and/or grading permits will not be issued to allow construction to begin before all plans have been approved. In addition, Project WQMPs and WQCs must be approved by City before grading or building permits will be issued.

During a project's construction phase, City inspectors confirm that required structural BMPs are being constructed per plan during their routine inspections. If structural BMP construction or installation varies from approved plans, the City requires in-field corrections be made, or for the project engineer to confirm that revisions continue to comply with project requirements. Any proposed revisions must be approved by applicable City planning or engineering staff. Prior to grading or building permit close-out and/or the issuance of a certificate of use or a certificate of occupancy, the City will verify that all required permanent structural BMPs have been constructed and installed in conformance with approved plans and specifications and that, if applicable, and Operations and Maintenance (O&M) Plan for all structural BMPs has been prepared and approved by the City.

Once a development project has been completed, ongoing operation and maintenance of post-construction BMPs is verified through inspections or through review of submitted maintenance verification certifications. Where operation or maintenance deficiencies are discovered, they are documented and the responsible party is directed to take necessary corrective actions. Minor deficiencies and corrective actions may warrant resolution through Education Letters or documented Verbal Warnings, and if the responsible party performs all necessary corrective actions promptly, the case is closed and the resolution is documented. Where determined appropriate, the City will issue a Notice of Noncompliance/Notice of Violation or Administrative Compliance Order setting forth required corrective actions as its initial enforcement response. Responsible parties are required to perform

corrective actions and demonstrate that all necessary operations and maintenance activities have been completed through re-inspection and/or submittal of appropriate documentation. Where initial enforcement actions fail to result in corrective action, the City will pursue Escalated Enforcement until compliance is achieved. The City's enforcement response approach for the Development Planning and Enforcement Component is described more fully below.

C. Enforcement Response Approaches

The nature of the City's enforcement response approach to operating and maintenance deficiencies for permanent BMPs is determined on a case-by-case basis and is based on factors such as severity of the violation, site-specific circumstances, and past compliance history. If the situation is determined to pose an immediate risk to public health or the environment, higher level Escalated Enforcement responses may be used initially, and the City will report this information to the Regional Board by phone or e-mail within 24 hours of the discovery followed by a written report within 5 days, as required by the NPDES Permit.

As required by the NPDES Permit, the City seeks to resolve incidents of observed noncompliance within 30 calendar days, or prior to the next rain event, whichever is sooner. In cases where more than 30 days are required to resolve a violation and achieve compliance, the reasons why additional time is needed is documented and kept on file. If Escalated Enforcement is not used when compliance is not achieved within the required compliance period, the rationale for why Escalated Enforcement actions were not used will also be documented.

The following table provides a general overview of the City's enforcement response approach when it discovers that permanent BMPs are not being operated and maintained as required. The enforcement response approaches described in Section III (Illicit Discharge Detection and Elimination Enforcement Component) and Section VI (Existing Development Enforcement Component) of this ERP may also apply. The descriptions in the Table as to when specific enforcement responses are used and appropriate timeframes for compliance are intended to be illustrative in nature and to provide general guidance to City enforcement staff, and are not intended to be exclusive or exhaustive. The City reserves the right to use whatever tools deemed most appropriate for a given situation, as dictated by the specifics of each case, and taking into account the factors described in Section II.A of this ERP.

Development Planning Enforcement Approach

Enforcement Action	Use	Time Schedule to Achieve Compliance
Education Letter	) If suspect noncompliance, but lack sufficient evidence to substantiate it.) May use to advise responsible party of legal obligations where O&M deficiencies are minor and easily correctable and there have been no previous violations.) May be used for first-time administrative violations, such as failure to submit a timely compliance certification.	Goal is to educate responsible party and remedy O&M deficiency. Noncompliance should be corrected within 30 calendar days or before next inspection or predicted rain event, whichever is sooner.
Verbal Warning	) Use to advise responsible party of legal obligations where O&M deficiencies are minor and easily correctable, there is no threat to water quality, there is no history of prior noncompliance, and the responsible party is cooperative and has indicated a willingness to immediately correct the problem.	Noncompliance should be corrected immediately, if possible, but at least within 30 calendar days or before follow-up inspection or next predicted rain event, whichever is sooner.
Notice of Noncompliance/Notice of Violation	) Use where a prior Verbal Warning was given, but the deficiency that was noted in a prior Verbal Warning has not been corrected within the specified timeframe or by the next inspection.) Use for recurring administrative violation.) Use where the severity of the BMP O&M deficiency calls for an enforcement action stronger than a Verbal Warning, but the violation was unknowing and the responsible party is cooperative and has shown a good faith effort to immediately correct the observed O&M deficiency.	Noncompliance should be corrected within 30 calendar days or before follow-up inspection or next predicted rain event, whichever is sooner. If more than 30 days is required to achieve compliance, then a written rationale must be documented and kept on file.

Enforcement Action	Use	Time Schedule to Achieve Compliance
Administrative Compliance Order	) Use where a prior Verbal Warning and/or Notice of Noncompliance has been insufficient to achieve compliance.) Use for recurring, but not significant, violations involving BMP O&M deficiencies.) Use for BMP O&M deficiencies that are not willful and pose no immediate threat to human health or the environment, but which cannot be remedied within a relatively short period of time.) Use to order implementation of a required BMP.) Use to order repair or replacement of a structural BMP or control device that is defective or has been removed.	Noncompliance should be corrected within 30 calendar days or before follow-up inspection or next predicted rain event, whichever is sooner. If more than 30 days is required to achieve compliance, then a written rationale must be documented and kept on file.
Cease and Desist Order	) Use where BMP O&M deficiencies pose an immediate threat of a significant Illegal Discharge.) Use where lower level enforcement actions have not resulted in compliance and/or available information indicates that further authority of the City may need to be demonstrated before remedial action is forthcoming.) Use for significant recurring violations of BMP O&M requirements.	Immediate compliance should be required where there is an imminent threat of a significant Illegal Discharge. Otherwise, the time schedule for compliance will vary based on the severity of the violation and will be determined on a case-by-case basis. Where possible, noncompliance should be corrected within 30 calendar days or before follow-up inspection or next predicted rain event, whichever is sooner. If more than 30 days is required to achieve compliance, then a written rationale must be documented and kept on file.
Nuisance Abatement	) Use where the responsible party has continually failed to comply with a previously issued compliance schedule.	Time schedule for compliance will vary based on the severity of the violation and will be determined on a case-by-case basis.

Enforcement Action	Use	Time Schedule to Achieve Compliance
Administrative Citation	) May be used in addition to an Administrative Compliance Order or Cease and Desist Order where monetary sanctions will deter future violations.) May be used in lieu of an Administrative Compliance Order or Cease and Desist Order where a compliance schedule is unnecessary and will help deter future violations.) Use where a prior Verbal Warning, Notice of Noncompliance, and/or Administrative Compliance Order has been insufficient to achieve compliance.) Use for recurring violations.	Time schedule for compliance will vary based on the severity of the violation and will be determined on a case-by-case basis. Generally, noncompliance should be corrected within 30 calendar days or before the follow-up inspection or next predicted rain event, whichever is sooner. If more than 30 days is required to achieve compliance, then a written rationale must be documented and kept on file.
Civil Action	) Use when response to administrative enforcement actions is inadequate or the responsible party fails to respond.) Use to obtain a civil injunction requiring restoration or replacement of a required structural BMP that has been improperly removed or is no longer operational.	Time schedule for compliance will vary based on the severity of the violation and will be determined on a case-by-case basis.
Criminal Action	) Use in cases where there is strong evidence of willfulness or intentional disregard for legal requirements, the responsible party has failed to respond to administrative enforcement actions, there is a history of repeated prior violations by the same responsible party, and/or there has been a direct attempt to conceal a violation.	Consult with Enforcing Attorney
Referrals	) Sites that fail to obtain state industrial or construction permits.) Sites that fail to comply with City enforcement actions.) Sites that discharge waste or hazardous wastes to receiving waters.	NA

V. Construction Management Enforcement Component

This Section of the ERP describes the City's approaches to investigating, responding to, and enforcing noncompliance with the City's Ordinances at public and private construction sites within the City.

A. Overview

All construction projects in the City, regardless of size, are required to implement BMPs to prevent Illegal Discharges of Pollutants into the Stormwater Drainage System or watercourses. The City has established a minimum set of BMPs and other measures to be implemented at all construction sites year round. All private and public works construction projects are required, at a minimum, to implement and be protected by an effective combination of erosion and sediment controls and waste and materials management BMPs. In addition, the City requires enhanced or additional BMPs should the project site pose an exceptional threat to water quality. The City's Construction Program and the City departments and staff responsible for overseeing, implementing, and enforcing it, are described in Section 8 of the LIP.

Construction sites that are subject to the Construction General Permit are required to prepare and implement a Storm Water Pollution Prevention Plan (SWPPP). Before issuing a grading or building permit, the City will require proof of Construction General Permit coverage. Private construction projects not covered by the General Permit, but covered under a grading permit, are required to develop Erosion and Sediment Control Plans (ESCPs) that show proposed locations of the erosion and sediment control BMPs that will be implemented during the construction project.

B. Investigating and Responding to Noncompliance

The City performs inspections of construction sites to verify that appropriate BMPs and other requirements for water quality protection are being implemented and maintained, that they appropriately comply with the City's Ordinances and the Construction General Permit, and that they continue to protect water quality. Construction sites are inspected, according to the established priority, until construction activity is complete. Threats to water quality are assessed by the City's Authorized Inspectors for construction site runoff that will not be reasonably controlled by the BMPs in place or if a failure of BMPs is resulting in the release of sediments or other Pollutants. Violations observed are documented by the inspectors, and appropriate enforcement actions are taken.

If a significant and/or immediate threat to water quality is observed by an Authorized Inspector, action is taken to require the developer/contractor to immediately cease the discharge and appropriate enforcement action is taken. The City's enforcement response approaches to violations at constructions sites are also described further in the following Section.

Although the City does not enforce the Construction General Permit, violations of the City's Ordinances or project permit conditions and plans may also be considered a violation of the General Construction Permit for sites subject to those requirements. When a construction site is subject to the General Construction Permit, City staff may also collaborate with Regional Board staff on enforcement actions.

C. Enforcement Response Approaches

The City's enforcement response approach to construction sites differs based on whether it is a private construction project or a City public works construction project. In either case, however, violations

determined to pose an immediate risk to public health or the environment will warrant the use of Escalated Enforcement responses. The following Table outlines the range and progression of enforcement actions that may be taken by the City with respect to both private construction projects and public works construction projects.

Enforcement Actions for Violations at Construction Sites

PRIVATE CONSTRUCTION PROJECTS	← ENFORCEMENT PROGRESSION	PUBLIC WORKS CONSTRUCTION PROJECTS
Verbal Warning		Verbal Warning
Written Warning ▪ Notice of Noncompliance/Notice of Violation ▪ Administrative Compliance Order ▪ Administrative Citations or Fines ▪ Cease and Desist Order		Written Warning ▪ Notice of Noncompliance/Notice of Violation
Stop Work Order		Enforcement of Contract ▪ Stop Work Order ▪ Withholding of Payment ▪ Bond ▪ Fines ▪ Revocation of Contract
Revocation of Permit(s) and/or Denial of Future Permits		
Civil and Criminal Court Actions		Civil and Criminal Court Actions

As required by the NPDES Permit, the City's NPDES Coordinator will notify the Regional Water Board in writing within five (5) calendar days of issuing Escalated Enforcement to a construction site that poses a significant threat to water quality as a result of violations or other noncompliance. Written notification may be provided to the appropriate Regional Water Board staff member by email. The City's NPDES Coordinator will also notify the Regional Board of any persons required to obtain coverage under the Construction General Permit and failing to do so, within five (5) calendar days from the time the City becomes aware of the circumstances. Written notification may be provided electronically by email to RB9_Nonfilers@waterboards.ca.gov.

The City seeks to resolve violations at both private and public works construction sites as quickly as possible, including prior to rain events where feasible. As required by the NPDES Permit, the City seeks to resolve incidents of observed noncompliance within 30 calendar days, or prior to the next rain event, whichever is sooner. In cases where more than 30 days are required to resolve a violation and achieve compliance, the reasons why additional time is needed is documented and kept on file. If Escalated Enforcement is not used when compliance is not achieved within the required compliance period, the rationale for why Escalated Enforcement actions were not used will also be documented.

A general overview of the City's enforcement response approach to violations at private construction sites and public works construction sites is set forth below. For violations at construction sites resulting in actual or threatened Illegal Discharges, refer to the enforcement response approaches described in Section III (Illicit Discharge Detection and Elimination Enforcement Component of this ERP. The overview below is intended to be illustrative in nature and to provide general guidance to City enforcement staff, and is not intended to be exclusive or exhaustive. The City reserves the right to use whatever tools deemed most appropriate for a given situation, as dictated by the specifics of each case, and taking into account the factors described in Section II.A of this ERP.

The nature of the City's enforcement response approach to violations at construction sites is determined on a case-by-case basis and is based on factors such as severity of the violation, site-specific circumstances, and the contractor's past compliance history. If the situation is determined to pose an immediate risk to water quality, higher level Escalated Enforcement responses may be used initially. The following charts depict the range of enforcement options available for violations at private and public works construction sites, respectively, and are intended to provide guidance to Authorized Inspectors in determining what enforcement response is appropriate for a given violation.

Enforcement of Noncompliance for Private Construction Projects

ENFORCEMENT OPTIONS	ACTIONS			CRIMINAL ACTIONS
	NOTICE OF NONCOMPLIANCE /NOTICE OF VIOLATION	ADMINISTRATIVE COMPLIANCE ORDER / ADMINISTRATIVE CITATION	CEASE & DESIST STOP WORK ORDER REVOCATION OF PERMIT(S)	INFRACTIONS AND MISDEMEANORS
COMPLIANCE STRATEGY				
Threat Level	Insignificant	No: Significant	May be Significant	Significant
Environmental Harm	None	No: Immediate	Potential/Immediate	Actual Immediate
Event Duration	Short	Short	Long/Continuous	Long/Continuous
Event Frequency	Isolated	Infrequent	Frequent/Ongoing	Frequent/Ongoing
Cooperation	Readily Complies	Working to Comply	Uncooperative/ Slow to Comply	Non-Responsive
Intent	Unknowingly	No: Willful	Possibly Willful	Willful

Enforcement of Noncompliance for Public Works Construction Projects

ENFORCEMENT OPTIONS	ACTIONS		CRIMINAL ACTIONS
	NOTICE OF NONCOMPLIANCE /NOTICE OF VIOLATION	CONTRACT REMEDIES	INFRACTIONS AND MISDEMEANORS
COMPLIANCE STRATEGY			
Threat Level	Insignificant	No: Significant	May be Significant	Significant
Environmental Harm	None	No: Immediate	Potential/Immediate	Actual Immediate
Event Duration	Short	Short	Long/Continuous	Long/Continuous
Event Frequency	Isolated	Infrequent	Frequent/Ongoing	Frequent/Ongoing
Cooperation	Readily Complies	Working to Comply	Uncooperative/ Slow to Comply	Non-Responsive
Intent	Unknowingly	No: Willful	Possibly Willful	Willful

- Verbal Warnings (both private and public works construction projects)

For insignificant violations that do not pose an immediate threat to water quality, the initial method of requesting corrective action and enforcing compliance will typically be a Verbal Warning from the

Authorized Inspector to the contractor. Verbal warnings are often sufficient to achieve correction of the violation, often while the Authorized Inspector is present at the construction site. The Authorized Inspector will notify the developer/contractor's project supervisor of the violation, and document the violation and the notification to the contractor's project supervisor in the inspection file. A specific time frame for correcting the problem and a follow-up inspection date will be documented by the inspector.

- Written Warnings (both private and public works construction projects)

If a deficiency that was noted in a prior Verbal Warning is not corrected by the next inspection, or the severity of the violation is such that a Verbal Warning is not strong enough, a written warning will be issued. A written warning will describe the deficiency that is to be corrected, suggested corrective action(s), and the specific time frame for correction and a date for a follow-up inspection. A copy of the written warning will be provided to the contractor's project supervisor and another copy will be provided to the owner/developer. A copy will be placed in the active inspection file. Once the violation has been corrected to the satisfaction of the inspector, the inspector will document compliance in the inspection file.

For private construction projects, written warnings may range from a Notice of Noncompliance/Notice of Violation, Administrative Compliance Order, Administrative Citation, or Cease and Desist Order – depending on the severity of the of the violation or threat to water quality and the responsiveness and compliance history of the contractor. For public works construction projects, a Notice of Noncompliance/Notice of Violation serves as the only form of written warning given.

- Contract Enforcement Mechanisms (public works construction projects only)

If a contractor is performing construction of a public works project on behalf of the City, then the City will use the provisions within the contract for enforcement of noncompliance where verbal or written warnings prove insufficient. Such contract provisions may allow the City to withhold payment(s), require bonds, apply monetary penalties, order work stopped (without time penalties), or terminate the contract if the contractor performing the work does not comply with all appropriate permits, laws, regulations and ordinances.

- Stop Work Orders (private construction projects only)

If a written warning has not been addressed by the next inspection, or if the developer/contractor has not complied with their permit requirements, or if a significant threat to water quality is observed (such as a failure of BMPs resulting in a significant release of sediment or other pollutants off site), a Stop Work Order will be issued by the inspector or the appropriate official. Stop Work Orders prohibit further construction activity until the problem is resolved and provide a time frame for correcting the problem. The Stop Work Order will describe the infraction and specify what corrective action must be taken. A copy of the Stop Work Order will be given to the contractor's project supervisor and placed in the active inspection file. For a private construction project, a copy of the Stop Work Order will also be sent to the owner/developer. To restart work once a Stop Work Order has been issued, the contractor's project supervisor must request the inspector to re-inspect the project and verify that the deficiencies have been satisfactorily corrected. If the inspector is satisfied with the corrections, the inspector may sign off on that phase of the project, and work may proceed.

- Revocation of Permit(s) and/or Denial of Future Permits (private construction projects only)

In severe cases of noncompliance or significant discharges at private construction sites, it may be necessary to revoke the grading and/or building permit that a developer/contractor is working under. The developer/contractor would then have to re-apply for permits and meet any requirements that the City may place on the project. Revocation of building or grading permits must be conducted in accordance with the process described in the City's Municipal Code. City Staff should consult with the Enforcing Attorney before proceeding with revocation of permits.

- Civil and Criminal Court Actions

In cases of severe and repeated noncompliance, Civil and/or Criminal court actions may be appropriate. Whether to pursue Civil or Criminal enforcement remedies will be determined in consultation with the Enforcing Attorney.

VI. Existing Development Enforcement Component

This Section of the ERP describes the City's approaches to investigating, responding to, and enforcing noncompliance with the City's Ordinances with respect to existing municipal, commercial and industrial, and residential development.

A. Overview

As required by the NPDES Permit, the City has implemented an Existing Development Management Program pursuant to which it inventories and tracks existing municipal, industrial, commercial, and residential development in the City; requires the implementation, operation, and maintenance of pollution prevention BMPs for activities associated with municipal, industrial, commercial, and residential activities; and periodically inspects inventoried existing development to ensure and enforce proper BMP implementation and compliance with the City's Ordinances. The City's Existing Development Management Program, is divided into separate Municipal, Industrial/Commercial, and Residential Programs. The Existing Development Management Program overlaps with the City's ID/IC and New Development/Significant Redevelopment Programs, and the problematic activities, types of violations, and enforcement response approaches described in Section III (Illicit Discharge Detection and Elimination Enforcement Component) and Section IV (Development Planning Enforcement Component) of this ERP also generally apply to existing development. In addition, summaries of applicable pollution prevention BMPs municipal facilities, industrial and commercial facilities, residential activities, and homeowners' associations / common interest developments can be found in in Sections 5 and 9 of the LIP.

B. Investigating and Responding to Noncompliance

1. Municipal Facilities and Areas

The City inspects and implements appropriate BMPs for Municipal facilities and areas in accordance with the requirements of the NPDES Permit. During routine municipal facility inspections, City or contract staff will assess facility areas and activities to ensure all are maintained in accordance with City regulations, ordinances and BMP requirements. If BMPs are found to be deficient or otherwise ineffective, the responsible party or department will be provided corrective actions. If the responsible City staff member or department does not perform the necessary corrective actions in response to the direction of their immediate supervisor, escalated enforcement will be taken by involving higher ranking

representatives within the responsible department, who may enact internal disciplinary procedures, until the deficiencies are resolved.

If the City determines that specific areas of a leased City facility require additional BMPs, the City often can require the implementation of BMPs in addition to the required minimum BMPs for the specific area/activity. If a leased City facility continues to be out of compliance, the City may choose to discontinue the lease and remove the tenant from the site.

2. Industrial and Commercial Development

a. Fixed Facilities

The City inspects commercial and industrial facilities to determine if they are in compliance with City's Ordinances, to review BMP implementation, to assess BMP effectiveness and to verify inventory information used for facility prioritization. Such inspections include review of: (i) material and waste handling and storage practices; (ii) pollution control BMP implementation and maintenance; and (iii) evidence of past or present unauthorized, non-stormwater discharges. The City will generally conduct on of two types of inspections, compliance inspections and follow-up inspections.

Initial compliance inspections are announced and focus on current facility operations and activities, BMPs currently in use, the effectiveness of those BMPs, and verifying inventory spreadsheet information. All re-occurring compliance inspections cover the same information as an initial compliance inspection, but will typically be unannounced in order to verify compliance and that BMPs are being effectively implemented.

For those facilities deemed to be non-compliant, the City will perform compliance inspections once a month until said facilities are shown to be complaint, and then once every four months for a full calendar year after the facility achieves compliance. Generally, these inspections will focus primarily on areas where a facility was deemed to be non-compliant and may be either announced or unannounced, depending on which course of action the Authorized Inspector deems will be most conducive to continued facility compliance.

Appropriate enforcement actions are taken against industrial and commercial facility owners and operators determined to be out of compliance. The Authorized Inspector will document each observed violation. Depending on the severity of the violation, enforcement actions can range from a verbal warning to civil or criminal court actions with monetary fines. Illegal Discharges and Illicit Connections from industrial and commercial facilities are investigated and responded to as described in Section III of this ERP. If an Authorized Inspector observes a significant and/or immediate threat to water quality, enforcement action will be taken to require the facility owner/operator to immediately cease and correct the discharge or activity and the City will coordinate notification of the appropriate agencies. Conditions that would warrant such action may include observations of runoff from an industrial site that are not reasonably controlled by protective measures or observation of a failure in BMPs resulting in an actual or threatened discharge of Pollutants to the Stormwater Drainage System or a water body. Escalated Enforcement measures will be implemented as needed to achieve compliance. The City may also require industrial/commercial facilities to implement monitoring programs where warranted.

b. Mobile Businesses

Stormwater violations associated with mobile car wash and surface cleaner businesses include Illegal Discharges and failure to properly implement specific activity-based BMPs required of such businesses. The City may become aware of violations associated with mobile cleaning businesses from complaints, field observations, or inspections. Where violations are observed, they are documented and appropriate enforcement actions are taken against mobile business owners and operators. Depending on the severity of the violation, enforcement actions can range from a verbal warning to civil or criminal court actions with monetary fines. If an Authorized Inspector observes a significant and/or immediate threat to water quality, enforcement action will be taken to require the mobile business owner and/or operator to immediately cease the discharge and/or implement the required BMPs. Illegal Discharges associated with mobile businesses are investigated and responded to as described in Section III of this ERP

3. Residential Development

Enforcement actions may be initiated by the City as a response to hotline reports and complaints, or by observations by City representatives. All enforcement actions will be documented

Enforcement of BMPs in common interest developments will be conducted using the following mechanisms: public reporting hotline, analysis of dry weather/illicit discharge monitoring results, and municipal employee observations.

The City may become aware of potential violations associated with activities on residential property through public reporting or complaints or through field observations of City personnel or contractors during residential area inspections, during scheduled dry weather water quality monitoring, and or during routine City activities such as Stormwater Drainage System inspections and maintenance. Additional, focused investigations of areas upstream of outfalls where Pollutants are identified during monitoring activities and complaint response investigations provide additional information sources. The combination of public reporting, direct observations, targeted investigations, and in-field monitoring provide effective oversight of residential areas and activities.

During investigations of incidents discovered through these mechanisms, the City will continue to use the opportunity to address any other issues of concern and provide education and outreach to residential property owners, occupants, and managers as appropriate to notify and urge them to observe designated BMPs for the high threat activities. When residential BMP deficiencies are observed, follow-up inspections will be performed and violations investigated within a reasonable timeframe.

Illegal Discharges and Illicit Connections from residential properties are investigated and responded to as described in Section III of this ERP. Other violations of the City's Ordinances will also be investigated and documented, and, depending on the nature and severity of the violation, the enforcement may consist of any of the enforcement measures described in this ERP.

C. Enforcement Response Approaches

The nature of the City's enforcement response approach to violations associated with Existing Development is determined on a case-by-case basis and is based the nature of the violation and on factors such as severity of the violation or threat to human health or the environment, site-specific circumstances, and past compliance history. Except as otherwise described in Subsection B, above, the

City's enforcement response approaches to violations associated with Existing Development will be the same as the City's enforcement response approaches described Section III (Illicit Discharge Detection and Elimination Enforcement Component) and Section IV (Development Planning Enforcement Component) of this ERP. As described in other components of this ERP, if a particular violation is determined to pose an immediate risk to public health or the environment, higher level Escalated Enforcement responses may be used immediately and, if needed, the City will respond itself to ensure the threat is eliminated in a timely and efficient manner.

As required by the NPDES Permit, the City seeks to resolve incidents of observed noncompliance within 30 calendar days, or prior to the next rain event, whichever is sooner. In cases where more than 30 days are required to resolve a violation and achieve compliance, the reasons why additional time is needed is documented and kept on file. If Escalated Enforcement is not used when compliance is not achieved within the required compliance period, the rationale for why Escalated Enforcement actions were not used will also be documented.

When a site is subject to the Industrial General Permit, the City may collaborate with Regional Board staff on enforcement actions. In addition, as required by the NPDES Permit, the City's NPDES Coordinator will notify the Regional Board of any persons required to obtain coverage under the Industrial General Permit and failing to do so, within five (5) calendar days from the time the City becomes aware of the circumstances. Written notification may be provided electronically by email to RB9_Nonfilers@waterboards.ca.gov.

5.0 MUNICIPAL ACTIVITIES

5.1 INTRODUCTION

Municipal facilities within the City of Laguna Niguel include public parks, administration buildings, community facilities, sports fields and a number of other city owned properties. The City also conducts activities and operations to maintain the urban infrastructure such as street and sidewalk repair, storm drain system cleaning and maintenance and graffiti removal. Stormwater BMPs and programs associated with these facilities and activities are described below. Integrating water quality protection into routine municipal programs supports both the principal requirements of the Fifth Term Permit and effectively address two (2) of the HPWQCs identified in the WQIP, specifically, unnatural water balance in dry weather and pathogen health risk.

The purpose of the Municipal Activities Program is to reduce municipal discharges of stormwater pollutants from the MS4 to the MEP and prevent municipal discharges from the MS4 from causing or contributing to a violation of water quality standards. The Model Municipal Activities Program described in Section 5 of the Orange County Drainage Area Management Plan (DAMP) was used as guidance for the City's program, within the basic framework set out by the Permit. This section describes guidelines and procedures specifically for the City of Laguna Niguel.

5.1.1 Municipal Program Management

The program structure and City department responsible for overseeing, implementing, and enforcing the Municipal Activities program within public rights-of-way and at City-owned facility sites are identified in Section 2, Program Management. As detailed in Section 2, a number of functions traditionally provided by municipalities are subcontracted out rather than provided by City staff in Laguna Niguel, so implementation of the Municipal program is coordinated by the Public Works Department between several City departments, County agencies, privately-owned construction and maintenance subcontractors, and the water/sewer district, which is a separate agency.

5.2 MUNICIPAL INVENTORY AND SOURCE IDENTIFICATION

As required by Provision E.5.a, the City maintains a GIS database with a watershed-based inventory of municipal areas and activities. The inventory includes the name, address, and a description of the area/activity; which pollutants are potentially generated by the area/activity; whether the area/activity is adjacent to an Environmentally Sensitive Area; and identification of whether the area/activity is tributary to a Clean Water Act Section 303(d) water body segment and generates pollutants for which the water body segment is impaired. The inventory map is attached as Exhibit 5.I and detailed in a table in Exhibit 5.III. The inventory is updated as needed when significant capital improvement projects are completed.

5.3 GENERAL BMP IMPLEMENTATION

As required by Provision E.5.b(1), the City integrates pollution prevention methods and minimum designated BMPs into its routine municipal activities, and requires their use by all municipal departments, personnel, and contractors, as appropriate. City Public Works staff and subcontractor operations at fixed facilities, within field programs, and at drainage facilities are carried out in compliance with pollution prevention methods and minimum BMPs incorporated into the City's Activity-Specific BMP Checklists, which are attached as Exhibit 5.II and are typically incorporated into contract specifications for the City's subcontractors, as applicable. The various types of municipal maintenance activities for which Activity Specific BMP Checklists have been developed are listed below.

Field Procedures	**Fixed Facilities**	**Drainage Facilities**
FP-2 Landscape Maintenance	FF-2 Building Maintenance/Repair	DF-1 Drainage System
FP-2A Irrigation Runoff	FF-3 Equipment Main./Repair	
FP-2B Integrated Pest Management	FF-4 Fueling	
FP-3 Roads, Streets & Highways	FF-6 Material Loading/Unloading	
FP-4 Sidewalk, Plaza & Fountains	FF-7 Material Storage, Handling & Disposal	
FP-5 Solid Waste Handling	FF-8 Minor Construction	
FP-6 Water & Sewer Utility O&M	FF-9 Parking Lot Maintenance	
FP-8 Power Washing/Surface Cleaning	FF-10 Spill Prevention & Control	
	FF-11 Vehicle & Equipment Cleaning	
	FF-12 Vehicle & Equipment Storage	
	FF-13 Waste Handling & Disposal	
	FF-14 Special Event Venues	

The Activity-Specific BMP Checklists include Suggested Implementation Strategies for each BMP to help guide the inspector and operator in evaluating performance, and in identifying alternative strategies if operational history, inspection findings, or other special situations warrant implementation. Operations subcontracted to County agencies are carried out in accordance with equivalent pollution prevention procedures and BMPs outlined in the DAMP Model Maintenance Program. Emergency and non-emergency activities conducted by the Orange County Fire Authority are undertaken in conformance with the Fire Authority's Waste Water Discharge/Best Management Practice Standard Operating Procedures (Exhibit 5.VII). Emergency Fire Authority operations utilize stormwater and non-stormwater BMPs as conditions allow. The BMPs and Suggested Implementation Strategies in the Activity Specific Checklists are reviewed as needed by the City and may be updated to improve efficacy and usability.

Provision B.2.a requires the City to implement enhanced measures for municipal areas and activities tributary to CWA Section 303(d) impaired water body segments when an area or activity generates pollutants for which the water body segment is impaired; or when an area or activity occurs within, directly adjacent to, or discharging directly to receiving waters within Environmentally Sensitive Areas (ESAs, as described in LIP Section 1). Drainage from a few residential streets along the City's borders discharges to NCCP ESAs with Wildlife Beneficial Use, which are considered sensitive to toxics and sediments. However, the contributory areas are fully built out, so that sediments are not typically considered problematic; and flow does not reach ESA receiving waters except in major storms. Over two-thirds of the City is located within areas that are tributary to creeks that are 303(d)-listed for bacteria, nutrients, and/or toxics/metals, where enhanced measures associated with landscape maintenance and integrated pest management (IPM) activities would be most relevant. However, because the City's Landscape Field Maintenance Program subcontracts are city-wide, the City requires enhanced measures for these activities consistently citywide to simplify administration, rather than differentiating by geographic subarea. The Suggested Implementation Strategies in the Activity Specific Checklist for landscape maintenance/IPM also include potential structural BMP retrofits to be considered, for which 303(d) and ESA-contributory areas are given priority (subject to the availability of funding), if such improvements would be cost-effective.

Exhibit 5.III summarizes pollution prevention, minimum BMPs and enhanced measures that the City implements, or requires to be implemented, for high priority and for other municipal areas and activities within the City's inventory, in accordance with Provision E.5.b. All BMPs are assessed, verified and evaluated for effectiveness during municipal facility inspections, as discussed under Section 5.5.

5.3.1 BMP Implementation for Management of Pesticides, Herbicides, and Fertilizers

The City implements BMPs compliant with Provision E.5.b to reduce the contribution of storm water pollutants associated with the application, storage, and disposal of pesticides, herbicides and fertilizers from municipal areas and activities to MS4s and receiving waters, in accordance with its Integrated Pest Management Policy and Implementation Guidelines (see BMP Sheet FP-2B in Exhibit 5.II). Designated BMPs are included in maintenance contract specifications and are assessed, verified and evaluated for effectiveness during municipal activity inspections. Up-to-date certification as a licensed pest control applicator is a subcontractual requirement for any contractors using pesticides or herbicides.

5.3.2 BMP Implementation for Flood Control Structures

The City initiates planning of a significant new or retrofit flood control or stream restoration capital improvement project, the City incorporates an assessment of potential erosion and sedimentation impacts on the water quality of receiving water bodies into its CEQA procedures, and implements water quality mitigation measures as applicable and feasible. For flood control device retrofit projects categorically exempt from CEQA, the City incorporates erosion and sedimentation protection measures where applicable. When evaluating its existing flood control devices for possible retrofit, the City identifies ways in which the devices may be causing or contributing to a condition of pollution, identifies measures to reduce or eliminate the structure's effect on pollution, and considers the measures' cost-effectiveness as well as the

technical, social and economic feasibility of retrofitting the structural flood control device to correct the problem.

5.3.3 BMP Implementation for Sweeping of Municipal Areas

The City uses a street sweeping subcontractor to implement a regular sweeping program for public streets and for parking facilities at the senior/community center and train station. Sweeping of parking areas and plazas/walkways at City parks is accomplished by the landscape maintenance subcontractors. All City streets and on-site parking facilities are swept at least twice a month, with sweeping typically scheduled to occur on the day after the scheduled trash collection day. Residents and businesses are asked to park off-street on sweeping days. The subcontracts allow the City to require extra sweepings as needed due to seasonal factors (e.g., special events, autumn leaf fall, windstorms, etc.) and in response to emergencies, visual observations or inspections of municipal areas/activities. The City typically does not experience any significant seasonal tourist influx that might generate extra sweeping needs. Certain streets with multifamily overflow parking issues have alternating one-way parking restrictions that are strictly enforced.

5.3.4 BMP Implementation for Irrigation Runoff Prevention from Municipal Facilities

All the City's landscaped areas are irrigated with centrally-controlled "smart" irrigation technology that is used to adjust watering times and durations seasonally and in reaction to specific weather conditions, and which has the capacity to shut down the operation of individual valves when a pressure drop indicates a possible line break. A weather gauge in Crown Valley Community Park feeds precipitation, humidity and temperature data into the system on an hourly basis for calculation of evapotranspiration rates. The City uses landscape maintenance subcontractors to conduct all routine landscape maintenance, whose contractual obligations include conformance with routine BMPs for irrigation runoff prevention, as listed in Exhibit 5.II - Activity-Specific BMP Sheet FP-2A. The City's maintenance subcontract managers are generally in the field on a daily basis to provide oversight. If the contract managers, the contractors' field supervisory personnel, water district staff or members of the public identify irrigation runoff issues that cannot be corrected through routine adjustments or repairs, design changes to the system and/or landscaping may be directed to be accomplished as extra work under the contracts, typically promptly for minor corrections; or they may be scheduled as a capital improvement for larger, more costly projects.

5.4 OPERATION AND MAINTENANCE OF MUNICIPAL SEPARATE STORM SEWERS (MS4s) AND STRUCTURAL CONTROLS

5.4.1 Municipal Post Construction BMP Inspection and Treatment Controls:

Priority Projects (see Section 7 of the LIP) approved since February 2003 are subject to inspection to assure that implementation and appropriate maintenance described in the project's Water Quality Management Plan (WQMP) is taking place during the post construction phase. In addition to post construction BMPs at municipal Priority Projects, the City has implemented other structural treatment control BMPs throughout the City designed to reduce storm water pollutant discharges to or from its MS4s and related drainage structures. The City inspects and maintains proper operation of all municipal treatment control BMPs. Maintenance

and operation is verified by inspection at least once annually, prior to the rainy season. The City's inventory of treatment control BMPs is attached as Exhibit 5.IV and is updated as new treatment units come on-line. Records of the municipal BMP inventory, inspection, waste disposal and maintenance activities are tracked in the City's BMP inventory database.

5.4.2 Maintenance of MS4 and Facilities

In accordance with Provision E.5.b, the City implements a schedule of maintenance activities for the MS4 and MS4 facilities (catch basins, storm drain inlets, open channels, etc). The maintenance activities include:

(i) Inspection and removal of accumulated waste at least once a year for all MS4 facilities;

(ii) Open channels are cleaned of observed anthropogenic litter as needed;

(v) Maintenance and cleaning activities including the overall quantity of waste removed are tracked in the City's database;

(vi) Waste removed is disposed of pursuant to applicable laws

(vii) Crews utilize BMPs as appropriate to avoid waste discharges during MS4 maintenance and cleaning activities. Measures include but are not limited to full recovery of jetter water using vacuum equipment, placing sandbags if necessary, and blocking storm drain pipes during cleaning operations as required.

A map of the City's MS4 facilities is attached as Exhibit 5.V.

5.4.3 Prevention of Infiltration from Sanitary Sewer to MS4

The wastewater treatment plants in the City are owned, operated, maintained and inspected by the South Orange County Wastewater Authority (SOCWA), which is a separate joint powers agency that does not include the City government. The sanitary sewer collection system in the City is owned, operated and maintained by the separate Moulton Niguel Water District, (MNWD) which is a member agency of SOCWA. MNWD cleans all 520 miles of sewer lines in its system annually with a jetter truck, and visually inspects the entire system with a camera every 5 years to identify any leaks. Locations with a history of problems are cleaned more often, depending on the situation. MNWD typically provides approximately $1 million in its annual budget for sewer repairs on a prioritized basis. MNWD also implements a Fats, Oils & Grease (FOG) program, which entails monthly inspections of the 400+ restaurants in its service area, to assure adequate maintenance of grease traps. All sewage spill incidents, including those on private properties, are reported by MNWD to the State, and are posted on the SSO Incident Map maintained by the State Board on its website, www.waterboards.ca.gov.

In accordance with Permit section Provision E.5.b.(1).(c), the City implements controls and measures to prevent and eliminate infiltration of seepage from the sanitary sewer system to the MS4 through routine preventive practices, repairs and maintenance of the MS4.

Such controls include:

(i) Plan checking for construction and new development,

(ii) Incident response training for municipal employees that identify sanitary sewer spills;

(iii) Building Code construction enforcement inspections; New construction and significant remodels are required to conduct a sewer lateral inspection and certification by a qualified plumber as a step in the building permit process.

(iv) MS4 maintenance and inspections;

(v) Interagency coordination with SOCWA and the MNWD

(vi) Training of municipal staff and contractors conducting field operations on the MS4

The City tracks all maintenance, training and inspection data in an NPDES permit compliance database.

5.5 INSPECTION OF MUNICIPAL AREAS AND ACTIVITIES

Pollution Prevention methods and Minimum BMPs are assessed, verified and evaluated for effectiveness during municipal facility inspections. Municipal facility and activity inspections are documented on a Municipal Facility/Activity Inspection Form (Exhibit 5.VI), then entered into the City's tracking database. Data from these inspections is compiled annually then reported to the Principal Copermittee and the RWQCB.

The City inspects high-priority municipal areas and activities at least annually including but not limited to City-owned areas and activities tributary to a CWA section 303(d) impaired water body segment where an area or activity generates pollutants for which the water body segment is impaired, City-owned areas and activities within or adjacent to or discharging directly to receiving waters within Environmentally Sensitive Areas defined in Exhibit 1.II, and the potential for a facility or area to discharge polluted non-stormwater and reflect the priorities set forth in the WQIP. For subcontracted field programs such as Citywide landscape maintenance, street sweeping and drainage system maintenance, which include BMPs in their subcontract specifications, the City's subcontract managers are trained to act as NPDES water quality inspectors while performing oversight on their daily rounds. The City's NPDES Authorized Inspector reviews the field programs and inspects the City's fixed facilities and structural treatment control BMPs at least once annually, prior to the rainy season. Documentation of inspections is tracked by inspection forms and facility cleaning/inspection logs. Inspections are tracked in the City's NPDES database. High priority municipal areas and activities include:

- Sweeping of Public Roads, Streets, Highways, and Parking Facilities
- Flood Management Projects, Flood Control Devices and Treatment Control BMPs owned by the City;

- Municipal maintenance and storage yards for materials, waste, equipment and vehicles, power washing; and

- All City parks and recreation facilities, and office/community building grounds;

- Special event venues following City-sponsored special events, or private events permitted on City properties;

- Other municipal areas and activities that have the potential to contribute a pollutant load to the MS4, such as power-washing and other municipal maintenance activities.

Other municipal areas and activities are inspected as needed in response to water quality data, valid public complaints, and findings from municipal or contract staff. Based upon site inspection findings, the City implements all follow-up actions necessary to enforce its stormwater ordinance and to comply with the designated minimum BMPs for all municipal areas and activities, as necessary to maintain compliance with the Permit. All follow-up actions are tracked in the City's NPDES permit database.

5.6 TRAINING AND EDUCATION OF MUNICIPAL STAFF AND CONTRACTORS

The City trains all municipal personnel and contractors that have responsibilities for selecting, implementing, and evaluating BMPs for municipal areas and activities to perform such tasks as required during normal work activities. Training of municipal personnel is detailed in Section 6 of the LIP.

5.7 REPORTING

The City provides notification to the RWQCB of noncompliant municipal facilities and/or activities in the City that are determined to pose a threat to human health or significant environmental degradation. Verbal notification within 24 hours of the verification of noncompliance and a written report are submitted to the RWQCB within 5 days of the incident.

The City submits an Annual Progress Report each year to the Principal Permittee and RWQCB. This report provides information detailing the city's efforts towards meeting the requirements of the Permit with respect to municipal activities. The Annual Progress Report includes:

- The total number of municipal facilities inventoried and prioritized, including structural treatment control BMPs;

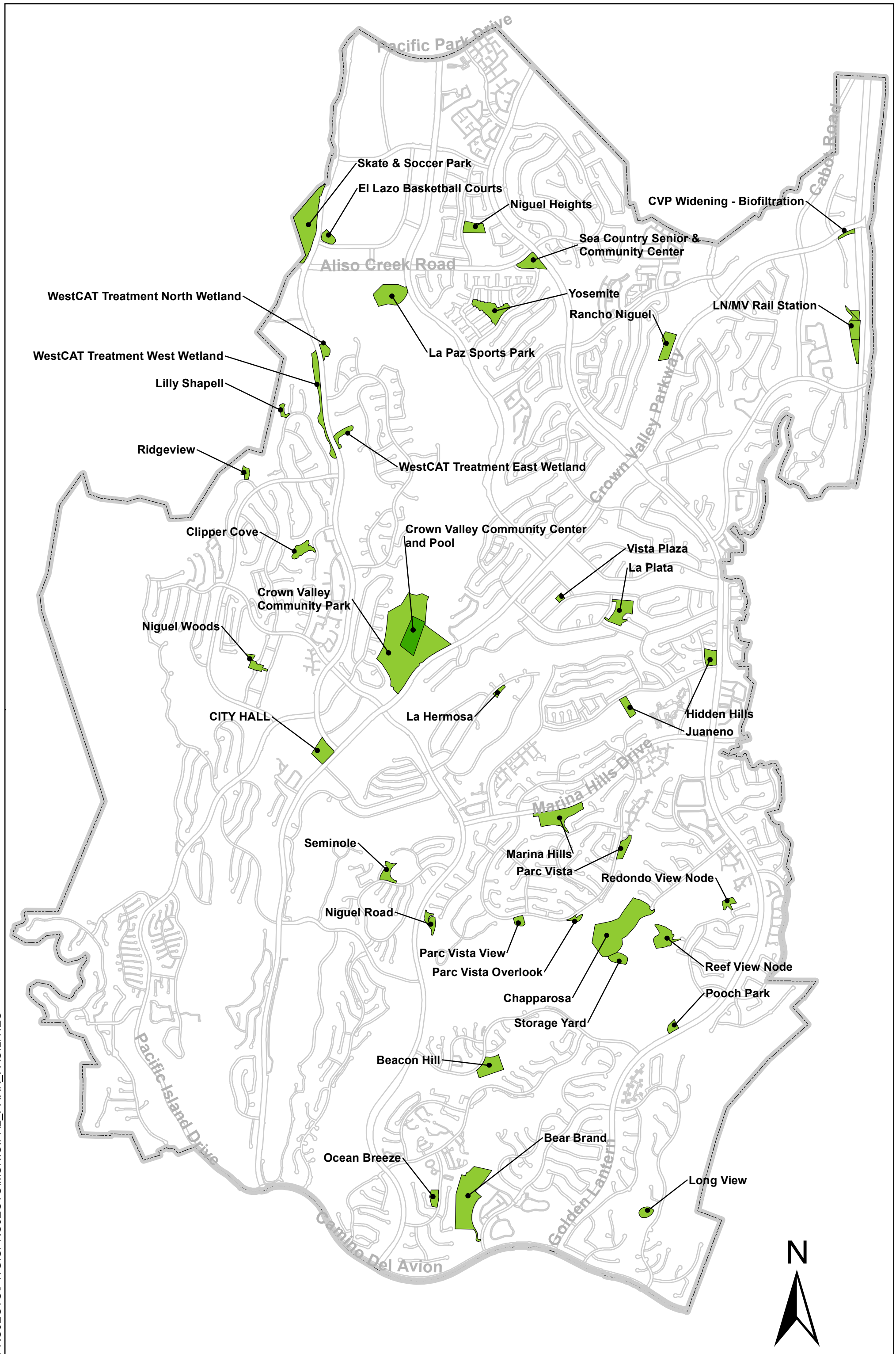
- The total number of municipal facilities, treatment control BMPs, maintenance activities and special event venues that were inspected, and dates and number of inspections conducted, including justifications for any facilities determined to be suitable for bi-annual inspections;

- The number, date and type of non-compliance violations identified, number of enforcement actions that were taken, and narrative description of findings and follow-up, broken down by facility or treatment control BMP; and

- Amount of waste materials removed from the MS4 and municipal treatment control BMPs, and how that waste was disposed.

EXHIBIT 5.I

MUNICIPAL FACILITIES INVENTORY MAP 2017



Municipal Facility Sites

Q:\GIS\GISPROJECTS\PWGISPROJECTS\MUNICIPAL_PARK_FACILITIES

EXHIBIT 5.II

ACTIVITY-SPECIFIC BMP CHECKLISTS

Field Procedures	**Fixed Facilities**	**Drainage Facilities**
FP-2 Landscape Maintenance	FF-2 Building Maintenance/Repair	DF-1 Drainage System
FP-2A Irrigation Runoff	FF-3 Equipment Main./Repair	
FP-2B Integrated Pest Management	FF-4 Fueling	
FP-3 Roads, Streets & Highways	FF-6 Material Loading/Unloading	
FP-4 Sidewalk, Plaza & Fountains	FF-7 Material Storage, Handling & Disposal	
FP-5 Solid Waste Handling	FF-8 Minor Construction	
FP-6 Water & Sewer Utility O&M	FF-9 Parking Lot Maintenance	
FP-8 Power Washing/Surface Cleaning	FF-10 Spill Prevention & Control	
	FF-11 Vehicle & Equipment Cleaning	
	FF-12 Vehicle & Equipment Storage	
	FF-13 Waste Handling & Disposal	
	FF-14 Special Event Venues	

DF-1
DRAINAGE FACILITY OPERATION AND MAINTENANCE

The matrix below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for Municipal Drainage Facility Maintenance activities. Drainage Facilities are considered High Priority regardless of location. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and to limit impact on stormwater surface water quality to the maximum extent practicable. Below the matrix is a listing of Suggested Implementation Strategies for each required BMP.

DESIGNATED MINIMUM BMPS	LOW	MEDIUM	HIGH	303(d)	ESA	
Inspection and Cleaning:						
___ Annually inspect and clean drainage structures prior to the rainy season, and keep appropriate records. Document which structures are typically clean upon inspection for possible cut-back to inspection every two years.			X	X	X	
___ Conduct supplemental intermittent visual inspections during the wet season and provide additional cleanout as appropriate.			X	X	X	
___ Record quantity of waste collected and provide for proper disposal, including laboratory analysis of representative sample(s) of removed material to ensure it does not meet EPA hazardous waste criteria.			X	X	X	
___ Regularly inspect treatment wetland systems and remove any flow obstacles.			X	X	X	
___ Remove anthropogenic litter from open channels at least once annually before the rainy season.			X	X	X	
Controlling Illicit Connections & Discharges:						
___ Prevent any discharges during the course of MS4 maintenance operations.			X	X	X	
___ Provide energy dissipators below pipe or culvert outfalls.			X	X	X	
___ Repair damaged gutters, v-ditches and pipes as needed.			X	X	X	
Controlling Illegal Dumping						
___ Properly dispose of removed materials at a landfill or recycling facility.			X	X	X	
___ Label all catch basins with "No Dumping – Drains to Ocean."			X	X	X	
POLLUTION PREVENTION METHODS						
___ Require drainage facility maintenance personnel to be trained in relevant BMPs.			X	X	X	
___ Incorporate BMPs into subcontracts.			X	X	X	

PROGRAM/FACILITY BEING INSPECTED: _____

Date: _____ Inspector Name: _____

When completed, the checklist should be attached to the General Inspection Form Cover Sheet

and copies should be provided to the Supervisor of the Facility/Program being inspected.

SUGGESTED IMPLEMENTATION STRATEGIES:

The following list of Suggested Implementation Strategies is divided between basic potential strategies suitable for general application (numbered with capital letters) and more specific tips and techniques(numbered with lower case letters) that may be considered under certain circumstances, especially where there are certain Pollutant Constituents of Concern. The specific target constituents are notated parenthetically as:

Bacteria (BACT) *Sediment (SED)* *Nutrients (NUT)* *Oil and Grease (O&G) Pesticides (PEST)* *Other Toxic Compounds (TOX)* *Trash (TRASH)* *Hydrological Impacts (HYD)* *Any/All or General*

1. Inspection and Cleaning of Drainage Facilities

General Guidelines

- ✓ 1A. Annually inspect all drainage structures, and clean as needed.
- ✓ 1B. Maintain appropriate records of inspections, cleaning, quantity of wastes removed and disposal.
- ✓ 1C. Properly dispose of removed materials at a landfill or recycling facility.
- ✓ 1D. Conduct intermittent supplemental visual inspections during the wet season to determine if there are problem inlets where sediment/trash or other pollutants accumulate, and provide for additional cleanouts as appropriate.
- ✓ 1E. Prevent or clean up any discharges that may occur during the course of maintenance and cleaning procedures.
- ✓ 1F. Verify that appropriate employees or subcontractors are trained in proper conductance of maintenance activities, including record keeping and disposal.
- ✓ 1G. Annually inspect and clean v-ditches as needed, prior to the wet season. On shrub-covered slopes, vegetative debris may be placed on the downhill side of the ditch. Trash should be bagged and disposed at a landfill.
- ✓ 1H. Store wastes collected during cleaning activities in appropriate containers.

Tips and Techniques

- ✓ 1h. Remove trash or anthropogenic debris as needed from open channels. (TRASH)
- ✓ 1i Consider retrofitting energy dissipators below culvert outfalls. (SED)
- ✓ 1j. Repair v-ditches that have cracked or displaced. (SED)
- ✓ 1k. Test samples of removed wastes if suspicious conditions exist (TOX)
- ✓ 1l. Consider more-frequent cleaning of selected structures to address specific impairments (ANY)
- ✓ 1m. Consider structural retrofits to the MS4 to help address specific impairments (ANY, HYD)
- ✓ 1n. Consider cleaning out pipes at gradient breaks or

other in-pipe debris accumulation points (ANY)

✓ 1o. Dewater collected wastes if necessary prior to disposal, with outflow water filtered and directed into the sanitary sewer or disposal tank. Do not dewater near a storm drain or stream. (SED, TRASH)

✓ 1p. Provide for lab analysis of random or suspicious samples from the cleaning program to ensure it does not meet the EPA criteria for hazardous waste. If a sample is determined to be hazardous, the sediment must be disposed of as a hazardous waste and the source must be investigated (TOX)

2. Controlling Illicit Connections and Discharges

General Guidelines

✓ 2A. Report prohibited discharges such as dumping, paint spills, abandoned oil containers, etc. observed during the course of normal daily activities so they can be investigated, contained, and cleaned up.

✓ 2B. Where field observations and/or monitoring data indicate significant problems, conduct field investigations to detect and eliminate existing illicit connections and improper disposal of pollutants into the storm drain (i.e. identify problem areas where discharges or illegal connections may occur and follow up stream to determine the source(s))

✓ 2C. Report all observed illicit connections and discharges to the NPDES Authorized Inspector at 949-362-4345 or to the 24-hour water pollution problem reporting hotline 1-877-89-SPILL (1-877-897-7455).

✓ 2D. Encourage public reporting of improper waste disposal by distributing public education materials and advertising the 24-hour water pollution problem reporting hotline.

Storm Drain Stenciling ("No Dumping—Drains to Ocean")

✓ 2E. Implement and maintain a storm drain stenciling program.

- 2a. Consider adding the hotline number to the storm drain stencils (BACT, TOX, TRASH).

3. Controlling Illegal Dumping

Field Investigation

✓ 3A. Report prohibited discharges such as dumpings observed during the course of normal daily activities so they can be investigated, contained and cleaned up.

✓ 3B. Conduct field investigations to detect and eliminate improper disposal of pollutants into the storm drain (i.e. identify problem areas where discharges or illegal connections may occur and follow up stream to determine the source(s)).

✓ 3C. Report all observed illegal dumping to the 24-hour

❑ _____ ❑	water pollution problem reporting hotline (1-877-897-7455).
	✓ 3D. Encourage public reporting of improper waste disposal by distributing public education materials and advertising the 24-hour water pollution problem reporting hotline.
❑ _____ ❑	✓ 3E. If perpetrator can be identified, take appropriate enforcement action.
❑ _____ ❑	• 3a. Consider posting "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs could also indicate fines and penalties for illegal dumping. (ANY)
	Training/Education/Outreach
❑ _____ ❑	✓ 3F. Verify that appropriate employees and subcontractors are trained to recognize and report illegal dumping.
	✓ 3G. Encourage public reporting of illegal dumping by advertising the 24-hour water pollution problem reporting hotline (1-877-897-7455.
❑ _____ ❑	• 3b. Take extra steps to educate the public in neighborhoods where illegal dumping has occurred to inform them why illegal dumping is a problem, and that illegal dumping carries a significant financial penalty. (ANY)
❑ _____ ❑	

FF-2
BUILDING MAINTENANCE AND REPAIR



The matrix below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for Municipal Building Maintenance and Repair activities based on priorities determined by site location and operational characteristics. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and limit impact on stormwater surface water quality to the maximum extent practicable. Below the matrix is a listing of Suggested Implementation Strategies for each required BMP.

DESIGNATED MINIMUM BMPS	LOW	MEDIUM	HIGH	303(d)	ESA
Building Maintenance:					
___ Prevent cleaning agents and other maintenance materials from entering the MS4.	X	X	X	X	X
___ Prevent repair and construction wastes from entering the MS4.	X	X	X	X	X
___ Clean up spills and leaks promptly.	X	X	X	X	X
Material Storage:					
___ Keep exterior storage areas tidy.	X	X	X	X	X
___ Store trash in covered watertight containers.	X	X	X	X	X
Building Cleaning:					
___ Prevent wash or rinsewaters from entering the storm drain system.	X	X	X	X	X
Graffiti Cleaning:					
___ Prevent cleaning agents, washwaters or wastes from entering the MS4.	X	X	X	X	X
Painting:					
___ Prevent paint or wastes from entering the MS4.	X	X	X	X	X
___ Properly dispose of leftover paint to keep it out of the MS4.	X	X	X	X	X
POLLUTION PREVENTION METHODS					
___ Require building maintenance personnel to be trained in relevant BMPs.	X	X	X	X	X
___ Incorporate relevant BMPs into contractual requirements for any building maintenance subcontracts.	X	X	X	X	X

PROGRAM/FACILITY BEING INSPECTED: _____

Date: _____ Inspector Name: _____

When completed, the checklist should be attached to the General Inspection Form Cover Sheet and copies should be provided to the Supervisor of the Facility/Program being inspected.

SUGGESTED IMPLEMENTATION STRATEGIES:

The following list of Suggested Implementation Strategies is divided between basic potential strategies suitable for general application (notated with checkmarks and capital letters) and more specific potential strategies (notated with bullet points and lower case letters) that may be applicable under certain circumstances, especially where there are certain Pollutant Constituents of Concern. The specific target constituents are notated parenthetically as:

Bacteria (BACT) *Sediment (SED)* *Nutrients (NUT)* *Oil and Grease (O&G) Pesticides (PEST)*
Other Toxic Compounds (TOX) *Trash (TRASH)* *Hydrological Impacts (HYD)* *Any/All or General*

1. Building Maintenance

General Guidelines

✓ 1A. If when repairing roofs, small particles have accumulated in the gutter, either sweep out the gutter or wash the gutter and trap the particles at the outlet of the downspout. A sock or geofabric placed over the outlet may effectively trap the materials. If the downspout is tight lined, use the sweep-out method; or place a temporary plug at the first convenient point in the storm drain and pump out the water with a vactor truck and clean the storm drain inlet where you placed the plug if necessary.

✓ 1B. Use sweeping or vacuuming techniques to clean gutters to the extent practical. If water is used for cleaning out gutters, seal storm drain inlets to prevent water from entering. Either direct the water to a landscaped area or dispose discharge to the sanitary sewer.

✓ 1C. When the work involves exposing large areas of soil, employ the appropriate soil erosion and control techniques.

✓ 1D. Protect storm drain inlets in the immediate vicinity of the construction activity, and clean them after work is completed if necessary.

• 1a. Consider retrofitting roof downdrains to route storm runoff to landscaped areas, rather than to impermeable surfaces or directly to the storm drain system. Do not route roof storm runoff directly to the base of the building or onto a slope.

Good Housekeeping

✓ 1E. Keep the work site clean and orderly. Remove debris in a timely fashion. Sweep the area.

✓ 1F. Cover materials of particular concern that must be left out, particularly during the rainy season.

✓ 1G. Do not dump waste liquids down the storm drain.

✓ 1H. Properly dispose of wash water, sweepings, and sediments; do not allow these materials to enter the storm drain.

Spill Response

✓ 1I. Clean up spills immediately.

✓ 1J. If a spill occurs on dirt, excavate and remove the contaminated (stained) soil.

2. Material Storage	
☐ ☐	✓ 2A. Properly store and cover materials that are normally used in repair and remodeling such as paints and solvents, to protect them from rain.
☐ ☐	✓ 2B. Properly store and dispose waste generated from the activity.
3. Building Cleaning	
☐ ☐	✓ 3A. When cleaning building exteriors and walls composed of glass, steel, or painted surfaces with no lead or mercury: • Do not allow wash water to enter the storm drain. • When washing without soap, discharges can be directed to landscaped or dirt areas. • When washing with soap, direct discharges to the sanitary sewer if permitted to do so or vacuum/pump water to a tank and dispose of properly
☐ ☐	✓ 3B. When washing building exteriors painted with lead-based or mercury additive paint: • Do not allow discharges to enter storm drain • Vacuum/pump discharges to a tank • Dispose of as a hazardous waste as needed
☐ ☐	✓ 3C. When acid washing mineral deposits: • Do not allow discharges to enter storm drain. • Rinse treated area with alkaline soap and direct washwater to a landscaped or dirt area • Alternatively, washwater may be collected and neutralized to a pH between 6 and 8, and disposed of properly.
☐ ☐	• 3a. When re-painting, consider switching to products without lead or mercury (TOX) • 3D. Also refer to BMP Sheet FP-8 (Power Washing & Surface Cleaning)
4. Graffiti Cleaning	
	Graffiti Removal
☐ ☐	✓ 4A. Avoid graffiti abatement activities during rain events.
☐ ☐	✓ 4B. When graffiti is removed by painting over, implement the procedures under Painting and Paint Removal in the *Roads, Streets*, and *Highway Operation and Maintenance* procedure sheet.
☐ ☐	✓ 4C. Protect nearby storm drain inlets prior to removing graffiti from walls, signs, sidewalks, or other structures needing graffiti abatement. Clean up afterwards by sweeping or vacuuming thoroughly, and/or by using absorbent and properly disposing of the absorbent.
☐ ☐	✓ 4D. Note that care should be taken when disposing of waste since it may need to be disposed of as hazardous waste.
☐ ☐	• 4a. Consider using a waterless and non-toxic chemical cleaning method for graffiti removal (e.g. gels or spray compounds). (TOX)

5. Painting

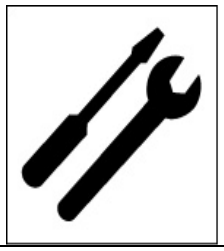
General Guidelines

- ✓ 5A. Develop paint handling procedures for proper use, storage, and disposal of paints.
- ✓ 5B. When practical, painting operations should be properly enclosed or covered to avoid drift.
- ✓ 5C. If transporting paint and materials to and from job sites, use containers with secure lids and tie down to the transport vehicle.
- ✓ 5D. Test and inspect spray equipment prior to starting to paint. Tighten all hoses and connections and do not overfill paint container.
- ✓ 5E. Transfer and load paint and hot thermoplastic away from storm drain inlets.
- ✓ 5F. Where there is significant risk of a spill reaching storm drains, protect or plug nearby storm drain inlets prior to starting painting and remove plugs when job is complete.
- ✓ 5G. If sand blasting is used to remove paint, cover nearby storm drain inlets prior to starting work and collect wash water and dispose of properly.
- ✓ 5H. If painting requires scraping or sand blasting of the existing surface, use a ground cloth to collect the chips. Dispose of the residue properly.
- ✓ 5I. If using water based paints, clean the application equipment in a sink that is connected to the sanitary sewer.
- ✓ 5J. Brushes and tools covered with non-water-based paints, finishes, or other materials should be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal. Waste solvents or oil based paints must be disposed of as hazardous waste.
- 5a. Consider mixing paint indoors before using so that any spill will not be exposed to rain. Do so even during dry weather because cleanup of a spill will never be 100% effective.
- 5b. Consider replacing paints containing lead or tributyltin with less toxic alternatives.

Paint Disposal

- ✓ 5K. Paints containing lead or tributyl tin are considered a hazardous waste and must be disposed of at an appropriate hazardous waste facility.
- ✓ 5L. Properly store leftover paints if they are to be kept for the next job.

FF-3
EQUIPMENT MAINTENANCE AND REPAIR



The matrix below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for Municipal Equipment Maintenance and Repair activities based on priorities determined by site location and operational characteristics. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and limit impact on stormwater surface water quality to the maximum extent practicable. Below the matrix is a listing of Suggested Implementation Strategies for each required BMP.

DESIGNATED MINIMUM BMPS	LOW	MEDIUM	HIGH	303(d)	ESA
General Maintenance and Repair:					
___ Clean up spills and leaks promptly upon discovery.	X	X	X	X	X
___ Steam cleaning or degreasing of engines is prohibited at municipal storage areas.	X	X	X	X	X
___ Prevent maintenance materials or repair wastes from entering the MS4.	X	X	X	X	X
___ Maintain equipment so as to prevent oil or gasoline leaks onto pavement or streets.	X	X	X	X	X
___ Place a stockpile of spill cleanup materials where it will be readily accessible.	X	X	X	X	X
Waste Handling/Disposal:					
___ Properly dispose or recycle waste materials.	X	X	X	X	X
POLLUTION PREVENTION MEASURES					
___ Utilize commercial equipment or vehicle maintenance and repair facilities to the extent feasible in lieu of conducting this activity at municipal sites.	X	X	X	X	X
___ Regularly inspect municipal vehicles and equipment for leaks.	X	X	X	X	X
___ Require equipment maintenance personnel to be trained in relevant BMPs.	X	X	X	X	X

PROGRAM/FACILITY BEING INSPECTED: _____

Date: _____ Inspector Name: _____

When completed, the checklist should be attached to the General Inspection Form Cover Sheet and copies should be provided to the Supervisor of the Facility/Program being inspected.

SUGGESTED IMPLEMENTATION STRATEGIES:

The following list of Suggested Implementation Strategies is divided between basic potential strategies suitable for general application (notated with checkmarks and capital letters) and more specific potential strategies (notated with bullet points and lower case letters) that may be applicable under certain circumstances, especially where there are certain Pollutant Constituents of Concern. The specific target constituents are notated parenthetically as:

Bacteria (BACT) *Sediment (SED)* *Nutrients (NUT)* *Oil and Grease (O&G)* *Pesticides (PEST)*
Other Toxic Compounds (TOX) *Trash (TRASH)* *Hydrological Impacts (HYD)* *Any/All or General (ANY)*

1.General Maintenance and Repair

General Guidelines

- ✓ 1A. Review maintenance activities to verify that they minimize the amount of pollutants discharged to receiving waters
- ✓ 1B. Regularly inspect vehicles and equipment for leaks.
- ✓ 1C. Clean yard storm drain inlets regularly.
- • 1a. Move activity indoors or cover repair area with a permanent or temporary roof if practical. (O&G)
- • 1b. Consider retrofitting to minimize contact of stormwater with outside operations through berming and drainage routing. (O&G)
- • 1c. Consider retrofitting to place curbs around the immediate boundaries of the process equipment.

Good Housekeeping

- ✓ 1D. To the extent practical, avoid hosing down work areas. Do not hose into storm drain inlets.
- ✓ 1E. Collect leaking or dripping fluids in drip pans or containers to the extent practical. Fluids are easier to recycle or dispose of properly if kept separate.
- ✓ 1F. Keep a drip pan or absorbent under the vehicle while you unclip hoses, unscrew filters, or remove other parts. Place a drip pan or absorbent material under any vehicle that might leak while you work on it to keep splatters or drips off the shop floor.
- ✓ 1G. Verify that appropriate employees and subcontractors are trained on proper handling and disposal of engine fluids.
- ✓ 1H. Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- ✓ 1I. Do not pour liquid waste to floor drains, sinks, outdoor storm drain inlets, or other storm drains or sewer connections. Recycle as appropriate, or dispose properly as hazardous waste if necessary.
- • 1d. If work areas are washed and if discharge to the sanitary sewer is allowed, consider retrofitting to treat water with an appropriate treatment device (e.g. clarifier) before discharging. If discharge to the sanitary sewer is not permitted, pump water to a tank and dispose of properly. (O&G)
- • 1e. Consider posting signs regarding dumping restrictions at sinks and stencil outdoor storm drain inlets. (O&G)

2. Vehicle Repair

- ✓ 2A. Regularly inspect vehicles and equipment for leaks, and repair as needed.
- ✓ 2B. Use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- ✓ 2C. Promptly drain all fluids from wrecked vehicles. Ensure that the drain pan or drip pan is large enough to contain drained fluids (e.g. larger pans are needed to contain antifreeze, which may gush from some vehicles).
- ✓ 2D. Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.

Vehicle Repair (cont.)

- ✓ 2E. Oil filters disposed of in trashcans or dumpsters can leak oil. Place the oil filter in a funnel over a waste oil-recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.
- ✓ 2F. Store cracked batteries in a non-leaking secondary container and dispose of properly at recycling or household hazardous waste facilities.
- ✓ 2a. Perform vehicle fluid removal or changing inside or under cover where feasible to prevent the run-on of stormwater and the runoff of spills. (O&G)

Vehicle Leak and Spill Control

- ✓ 2G. Use absorbent materials on small spills. Remove the absorbent materials promptly and dispose of properly.
- ✓ 2H. Place a stockpile of spill cleanup materials where it will be readily accessible.
- ✓ 2I. Sweep floor using dry absorbent material.

3. Machine Repair

- ✓ 3A. Don't allow excessive build-up of oil or grease on equipment.
- ✓ 3B. Use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- ✓ 3C. Perform major equipment repairs at an appropriately controlled facility, whenever practical.
- ✓ 3D. Following good housekeeping measures in Vehicle Repair section.

4. Waste Handling/Disposal

Waste Reduction

- ✓ 4A. Try to prevent spills and drips of solvents and cleansers to the shop floor.
- 4a. Do liquid cleaning at a centralized station so the solvents and residues stay in one area. Recycle liquid cleaners when feasible. (TOX)
- 4b. Locate drip pans, drain boards, and drying racks to direct drips back into a solvent sink or fluid holding tank for reuse. (O&G)

☐ _____ ☐

☐ _____ ☐

Safer Alternatives

- 4c. If possible, eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous material:
  - Use non-caustic detergents instead of caustic cleaning for parts cleaning.
  - Use a water-based cleaning service and have tank cleaned. Use detergent-based or water-based cleaning systems in place of organic solvent degreasers.
  - Replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check list of active ingredients to see whether it contains chlorinated solvents.
  - Choose cleaning agents that can be recycled.

Recycling

- 4d. Separate wastes for easier recycling. Keep hazardous and non-hazardous wastes separate, do not mix used oil and solvents, and keep chlorinated solvents separate from non-chlorinated solvents. (O&G, TOX)

FF-4
FUELING



The matrix below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for Municipal Material Loading and Unloading activities based on priorities determined by site location and operational characteristics. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and impact on stormwater surface water quality. Below the matrix is a listing of Suggested Implementation Strategies for each required BMP.

DESIGNATED MINIMUM BMPS	LOW	MEDIUM	HIGH	303(d)	ESA
___ Stockpile fuel spill cleanup materials where they are readily accessible.	X	X	X	X	X
___ Use absorbent materials for cleaning up fuel spills instead of washing down.	X	X	X	X	X
___ Regularly inspect fuel storage and fueling equipment for leaks.	X	X	X	X	X
___ Keep spilled or leaked fuels out of the MS4.	X	X	X	X	X
POLLUTION PREVENTION METHODS					
___ Use commercial fueling services to the extent feasible instead of performing this activity at a municipal site.	X	X	X	X	X

PROGRAM/FACILITY BEING INSPECTED: _____

Date: _____ Inspector Name: _____

When completed, the checklist should be attached to the General Inspection Form Cover Sheet and copies should be provided to the Supervisor of the Facility/Program being inspected.

SUGGESTED IMPLEMENTATION STRATEGIES:

The following list of Suggested Implementation Strategies is divided between basic potential strategies suitable for general application (notated with checkmarks and capital letters) and more specific potential strategies (notated with bullet points and lower case letters) that may be applicable under certain circumstances, especially where there are certain Pollutant Constituents of Concern. The specific target constituents are notated parenthetically as:

Bacteria (BACT) Sediment (SED) Nutrients (NUT) Oil and Grease (O&G) Pesticides (PEST)
Other Toxic Compounds (TOX) Trash (TRASH) Hydrological Impacts (HYD) Any/All or General (ANY)

General Guidelines

- ✓ 1A. If refueling must be done on site, use a location away from storm drains and creeks.
- ✓ 1B. Discourage "topping off" of fuel tanks.
- ✓ 1C. Use dry methods to clean the fueling area whenever possible. If you periodically clean by pressure washing, place a temporary plug in the downstream drain and pump out the accumulated water. Properly dispose of the water.
- ✓ 1D. Verify that appropriate employees and subcontractors are trained on proper fueling and cleanup procedures
- 1a. If re-developing the fueling area, consider retrofitting the area to prevent the run-on of stormwater and the runoff of spills:
  - Pave fueling area with Portland cement concrete (or equivalent smooth impervious surface), with a 2% to 4% slope to prevent ponding. (O&G)
  - Separate the dispensing area from the rest of the site by a grade break that prevents run-on of storm water to the extent practicable. The fuel dispensing area is defined as extending 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly area may be operated plus 1 foot, whichever is less. The paving around the fuel dispensing area may exceed the minimum dimensions of the "fuel dispensing area" stated above.(O&G)
  - Cover the fuel dispensing area. The cover's minimum dimensions must be equal to or greater than the area within the grade break for the fuel dispensing area. (O&G)
  - Design the cover so that is does not drain onto the fuel dispensing area. (O&G)
- 1b. Consider retrofitting vapor recovery nozzles to help control drips as well as air pollution. (O&G)
- 1c. Consider retrofitting to provide secondary containment such as curbs, berms, etc. at locations designated for transferring fuel from the tank truck to the fuel tank. (O&G)
- 1d. If the facility has large numbers of mobile equipment working throughout the site and they are fueled with a mobile fuel truck, establish a designated area for fueling. With the exception of racked equipment such as bulldozers and perhaps small forklifts, most vehicles should be able to travel to a designated area with little lost time. Place temporary "caps" over nearby storm drain inlets so that if a spill occurs it is prevented from entering the storm drain. (O&G)
- 1e. Consider retrofitting if needed to ensure the following safeguards are in place: (O&G)
  - Overflow protection devices on tank systems to warn the operator or automatically shutdown transfer pumps when the tank reaches full capacity
  - Protective guards around tanks and piping to prevent vehicle or forklift damage
  - Clearly tagging or labeling all valves to reduce human error

- Placement of spill kits at fueling areas and/or on vehicles.
- 1f. Stencil storm drain inlets within the facility boundary, by paint/stencil (or equivalent), to indicate whether they flow to an oil/water separator, directly to the sewer, or to a storm drain. Labels are not necessary for plumbing fixtures directly

Spill Response

✓ 1E. Use absorbent materials on small spills and general cleaning rather than hosing down the area. Remove the absorbent materials promptly.

✓ 1F. Place a stockpile of spill cleanup materials where it will be readily accessible. (O&G)

✓ 1G. Aboveground tank leak and spill control (not applicable to propane):

- Check for external corrosion and structural failure
- Check for spills and overfills due to operator error
- Check for failure of piping system
- Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa
- Visually inspect new tank or container installation for loose fittings, poor welding, and improper or poorly fitted gaskets
- Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.

- 1g. Periodically, integrity testing should be conducted by a qualified professional. (O&G)

FF-6
MATERIAL LOADING AND UNLOADING



The matrix below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for Municipal Material Loading and Unloading activities based on priorities determined by site location and operational characteristics. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and limit impact on stormwater surface water quality to the maximum extent practical. Below the matrix is a listing of Suggested Implementation Strategies for each required BMP.

DESIGNATED MINIMUM BMPS	LOW	MEDIUM	HIGH	303(d)	ESA
___ Stockpile spill cleanup materials where they are readily available.	X	X	X	X	X
___ Regularly inspect loading equipment for leaks.	X	X	X	X	X
POLLUTION PREVENTION METHODS					
___ Require materials handling personnel to be trained in relevant BMPs.	X	X	X	X	X

PROGRAM/FACILITY BEING INSPECTED: _____

Date: _____ Inspector Name: _____

When completed, the checklist should be attached to the General Inspection Form Cover Sheet and copies should be provided to the Supervisor of the Facility/Program being inspected.

SUGGESTED IMPLEMENTATION STRATEGIES:

The following list of Suggested Implementation Strategies is divided between basic potential strategies suitable for general application (notated with checkmarks and capital letters) and more specific potential strategies (notated with bullet points and lower case letters) that may be applicable under certain circumstances, especially where there are certain Pollutant Constituents of Concern. The specific target constituents are notated parenthetically as:

Bacteria (BACT) *Sediment (SED)* *Nutrients (NUT)* *Oil and Grease (O&G) Pesticides (PEST)*
Other Toxic Compounds (TOX) *Trash (TRASH)* *Hydrological Impacts (HYD)* *Any/All or General(ANY)*

General Guidelines

✓ 1A. Regularly clean work areas to remove materials such as debris, sandblasting material, etc.

✓ 1B. Try to avoid loading and exposing materials during rain events unless the loading dock is covered and protected from rain. A seal or door skirt between the trailer and the building may also prevent exposure to rain.

- 1a. Consider retrofitting the loading/unloading area to prevent stormwater runon that would include grading or berming the area, and positioning roof downspouts so they direct stormwater away from loading/unloading areas. (TRASH, TOX, O&G)
- 1b. Consider retrofitting with overhangs or door skirts that enclose the trailer. (TRASH, TOX, O&G)
- 1c. Consider retrofitting parking areas for tank trucks or delivery vehicles so that spills or leaks can be contained. (TRASH, TOX, O&G)
- 1d. Consider retrofitting so that shipboard cooling and process water discharges are directed away to to minimize contact with areas where spent abrasives, paint, and other debris might accumulate. (TRASH, TOX)

Tank Truck Transfers

✓ 1C. The area where the transfer takes place should be paved. If the liquid is reactive with the asphalt, Portland cement should be used to pave the area.

- 1e. Consider retrofitting the transfer area to prevent runon of stormwater from adjacent areas. Sloping the pad and using a berm around the uphill side of the transfer area should reduce runon. (TRASH, TOX, O&G)
- 1f. Consider retrofitting the transfer area to prevent runoff of spilled liquids from the area. Sloping the area to a drain should prevent runoff. The drain should be connected to a dead-end sump. A positive control valve should be installed on the drain. (TRASH, TOX, O&G)

Spill Control

✓ 1D. Contain leaks during transfer.

✓ 1E. Place spill kits and materials next to or near each loading/unloading area.

- 1g. Use drip pans under hoses.
- 1h. Use drip pans or comparable devices when transferring oils, solvents, and paints.

Inspection

✓ 1F. Check loading and unloading equipment regularly for leaks, including valves, pumps, flanges and connections.

✓ 1G. Inspect regularly for leaking valves, pipes, hoses, or soil chutes carrying either water or wastewater.

FF-7
MATERIAL STORAGE, HANDLING, AND DISPOSAL

The matrix below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for Municipal Material, Storage, Handling and Disposal activities based on priorities determined by site location and operational characteristics. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and limit impact on stormwater surface water quality to the maximum extent practicable. Below the matrix is a listing of Suggested Implementation Strategies for each required BMP.

DESIGNATED MINIMUM BMPS	LOW	MEDIUM	HIGH	303(d)	ESA
General Materials:					
___ Protect material stores from concentrated surface rain flows.	X	X	X	X	X
___ Keep exterior storage areas tidy.	X	X	X	X	X
Chemical Materials					
___ Exterior storage of chemical materials should be in watertight containers.	X	X	X	X	X
Hazardous Materials					
___ Do not store hazardous materials directly on the ground. Use secondary containment.	X	X	X	X	X
___ Do not store hazardous materials at remote job sites. Keep in a secured storage area.	X	X	X	X	X
POLLUTION PREVENTION METHODS					
___ Require materials-handling personnel to be trained in relevant BMPs.	X	X	X	X	X

PROGRAM/FACILITY BEING INSPECTED: _____

Date: _____ Inspector Name: _____

When completed, the checklist should be attached to the General Inspection Form Cover Sheet and copies should be provided to the Supervisor of the Facility/Program being inspected.

SUGGESTED IMPLEMENTATION STRATEGIES

The following list of Suggested Implementation Strategies is divided between basic potential strategies suitable for general application (notated with checkmarks and capital letters) and more specific potential strategies (notated with bullet points and lower case letters) that may be applicable under certain circumstances, especially where there are certain Pollutant Constituents of Concern. The specific target constituents are notated parenthetically as:

Bacteria (BACT) *Sediment (SED)* *Nutrients (NUT)* *Oil and Grease (O&G)* *Pesticides (PEST)* *Other Toxic Compounds (TOX)* *Trash (TRASH)* *Hydrological Impacts (HYD)* *Any/All or General*

1. General Material Storage, Handling, and Disposal

☐ _____ ☐ _____

_____

☐ _____ ☐ _____

_____

☐ _____ ☐ _____

✓ Storage

✓ 1A. Keep storage areas clean and dry to the extent practical.

✓ 1B. Encourage vigilance so that leaks and spills are detected as soon as possible.

✓ 1C. Keep outdoor storage areas in good condition (e.g. repair roofs, floors, etc. to limit releases to runoff).

✓ 1D. Wood products treated with chromated copper arsenate,

ammonical copper zinc arsenate, creosote, or pentachlorophenol should be covered with tarps during rain events or stored indoors.

✓ 1E. Parking lots or other surfaces near bulk materials storage areas should be swept periodically to remove debris blown or washed from storage area.

✓ 1F. Verify that appropriate employees and subcontractors are trained in proper storage measures.

- 1a. Store materials indoors if possible. (ANY)

1b. If stored outdoors, cover the storage area with a roof or with temporary cover during rain events. [*Note: the local fire authority/department must be consulted for limitations on clearance of roof covers over containers used to store flammable materials*]. (ANY)

- 1c. Consider retrofitting to minimize stormwater run-on and runoff by covering, enclosing or providing secondary containment for the area. (ANY)
- 1d. Drums stored in an area where unauthorized persons may gain access must be secured to prevent accidental spillage, pilferage, or any unauthorized use. Only personnel with proper training may handle hazardous waste. (TOX, PEST)

Secondary Containment

✓ 1G. Keep liquids in a designated area on a paved impervious surface.

✓ 1H. Review storage areas regularly for leaks or spills.

✓ 1I. Check for external corrosion of material containers. Also check for structural failure, spills and overfills due to operator error, failure of piping system.

✓ 1J. Check for leaks or spills during pumping of liquids or gases from trucks to a storage facility or vice versa.

- 1e. Consider retrofitting existing tanks so that they are bermed or surrounded by a secondary containment system such as dikes, liners, vaults, or double walled tanks. (TOX, PEST)
- 1f. Consider retrofitting existing liquids storage areas to create a secondary containment. The area inside the berm should slope to a drain with a dead-end sump that is periodically pumped out. (TOX, PEST, O&G)

2. General Chemical Material Handling and Disposal

☐ _____ ☐

☐ _____ ☐

☐ _____ ☐

☐ _____ ☐

General Guidelines

- ✓ 2A. Try to keep chemicals in their original containers, and keep them well labeled.
- ✓ 2B. Keep secured lids on waste barrels and containers.
- 2a. Do not store chemicals, drums, or bagged materials directly on the ground. Place these items in secondary containment. Designate a secure chemical material storage area that is paved with Portland cement concrete, free of cracks and gaps, and impervious in order to contain leaks and spills. (TOX, PEST, O&G)
- 2b. Containers should be placed in a designated area and covered. (TOX, PEST, O&G)
- 2c. Consider retrofitting the existing chemical storage area to reduce exposure to storm water: (TOX, PEST, O&G)
- Store materials inside or under cover on paved surfaces
  - Use secondary containment
  - Use covered dumpsters for waste product containers. Dumpsters shall be kept in good condition without corrosion or leaky seams. Garbage dumpsters should be replaced if they are deteriorating to the point where leakage is occurring.

General Guidelines (cont.)

- 2d. Consider retrofitting so that liquid materials are stored in UL approved double walled tanks or surrounded by a curb or dike to provide the volume to contain 10 percent of the volume of all the containers or 110 percent of the volume of the largest container, whichever is greater. (TOX, PEST, O&G)

Spill Control

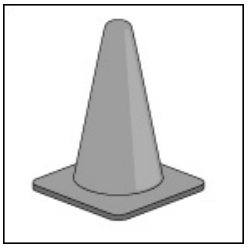
- ✓ 2C. Clean up spills immediately.
- ✓ 2D. Use clear tagging or labeling, and consider restricting access to valves to reduce human error.
- ✓ 2E. Employees or subcontractors trained in emergency spill cleanup procedures should be present when dangerous waste, liquid chemicals, or other wastes are delivered or transferred off-site.
- 2e. Safeguards against accidental releases:
  - Consider retrofitting overflow protection devices to warn operator or automatic shut down transfer pumps (TOX, PEST)
  - Consider retrofitting protection guards (bollards) around tanks and piping to prevent vehicle or forklift damage (TOX, PEST, O&G)
  - Consider purchasing a hazardous materials spill kit.

3. General Hazardous Material Handling

General Guidelines

- ✓ 3A. All hazardous waste must be labeled according to hazardous waste regulations. Consult your Fire Department or your local hazardous waste agency for details.
- ✓ 3B. Store as few hazardous materials on-site as possible. Do not store any hazardous waste directly on the ground. Place these items in secondary containers.
- ✓ 3C. Employees trained in emergency spill cleanup procedures should be present when dangerous waste, liquid chemicals, or other wastes are delivered or transferred off-site.
- 3a. Consider designating a secure hazardous waste storage area that is paved with Portland cement concrete, free of cracks and gaps, and impervious in order to contain leaks and spills. (TOX, PEST, O&G)
- ✓ Batteries
- ✓ 3D. Store new and used batteries securely to avoid breakage and acid spills during earthquakes.

FF-8
MINOR CONSTRUCTION



The matrix below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for Municipal Minor Construction activities based on priorities determined by site location and operational characteristics. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and to limit impact on stormwater surface water quality to the maximum extent practicable. Below the matrix is a listing of Suggested Implementation Strategies for each required BMP.

DESIGNATED MINIMUM BMPS	LOW	MEDIUM	HIGH	303(d)	ESA
General Construction Activities:					
___ Conduct minor construction in dry weather to the extent feasible.	X	X	X	X	X
___ Prevent construction materials and wastes from entering the MS4.	X	X	X	X	X
___ Keep washwater and sediment out of the MS4.	X	X	X	X	X
Interim Material Storage:			X	X	X
___ Protect stored materials from concentrated rain flows.	X	X	X	X	X
___ Store chemical materials in watertight containers.	X	X	X	X	X
Concrete Work:			X	X	X
___ Prevent cement or concrete wastes from entering the MS4.	X	X	X	X	X
___ Prevent concrete truck washdown rinsewater from entering the MS4.	X	X	X	X	X
Building Work:					
___ Prevent repair and construction materials or wastes from entering MS4.	X	X	X	X	X
POLLUTION PREVENTION MEASURES	X	X	X	X	X
___ Require construction project supervisory personnel to be trained in relevant BMPs.	X	X	X	X	X
___ Incorporate relevant BMPs into minor construction subcontracts.	X	X	X	X	X

PROGRAM/FACILITY BEING INSPECTED: _____

Date: _____ Inspector Name: _____

When completed, the checklist should be attached to the General Inspection Form Cover Sheet and copies should be provided to the Supervisor of the Facility/Program being inspected.

SUGGESTED IMPLEMENTATION STRATEGIES:

The following list of Suggested Implementation Strategies is divided between basic potential strategies suitable for general application (notated with checkmarks and capital letters) and more specific potential strategies (notated with bullet points and lower case letters) that may be applicable under certain circumstances, especially where there are certain Pollutant Constituents of Concern. The specific target constituents are notated parenthetically as:

Bacteria (BACT) *Sediment (SED)* *Nutrients (NUT)* *Oil and Grease (O&G) Pesticides (PEST)*
Other Toxic Compounds (TOX) *Trash (TRASH)* *Hydrological Impacts (HYD)* *Any/All or General (ANY)*

1. General Construction Activities	
☐ _____ ☐ ☐ _____ ☐ ☐ _____ ☐ ☐ _____ ☐ _____ _____ _____ _____ _____ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____	✓ 1A. Prevent debris from entering the storm drain. ✓ 1B. Do not wash materials into a storm drain or bury spilled dry material. ✓ 1C. Do not clean or rinse equipment into a street, gutter, or storm drain. ✓ 1D. Use a storm drain cover or filtering device if dust, grit, wash water, or other pollutants may escape the work area and enter a storm drain inlet. If appropriate, select devices that will not clog flow on rainy days, or remove them temporarily when rain is imminent. The containment device(s) should be in place at the beginning of the workday, and accumulated dirty runoff and solids should be collected and disposed of regularly, before removing the containment device(s) at the end of the work. ✓ 1E. Clean the storm drain inlets in the immediate vicinity of the construction activity after it is completed. ✓ 1F. If a spill occurs on dirt, excavate and remove the contaminated (stained) soil. ✓ 1G. Clean up spills and leaks immediately using dry methods, whenever possible. ✓ 1H. Designate an area for clean up and proper disposal of excess materials. ✓ 1I. Sweep up dry materials and residue from cleaning operations. Avoid using water to clean up. ✓ 1J. Use soil erosion control techniques if bare ground is temporarily exposed. ✓ 1K. Promptly clean up trash, debris, and litter from job sites and dispose properly. ✓ 1L. Inspect vehicles and equipment used at the construction site regularly for leaks. ✓ 1M. Verify that appropriate employees and subcontractors are trained in proper waste management.
2. Interim Material Storage	
☐ _____ ☐ _____ _____ ☐ _____ ☐	✓ 2A. Properly store and cover materials that are normally used during minor construction such as paints, solvents, equipment, fuel, asphalt/concrete materials, sand, etc. ✓ 2B. Properly store and dispose of wastes generated from the activity. ✓ 2C. To the extent practical, store dry and wet materials under cover, protected from rainfall and runoff and away from storm drain inlets. After job is complete, remove temporary stockpiles (asphalt materials, sand, etc.)

☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐	and other materials as soon as possible. ✓ 2D. Apply and store all products in accordance with manufacturer's instructions and proper safety measures. ✓ 2E. Store products in labeled containers and with covers or lids. ✓ 2F. Place stockpiled materials away from storm drain inlets, drainage paths, and natural waterways and provide cover to protect from run-on/run-off if feasible. ✓ 2G. Control stockpiled materials if windy or rainy weather is predicted (e.g. tarps, berming, sandbags, etc.). ✓ 2H. Prevent storm water from eroding stockpiles. ✓ 2I. Inspect stockpiles regularly and after significant rain events.
3. Concrete Work	
☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐	✓ 3A. Take measures to protect nearby storm drain inlets prior to breaking up asphalt or concrete (e.g. place hay bales or sand bags around inlets). Clean afterwards by dry sweeping up as much waste material as possible. ✓ 3B. When making saw cuts in pavement, use as little water as possible. Cover each storm drain inlet completely with filter fabric during the sawing operation and contain the slurry by placing straw bales, sandbags, or gravel dams around the inlets. Vacuum saw cuttings and water from the pavement or gutter and remove from site. ✓ 3C. To the extent practical, avoid mixing excess amounts of fresh concrete or cement mortar on site. ✓ 3D. To the extent practical, apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff. ✓ 3E. To the extent practical, protect applications of fresh concrete from rainfall and runoff until the material has hardened. ✓ 3F. Do not allow excess concrete to be dumped on-site, except in designated areas and promptly remove when concrete has dried. ✓ 3G. Wash concrete trucks and concrete pumper trucks and trailers off site or in designated areas on site, such that there is no discharge of concrete wash water into storm drains, open ditches, streets, catch basins, or other stormwater conveyance structures. ✓ 3H. For on-site washout: • To the extent practical, locate washout area at least 50 feet from storm drains, open ditches, or water bodies. Do not allow runoff from this area by constructing a temporary pit or bermed area large enough for liquid and solid waste. • To the extent practical, wash out wastes into the temporary pit where the concrete can set, be broken up, and then disposed of properly. • Wherever practical, recycle washout by pumping back into mixers for reuse. • Never dispose of washout into the street, storm drains, drainage

ditches, or creeks.

- ✓ 3I. When washing concrete to remove fine particles and expose the aggregate, contain the wash water for proper disposal. Do not allow water to enter storm drain inlets.
- ✓ 3J. Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stock pile, or dispose in the trash
- ✓ 3K. To the extent practical, return left-over materials to the transit mixer. Dispose excess concrete, grout, and mortar in the trash.
- 3a. Tarps should be placed under concrete pumper trucks and the rear of trucks while concrete is being delivered or transferred from one area to another, or clean the area immediately after delivery is complete. (TOX))

4. Building Work

General Guidelines

- ✓ 4A. Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.
- ✓ 4B. Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.
- ✓ 4C. Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.
- ✓ 4D. Clean paint brushes and tools covered with water-based paints in sinks connected to sanitary sewers. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.
- ✓ 4E. If a spill occurs on dirt, excavate and remove the contaminated (stained) soil

Building Demolition

- ✓ 4F. Spray water throughout the site to help control wind blowing of fine materials such as soil, concrete dust, paint chips, and metal chips. The amount of water must be controlled so that runoff from the site does not occur; yet dust control is accomplished.
- ✓ 4G. Oils must never be used for dust control.
- ✓ 4H. Place filter fabric or a similarly effective device at nearby storm drain inlets to prevent particles and solids from entering the storm drainage system. Filters should be placed at the beginning of the workday and the accumulated materials collected and disposed regularly before removing permanently them at the end of the work. Select devices that won't clog storm flow.
- ✓ 4I. Dry sweep surrounding street gutters, sidewalks, driveways, and other paved surfaces at the end of each workday to collect and properly dispose of loose debris and garbage, do not hose down the area to a storm drain.
- ✓ 4J. Use permanent soil erosion control techniques if a building cleared from an area is not to be replaced.

FF-9
PARKING LOT MAINTENANCE

The matrix below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for Municipal Parking Lot Maintenance activities based on priorities determined by site location and operational characteristics. Parking Facilities are considered High Priority regardless of location. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and limit impact on stormwater surface water quality to the maximum extent practicable. Below the matrix is a listing of Suggested Implementation Strategies for each required BMP.

DESIGNATED MINIMUM BMPS	LOW	MEDIUM	HIGH	303(D)	ESA
Sweeping and Cleaning					
___ Sweep or vacuum parking lots at least monthly.			X	X	N/a
___ Clean out parking lot drain inlets as needed and at least once before the wet season.			X	X	N/A
Surface Repair					
___ Conduct repairs during dry weather.			X	X	N/a
___ Prevent materials or wastes from entering drain inlets.			X	X	N/a
Spill Control					
___ If cleaning oily deposits or other spills, use absorbent materials and prevent any discharge to parking lot drain inlets or the MS4.			X	X	N/a
POLLUTION PREVENTION METHODS					
___ Require maintenance personnel to be trained in relevant BMPs.	X	X	X	X	N/a
___ Incorporate relevant BMPs into maintenance subcontracts.	X	X	X	X	N/a

PROGRAM/FACILITYBEING INSPECTED: _____

Inspector name: _____ Date: _____

When completed, the checklist should be attached to the General Inspection Form Cover Sheet and copies should be provided to the Supervisor of the Facility/Program being inspected.

SUGGESTED IMPLEMENTATION STRATEGIES

The following list of Suggested Implementation Strategies is divided between basic potential strategies suitable for general application (notated with checkmarks and capital letters) and more specific potential strategies (notated with bullet points and lower case letters) that may be applicable under certain circumstances, especially where there are certain Pollutant Constituents of Concern. The specific target constituents are notated parenthetically as:

Bacteria (BACT) Sediment (SED) Nutrients (NUT) Oil and Grease (O&G) Pesticides (
Other Toxic Compounds (TOX) Trash (TRASH) Hydrological Impacts (HYD) Any/All or General

SUGGESTED IMPLEMENTATION STRATEGIES:

1. Sweeping and Cleaning

- ✓ 1A. Sweep/vacuum all parking lots at least once before the onset of the wet season.
- ✓ 1B. Clean out parking lot drain inlets as needed at least once before the wet season.
- ✓ 1C. If cleaning with water is necessary, follow the procedures below:
  - Block the storm drain or contain runoff.
  - Wash water should be collected and disposed of properly. If wash water does not contain soap or other cleaning agents the water may be discharged to a pervious surface (dirt or landscaped area).
- ✓ 1D. Dispose of parking lot sweeping debris and dirt at a landfill.
- ✓ 1E. When cleaning heavy oily deposits:
  - Clean oily spots with absorbent materials
  - Do not allow discharges to the storm drain
  - Collect wash water and dispose of properly.
- ✓ 1F. Dispose of spilled materials and absorbents.
- ✓ 1G. If cleaning agents are used, select biodegradable products to the extent practical.
- 1a. Establish more frequent sweeping or drain inlet cleaning schedule based on usage and field observations of waste accumulation. (SED, TRASH, BACT)

Litter Control

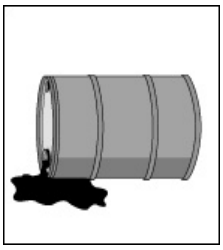
- ✓ 1H. Enforce anti-litter laws.
- ✓ 1I. Provide an adequate number of litter receptacles.
- ✓ 1J. Clean out litter receptacles frequently to prevent spillage.
- ✓ 1K. Sweep/vacuum all parking lots at least once before the onset of the wet season.
- 1b. Post "No Littering" signs. (TRASH)

2. Surface Repair

- ✓ 2A. Pre-heat, transfer or load hot bituminous material away from storm drain inlets.
- ✓ 2B. To the extent practical, apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff.
- ✓ 2C. Cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered maintenance holes and drains for proper disposal.
- ✓ 2D. Use only as much water as necessary for dust control, to avoid runoff.
- 2a. When repairing parking lots, consider retrofitting to direct stormwater to landscaped areas, and/or installing grate screens or inlet inserts on drain inlets to capture leaf litter, sediment and/or hydrocarbons. (TRASH, SED,

_____	O&G)
3. Control Spills	
☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____	✓ 3A. If a spill occurs on dirt, excavate and remove the contaminated (stained) dirt. ✓ 3B. Store spill response materials at a central location and keep maintenance vehicles adequately supplied. ✓ 3C. Appropriately dispose of spilled materials and absorbents.

FF-10
SPILL PREVENTION AND CONTROL



The matrix below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for Municipal Spill Prevention and Control activities based on priorities determined by site location and operational characteristics. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and limit impact on stormwater surface water quality to the maximum extent practicable. Below the matrix is a listing of Suggested Implementation Strategies for each required BMP.

DESIGNATED MINIMUM BMPS	LOW	MEDIUM	HIGH	303(d)	ESA
Preparation:					
___ Stockpile spill cleanup materials where they are readily accessible.	X	X	X	X	X
Spill Response:					
___ Clean up leaks and spills promptly upon discovery.	X	X	X	X	X
___ Sweep, scoop up or absorb exterior spills instead of washing down.	X	X	X	X	X
POLLUTION PREVENTION METHODS					
___ Train personnel in appropriate spill prevention and cleanup BMPs.	X	X	X	X	X

PROGRAM/FACILITY BEING INSPECTED:: _____

Date: _____ Inspector Name: _____

When completed, the checklist should be attached to the General Inspection Form Cover Sheet and copies should be provided to the Supervisor of the Facility/Program being inspected.

SUGGESTED IMPLEMENTATION STRATEGIES

The following list of Suggested Implementation Strategies is divided between basic potential strategies suitable for general application (notated with checkmarks and capital letters) and more specific potential strategies (notated with bullet points and lower case letters) that may be applicable under certain circumstances, especially where there are certain Pollutant Constituents of Concern. The specific target constituents are notated parenthetically as:

Bacteria (BACT) *Sediment (SED)* *Nutrients (NUT)* *Oil and Grease (O&G)* *Pesticides (PEST)* *Other Toxic Compounds (TOX)* *Trash (TRASH)* *Hydrological Impacts (HYD)* *Any/All or General (ANY)*

SUGGESTED IMPLEMENTATION STRATEGIES

1. Preparation/Prevention	
☐ _____ ☐	✓ 1A. Stockpile appropriate spill cleanup materials where they will be readily accessible.
2. Spill Response	
☐ _____ ☐	✓ 2A. Clean up leaks and spills promptly upon discovery.
☐ _____ ☐	✓ 2B. On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste.
☐ _____ ☐	✓ 2C. Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
☐ _____ ☐	✓ 2D. Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
☐ _____ ☐	✓ 2E. For larger spills, a private spill cleanup company or Hazmat team may be necessary.
☐ _____ ☐	• 2a. If illegal dumping is observed, consider retrofitting "No Dumping" signs with a phone number for reporting dumping and disposal. (ANY)
3. Reporting	
☐ _____ ☐	✓ 3A. Report spills to the MS4 or persistent problems to a city Authorized Inspector
4. Training	
☐ _____ ☐	✓ 4A. Verify that appropriate employees and subcontractors are trained in spill prevention and cleanup.

FF-11
VEHICLE AND EQUIPMENT CLEANING



The matrix below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for Municipal Vehicle and Equipment Cleaning activities based on priorities determined by site location and operational characteristics. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and limit impact on stormwater surface water quality to the maximum extent practicable. Below the matrix is a listing of Suggested Implementation Strategies for each required BMP.

DESIGNATED MINIMUM BMPS	**LOW**	**MEDIUM**	**HIGH**	**303(d)**	**ESA**
___ Steam cleaning or degreasing of engines is prohibited at municipal yards.	X	X	X	X	X
___ Prevent wash, rinsewater, or cleaning agents from entering the MS4.	X	X	X	X	X
POLLUTION PREVENTION METHODS					
___ Use commercial car wash or equipment cleaning facilities to the extent feasible.	X	X	X	X	X

PROGRAM/FACILITY BEING INSPECTED: _____

Date: _____ Inspector Name: _____

When completed, the checklist should be attached to the General Inspection Form Cover Sheet and copies should be provided to the Supervisor of the Facility/Program being inspected.

SUGGESTED IMPLEMENTATION STRATEGIES

The following list of Suggested Implementation Strategies is divided between basic potential strategies suitable for general application (notated with checkmarks and capital letters) and more specific potential strategies (notated with bullet points and lower case letters) that may be applicable under certain circumstances, especially where there are certain Pollutant Constituents of Concern. The specific target constituents are notated parenthetically as:

Bacteria (BACT) *Sediment (SED)* *Nutrients (NUT)* *Oil and Grease (O&G)* *Pesticides (PEST)*
Other Toxic Compounds (TOX) *Trash (TRASH)* *Hydrological Impacts (HYD)* *Any/All or General (ANY)*

☐ _____ ☐ _____

☐ _____ ☐ _____

☐ _____ ☐ _____

☐ _____ ☐ _____

☐ _____ ☐ _____

☐ _____ ☐ _____

✓ 1A. Do not permit steam cleaning or engine degreasing at the wash out area.

- 1a. Use designated, covered, wash areas to prevent contact with stormwater and bermed to contain wash water.
- 1b. Designated wash areas should be well marked with signs indicating where and how washing must be done.
- 1c. Water may be discharged to the sanitary sewer after flowing through a clarifier, upon approval from the sewer agency. If the above conditions are not met, other pre-treatment may be required.
- 1d. Washing operations should be conducted in a designated wash area having the following characteristics:
  - Paved with Portland cement concrete
  - Covered or bermed to prevent contact with storm water

_____ _____ _____ ☐ _____ ☐ ☐ _____ ☐	• Sloped for wash water collection • Connected to the sanitary sewer – upon approval. • Clearly designated • 1e. Consider filtering and recycling wash water. • 1f. Consider retrofitting wash areas with oil/water separators.

FF-12
VEHICLE AND EQUIPMENT STORAGE



The matrix below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for Municipal Vehicle and Equipment Storage activities based on priorities determined by site location and operational characteristics. Storage Yards are considered High-Priority areas. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and limit impact on stormwater surface water quality to the maximum extent practicable. Below the matrix is a listing of Suggested Implementation Strategies for each required BMP.

DESIGNATED MINIMUM BMPS	LOW	MEDIUM	HIGH	303(d)	ESA
Storing Vehicles and Equipment:					
___ Maintain vehicles so as to prevent oil or gasoline leaks onto pavement or streets.	X	X	X	X	N/a
Cleaning Vehicle Storage Areas:					
___ Keep vehicle storage areas tidy.	X	X	X	X	N/a
___ Do not hose down to drain inlets or MS4.	X	X	X	X	N/a
POLLUTION PREVENTION METHODS					
___ Require personnel to be trained in relevant BMPs.	X	X	X	X	X

PROGRAM/FACILITY BEING INSPECTED: _____

Date: _____ Inspector Name: _____

When completed, the checklist should be attached to the General Inspection Form Cover Sheet and copies should be provided to the Supervisor of the Facility/Program being inspected.

SUGGESTED IMPLEMENTATION STRATEGIES

The following list of Suggested Implementation Strategies is divided between basic potential strategies suitable for general application (notated with checkmarks and capital letters) and more specific potential strategies (notated with bullet points and lower case letters) that may be applicable under certain circumstances, especially where there are certain Pollutant Constituents of Concern. The specific target constituents are notated parenthetically as:

Bacteria (BACT) *Sediment (SED)* *Nutrients (NUT)* *Oil and Grease (O&G)* *Pesticides (PEST)*
Other Toxic Compounds (TOX) *Trash (TRASH)* *Hydrological Impacts (HYD)* *Any/All or General (ANY)*

SUGGESTED IMPLEMENTATION STRATEGIES:

1. Storing Vehicles and Equipment

☐ _____ ☐ _____

☐ _____ ☐ _____

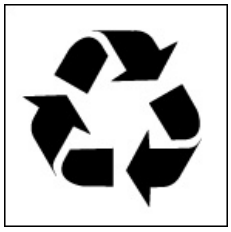
☐ _____ ☐ _____

General Guidelines

- ✓ 1A. Review the storage yard for filling drip pans and other problems (leaking equipment) regularly.
- ✓ 1B. Verify that appropriate employees and subcontractors are trained on procedures.
- 1a. Consider placing drip pans or absorbent materials under

	vehicles and heavy equipment when not in use for significant periods. (O&G) **Batteries** ✓ 1C. Store batteries that have been dropped or are cracked in a secondary container even if it appears that the acid has already drained.
2. Wrecked Vehicle Storage	
	✓ 2A. As the vehicles arrive, place drip pans under them immediately, even if the fluids have leaked out before the car arrives. ✓ 2B. Drain all fluids from wrecked vehicles and "part" cars. Also drain engines, transmission, and other used parts. ✓ 2C. Promptly transfer used fluids to the proper container; do not leave full drip pans or other open containers lying around. • 2a. To the extent practical, do not store vehicles near storm drain inlets. (O&G)
3. Cleaning Vehicle Storage Areas	
	• 3a. Dry sweep parking lots, storage areas, and driveways as needed to collect dirt, waste, and debris. Do not hose down the area to a storm drain. (SED, TRASH) • 3b. Considering using an outside service to clean vehicle storage areas and collect water for off-site disposal. (SED, TRASH)

FF-13
WASTE HAULING AND DISPOSAL



The matrix below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for Municipal Waste Hauling and Disposal activities based on priorities determined by site location and operational characteristics. Drainage Facilities are considered High Priority regardless of location. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and limit impact on stormwater surface water quality to the maximum extent practicable. Below the matrix is a listing of Suggested Implementation Strategies for each required BMP.

DESIGNATED MINIMUM BMPS	LOW	MEDIUM	HIGH	303(d)	ESA
Litter Control:					
___ Provide covered litter receptacles in busy pedestrian areas.	X	X	X	X	X
Waste Collection:			X	X	X
___ Store trash in covered watertight containers.	X	X	X	X	X
Spill/Leak Control:			X	X	X
___ Clean out litter receptacles frequently to prevent spillage.	X	X	X	X	X
___ Stockpile spill cleanup materials where they are readily accessible.			X	X	X
___ Prevent any trash container or storage area rinsewater from entering the MS4.	X	X	X	X	X
Run-on/Run-off Prevention:					
___ Keep trash storage areas tidy.	X	X	X	X	X
___ Protect trash storage area from concentrated surface rain flows.	X	X	X	X	X
POLLUTION PREVENTION METHODS					
___ Require waste hauling/disposal personnel to be trained in relevant BMPs.	X	X	X	X	X
___ Incorporate relevant BMPs into contractual requirements for any waste hauling/disposal subcontracts.	X	X	X	X	X

PROGRAM/FACILITY BEING INSPECTED: _____

Date: _____ Inspector Name: _____

When completed, the checklist should be attached to the General Inspection Form Cover Sheet and copies should be provided to the Supervisor of the Facility/Program being inspected.

SUGGESTED IMPLEMENTATION STRATEGIES:

The following list of Suggested Implementation Strategies is divided between basic potential strategies suitable for general application (notated with checkmarks and capital letters) and more specific potential strategies (notated with bullet points and lower case letters) that may be applicable under certain circumstances, especially where there are certain Pollutant Constituents of Concern. The specific target constituents are notated parenthetically as:

Bacteria (BACT) *Sediment (SED)* *Nutrients (NUT)* *Oil and Grease (O&G) Pesticides (PEST)*
Other Toxic Compounds (TOX) *Trash (TRASH)* *Hydrological Impacts (HYD)* *Any/All or General*

1. Litter Control

General Guidelines

- ✓ 1A. Enforce anti-litter laws.
- ✓ 1B. Provide a sufficient number of litter receptacles at each fixed facility.
- ✓ 1C. Clean out litter receptacles frequently to prevent spillage.
- ✓ 1D. Place trash receptacles at transit stop benches and maintain as necessary.

1a. Consider posting "No Littering" signs. (TRASH)
1b. Provide covered trash receptacles. (TRASH).

2. Waste Collection

General Guidelines

- ✓ 2A. Keep waste collection areas clean.
- ✓ 2B. Regularly inspect solid waste containers for structural damage. Repair or replace damaged containers as necessary.
- ✓ 2C. Do not fill solid waste containers with washout water or any other liquid.
- ✓ 2D. Educate the public and verify that appropriate employees and subcontractors are trained to ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, CRTs, TVs, computers etc. may not be disposed of in solid waste containers (see chemical/ hazardous waste collection section below).
- ✓ 2E. Do not mix liquid wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal.
- 2a. Secure solid waste containers; containers should be closed tightly when not in use. (TRASH)

Good Housekeeping

- ✓ 2F. The waste management area should be kept clean by sweeping and cleaning up spills immediately.
- ✓ 2G. When cleaning around dumpster areas use dry methods when possible (e.g. sweeping, use of absorbents). If water must be used after sweeping/using absorbents, collect water and discharge to landscaped area; or discharge through a grease interceptor, if needed and practical, to the sewer if permitted to do so.
- 2b. Use the entire product before disposing of the container.

	Chemical/Hazardous Waste Management
☐ _____ ☐	✓ 2H. All hazardous waste must be labeled according to hazardous waste regulations. Consult your Fire Department or your local hazardous waste agency for details.
☐ _____ ☐	✓ 2I. Verify that appropriate employees and subcontractors are trained in proper hazardous waste handling management practices.
☐ _____ ☐	✓ 2J. Select designated hazardous waste collection areas on-site and make sure that hazardous waste is collected, removed, and disposed of only at these authorized disposal areas.
☐ _____ ☐	✓ 2K. Hazardous materials and wastes should be stored in covered containers and protected from vandalism.
☐ _____ ☐	• 2c. Consider retrofitting if necessary to place hazardous waste containers in secondary containment. (TOX)
☐ _____ ☐	• 2d. Stencil storm drains on the facility's property. (TOX)
3. Spill/Leak Control	
☐ _____ ☐	✓ 3A. Clean up spills promptly upon discovery.
☐ _____ ☐	✓ 3B. Spill cleanup materials should be placed where they are easily accessible
☐ _____ ☐	✓ 3C. Minimize spillage/leaking from solid waste containers. For larger solid waste containers (especially compactors) that utilize a hydraulic fluid pump system, regularly inspect and replace faulty pumps or hoses to minimize the potential of releases and spills.
☐ _____ ☐	✓ 3D. Check waste management areas for leaking containers or spills.
☐ _____ ☐	✓ 3E. Leaking equipment including valves, lines, seals, or pumps should be repaired promptly.
☐ _____ ☐	✓ 3F. Transfer waste from damaged containers into safe containers.
☐ _____ ☐	✓ 3G. Vehicles transporting waste should have spill prevention equipment that can prevent spills during transport. The spill prevention equipment may include: • Vehicles equipped with baffles for liquid waste • Trucks with sealed gates and spill guards for solid waste
☐ _____ ☐	✓ 3H. Special care should be taken when loading or unloading wastes. *See Loading and Unloading procedure sheet.*
4. Run-on/Run-off Prevention	
☐ _____ ☐	• 4a. Consider retrofitting to prevent stormwater run-on from entering waste management areas by enclosing the area or building a berm around the area. (TOX, PEST, O&G, NUT))
☐ _____ ☐	• 4b. Consider retrofitting to prevent the waste materials from directly contacting rain. (TOX, PEST, O&G, NUT))
☐ _____ ☐	• 4c. Consider retrofitting to cover waste areas with a permanent roof if practical. If not feasible, consider covering waste piles with temporary covering material such as reinforced tarpaulin, polyethylene, polyurethane, polypropylene or hypalon. (TOX, PEST, O&G, NUT)
☐ _____ ☐	• 4d. If possible, move the activity indoors; ensuring first that all safety concerns such as fire hazard and ventilation are addressed. (TOX, PEST, O&G, NUT)

Run-on/Run-off Prevention (cont.)

- 4e. Consider replacing dumpsters with covered units to prevent rain from washing waste out of holes or cracks in the bottom of the dumpster. (ANY)
- 4f. Minimize the runoff of stormwater for land application by: (BACT, TOX, PEST)
  - Choosing a site where slopes are under 6%, the soil is permeable, there is a low water table, it is located away from wetlands or marshes, there is a closed drainage system.
  - Avoiding application of waste to the site when it is raining or when the ground is saturated with water.
  - Growing vegetation on land disposal areas to stabilize soils and reduce the volume of surface water runoff from the site.
  - Maintaining adequate barriers between the land application site and the receiving waters. Planted strips are particularly good.
  - Using erosion control techniques such as mulching and matting, filter fences, straw bales, diversion terracing, and sediment basins.
  - Performing routine maintenance to ensure the erosion control or site stabilization measures are working.

CITY OF LAGUNA NIGUEL

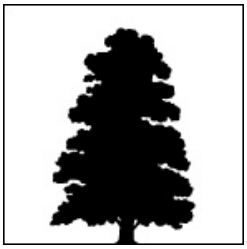
FF-14:
SPECIAL EVENTS

The matrix below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for Special Events, based on priorities determined by site location and operational characteristics. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and limit impact on stormwater surface water quality to the maximum extent practicable.

ACTIVITY / ITEM	DESIGNATED MINIMUM BEST MANAGEMENT PRACTICES (BMPs)
Trash/ Litter Management	• Ensure that an adequate number of receptacles are provided for use by vendors and guests. Any overflowing containers observed shall be managed and serviced in a timely manner. • Release of balloons (rubber, latex, mylar or other material) is not allowed. • All waste receptacles shall be leak tight and equipped with lids or covers. Dumpsters shall be closed when not in use. • Pick up litter at least once daily. Litter should not be allowed to be blown away by blowers or wind. • Hazardous and liquid waste shall not be disposed of in dumpsters or trash bins. Hazardous waste shall be disposed of properly at a hazardous waste facility. Liquid waste, such as cooking grease or other food related materials, shall be properly disposed of off-site by generator. Other non-hazardous liquids, such as left over beverages, ice bin residual, etc, should be disposed of in the sanitary sewer system through a sink or toilet, or poured on a pervious area, such as a landscaped or dirt/gravel area, where the liquids can be fully absorbed prior to leaving the site. • If commercial vendors/sales are involved, provide required recycling containers as set forth by City contract waste hauler. • After the event is over and any temporary event facilities are removed, inspect the site for litter or spills, and provide for prompt cleanup and disposal.
Portable Toilets	• Require the vendor to provide a secondary containment pan or storm drain inlet protection, if a spill could reach the storm drain. • Do not place portable toilets near or over a storm drain without secondary containment. • The contact information for the company responsible for the portable facilities must be clearly marked on or near the facilities. • Ensure adequate servicing to prevent overflows or leaks. • It is recommended that vendors be requested to stake down the portable toilets to prevent them from tipping over from wind or vandals, if appropriate.

Car Wash Fundraisers	• The use of an experienced car wash fundraiser vendor, with proper containment equipment such a Prontowash, or dry methods are encouraged. • All car wash water must be contained on site and not allowed to drain to adjacent property or storm drains without treatment BMPs. • If there is adequate on-site area, car wash water may be allowed to absorb into a pervious (i.e. landscaped or gravel/dirt) area. The event water must be fully absorbed prior to leaving site. • If draining to a vegetated area, a filtering device, such as sand or gravel bags shall be used to collect sediment and debris prior to draining to the vegetated area. The collected debris shall be removed and disposed of properly at the end of the event. • A high pressure hose nozzle is encouraged to minimize water use and runoff. An automatic shut off nozzle is required per water district regulations. • A non-toxic, biodegradable soap shall be used.
Pressure Washing / Wet Washing	• All water or wastewater discharges from any washing activities must be prevented from entering streets, storm drains and gutters and collected for proper disposal. • Storm drain inlets (or low points of the site) must be protected with a temporary berm where washwater is contained and then collected for proper disposal. • If contractors (such as powerwashers) are used for wet washing services, they must contain, collect and properly dispose of washwater (most likely offsite). Include this requirement in your contract. • Small amounts of water can be dumped into a sanitary sewer connection, such as a utility sink or toilet, if available, or could be diverted to a pervious (ie. landscaped or gravel/dirt) area, and allowed to soak into the ground. The water must be fully absorbed into the ground prior to leaving site.
Spill Clean Up & Reporting	• Prior to start of event, organizers & staff should assess the event location, and identify the nearby catch basins, that would receive any trash, debris or spills from the event. • Spills of drinks, food, and any other material on a paved area must be cleaned. Liquid spills can be cleaned by using absorbent materials such as paper towels, mops, or an absorbent material. Food or other solid materials may be swept up, and placed in the trash. • Regularly inspect storm drains during the event to assure that pollutants are not entering them. • If pollutants enter a storm drain or if a hazardous material spill occurs, please call Police Dispatch at 949-770-6011 immediately.
Post-Event Clean Up	• All streets, sidewalks, and public areas must be cleaned (sweeping, litter pickup, etc.) and returned to the pre-event condition. • Remove temporary public art (chalk, paint, charcoal, clay, etc). Any wet washing conducted should follow BMPs as noted above. • All storm drain inlet protection devices must be removed.
Contracts & Leases	• Provide adequate language in contracts with vendors to ensure compliance with these rules. • Discuss and distribute information about these water quality requirements during staff (including contractor) training and vendor registration.

FP-2
LANDSCAPE MAINTENANCE



The matrix below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for Municipal Landscape Maintenance activities based on priorities determined by site location and operational characteristics. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and to limit impact on stormwater surface water quality to the maximum extent practicable. Below the matrix is a listing of Suggested Iimplementation Strategies for each required BMP.

DESIGNATED MINIMUM BMPS	LOW	**MEDIUM**	**HIGH**	**303(d)**	**ESA**
Mowing, Trimming, Weeding, or Planting:					
___ Keep green wastes out of drain inlets.	X	X	X	X	X
___ Immediately clean up and remove grass clippings, trimmings, and weed debris.	X	X		X	X
Irrigation:					
___ Take all feasible measures to eliminate surface irrigation runoff.	X	X	X	X	X
____ Comply with Water District regulations for waste prohibition, water conservation and drought response.	X	X	X	X	X
___ Prevent irrigation overspray onto pavements.	X	X	X	X	X
___ Equip systems with automatic rain sensing shut off.	X	X	X	X	X
Fertilizer and Pesticide Management:					
___ Adhere to all laws and regulations for use, storage and disposal of fertilizers and pesticides.	X	X	X	X	X
___ All pesticide application shall be supervised by a Certified Pest Control Applicator.	X	X	X	X	X
___ Utilize biological controls for pests where feasible.	X	X	X	X	X
___ Do not apply landscape pesticide or herbicide chemicals when rain is imminent.	X	X	X	X	X
___ Do not operate irrigation systems after chemical treatment until all liquid chemical applications have fully dried.	X	X	X	X	X
___ Immediately clean up spilled or excess chemicals or fertilizers.	X	X	X	X	X
___ Use appropriate Integrated Pest Management Techniques.	X	X	X	X	X
___ Reduce fertilizer and pesticide needs by retaining or revegetating with native plants when and where determined appropriate.	X	X	X	X	X
Managing Landscape Waste					
___ Remove pet or wildlife feces by scooping, sweeping or wiping. If needed, direct any hose-down to landscaped areas.	X	X	X	X	X

Erosion Control					
___ Keep soil or soil amendments out of drain inlets**.**	X	X	X	X	

POLLUTION PREVENTION METHODS

___ Require landscape maintenance personnel to be trained in relevant BMPs.
___ Incorporate BMPs into subcontracts when renewed.

PROGRAM/FACILITY BEING INSPECTED: _____
Inspector name: _____ Date: _____
When completed, the checklist should be attached to the General Inspection Form Cover Sheet and copies should be provided to the Supervisor of the Facility/Program being inspected.

SUGGESTED IMPLEMENTATION STRATEGIES

This list of Suggested Implementation Strategies is divided between basic potential strategies suitable for general application (notated with checkmarks and capital letters) and more specific potential strategies (notated with bullet points and lower case letters) targeted at specific constituents of concern . The specific target constituents are notated parenthetically as:

Bacteria (BACT) Sediment (SED) Nutrients (NUT) Oil and Grease (O&G) Pesticides (PEST) Other Toxics (TOX) Trash (TRASH) Hydrological Impacts (HYD) Any/All or General (ANY)

1. Mowing, Trimming/Weeding, and Planting

☐ _____ ☐ _____
_____
_____
☐ _____ ☐ _____
_____
_____

☐ _____ ☐ _____
_____
_____
☐ _____ ☐ _____
_____
_____
☐ _____ ☐ _____
_____
_____
☐ _____ ☐ _____
_____
_____
☐ _____ ☐ _____
_____
_____

✓ 1A. Where cost effective and appropriate, use mechanical methods of vegetation removal rather than applying herbicides.

✓ 1B. When conducting mechanical or manual weed control, try to minimize loosening the soil, which could erode into streams or storm drains.

✓ 1C. Do not blow or rake leaves, etc. into the street or place yard waste in gutters or on dirt shoulders. Sweep up any leaves, litter or residue in gutters or on street.

✓ 1D. Collect lawn and garden clippings, pruning waste, tree trimmings, and weeds. Chip if necessary, and compost or dispose of at a landfill (see waste management section of this procedure sheet).

✓ 1E. Place temporarily stockpiled material away from watercourses, and berm or cover stockpiles to prevent material releases to storm drains.

✓ 1F. Use baggers on mowing equipment, or use composting mowers.

- 1a. Consider retrofitting with coarse textured mulches or geotextiles to suppress weed growth and reduce the use of herbicides. (PEST, SED)

Planting

- 1b. Where feasible and appropriate, retain and/or plant selected native vegetation whose features are determined to

☐ ☐	be beneficial. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting ornamental vegetation. (PEST, NUT, HYD, BACT) • 1c. When planting or replanting consider retrofitting with low water use or inert groundcovers, and/or drought-tolerant, pest-resistant shrubs or trees. (PEST, NUT, HYD, BACT). • 1d. When planting, consider using broadleaf evergreen trees to reduce leaf litter. (BACT)
2. Irrigation	
☐ ☐	✓ 2A. When scheduling irrigation application durations, consider the equipment's precipitation rates and the infiltration rate and slope of the soil to minimize runoff. ✓ 2B. Only irrigate as much as is needed. Adjust irrigation frequencies seasonally and in response to rain. ✓ 2C. Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed. Adjust sprinkler head spray patterns to minimize over spray while achieving necessary coverage. ✓ 2D. If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas. ✓ 2E. Verify that appropriate employees and subcontractors are trained in irrigation management techniques for pollution prevention. • 2a. Consider retrofitting popup sprinkler heads in areas with a lot of activity or where there is a chance the pipes may be broken. (HYD, SED) • 2b. Consider the use of mechanisms that reduce water flow to sprinkler heads if broken. (HYD, SED) • 2c. If recycled water is used for irrigation, ensure that runoff from the landscaped area(s is minimized to the maximum extent practical. (HYD, BACT, NUT) • 2d. Consider retrofitting raised edgings, berms or other measures to reduce runoff. (HYD, BACT, NUT, PEST) • 2e. Consider retrofitting to an evapotranspiration-driven controller. (HYD) • 2f. Consider retrofitting to lower-precipitation-rate sprinkler heads, or to a drip system where appropriate. (HYD)
3. Fertilizer and Pesticide Management	
☐ ☐	✓ 3A. Utilize appropriate integrated pest management techniques.

- ✓ 3B. Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.
- ✓ 3C. Verify that appropriate employees and subcontractors are trained on use of pesticides and in pesticide application techniques to prevent pollution.
- ✓ 3D. Pesticide application must be under the supervision of a California qualified pesticide applicator.
- ✓ 3E. When applicable use the least toxic pesticides that will do the job. Avoid use of copper-based pesticides if possible.
- ✓ 3F, Do not mix or prepare pesticides or fertilizers for application near storm drains.
- ✓ 3G. Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the pest.
- ✓ 3H. Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
- ✓ 3I. Calibrate fertilizer and pesticide application equipment to avoid excessive application.
- ✓ 3J. Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- ✓ 3K. Inspect pesticide/fertilizer equipment and transportation vehicles for leaks and repair as needed.
- ✓ 3L. Refer to Appendix D for further guidance on Fertilizer and Pesticide management
- 3a. Periodically test soils for determining proper fertilizer use. (NUT)
- 3b. Work fertilizers into the soil rather than dumping or broadcasting them onto the surface. (NUT, BACT)
- 3c. Use beneficial insects where possible to control pests (green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seedhead weevils, and spiders prey on detrimental pest species). (PEST)
- 3d. Use slow release fertilizers when/where possible to minimize leaching. (NUT, BACT)

Scheduling

- ✓ 3M. Do not use pesticides if rain is expected within 24 hours.
- ✓ 3N. Apply pesticides only when wind speeds are low (less than 5 mph).

Disposal

- ✓ 3O. Dispose of empty pesticide containers according to the instructions on the container label.
- 3e. Consider purchasing only the amount of pesticide that you can reasonably use in a given time period (month or year depending on the product), to reduce the potential for accidental release during storage. (PEST)
- 3f. Triple rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste. (PEST)

4. Managing Landscape Waste	
☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____	✓ 4A. Compost leaves, sticks, or other collected vegetation or dispose of at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems. ✓ 4B. Place temporarily stockpiled material away from watercourses and storm drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system. ✓ 4C. Inspection of drainage facilities should be conducted to detect illegal dumping of clippings/cuttings in or near these facilities. Materials found should be picked up and properly disposed of. ✓ 4D. Landscape wastes in and around storm drain inlets should be avoided by either using bagging equipment or by manually picking up the material. • 4a. Reduce the use of high nitrogen fertilizers that produce excess growth requiring more frequent mowing or trimming. (NUT)
5. Erosion Control	
☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____	✓ 5A. Maintain vegetative or other cover on medians and embankments to prevent soil erosion. • 5a. Apply mulch or leave clippings to serve as additional cover for soil stabilization. (SED) • 5b. Minimize the use of disking as a means of vegetation management because the practice may result in erodable barren soil. (SED) • 5c. Confine excavated materials to pervious surfaces away from storm drain inlets, sidewalks, pavement, and ditches. Material must be covered if rain is expected. (SED) • 5d. Consider retrofitting structural erosion control measures if needed. •

FP-2A
IRRIGATION RUNOFF ELIMINATION

The matrix below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for Municipal Irrigation Runoff Elimination activities based on priorities determined by site location and operational characteristics. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and to limit impact on stormwater surface water quality to the maximum extent practicable. Below the matrix is a listing of Suggested Iimplementation Strategies for each required BMP.

DESIGNATED MINIMUM BMPS	LOW	**MEDIUM**	**HIGH**	**303(d)**	**ESA**
Irrigation:					
___ Implement all feasible measures to eliminate surface irrigation runoff.	X	X	X	X	X
____ Comply with Water District regulations for waste prohibition, water conservation and drought response.	X	X	X	X	X
___ Prevent irrigation overspray onto pavements.	X	X	X	X	X
___ Equip systems with automatic rain sensing shut off.	X	X	X	X	X

POLLUTION PREVENTION METHODS

___ Require landscape maintenance personnel to be trained in relevant BMPs.
___ Incorporate BMPs into subcontracts when renewed.

PROGRAM/FACILITY BEING INSPECTED: _____

Inspector name: _____ Date: _____

When completed, the checklist should be attached to the General Inspection Form Cover Sheet and copies should be provided to the Supervisor of the Facility/Program being inspected.

SUGGESTED IMPLEMENTATION STRATEGIES

The following list of Suggested Implementation Strategies is divided between basic potential strategies suitable for general application (notated with checkmarks and capital letters) and more specific potential strategies (notated with bullet points and lower case letters) targeted at specific constituents of concern . The specific target constituents are notated parenthetically as:

Bacteria (BACT) Sediment (SED) Nutrients (NUT) Oil and Grease (O&G) Pesticides (PEST) Other Toxics (TOX) Trash (TRASH) Hydrological Impacts (HYD) Any/All or General (ANY)

1. <u>Implement all feasible measures to eliminate surface runoff of landscape irrigation water.</u>

☐ ☐	✓ 1A. Ensure that persons responsible for landscape maintenance are aware of irrigation management techniques for pollution prevention.
☐ ☐	✓ 1B. Replace irrigation controller batteries routinely, preferably in the spring and fall.
	✓ 1C. Inspect the irrigation system regularly, while it is operating, to identify leaks and to determine if runoff is occurring.
☐ ☐	✓ 1D. Promptly repair any leaks or breaks. If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.
☐ ☐	✓ 1E. Adjust sprinkler heads and nozzles to avoid over-spray onto pavement and/or other impervious areas.
	✓ 1F. Irrigate slowly or pulse irrigate so the infiltration rate of the soil is not exceeded. This can occur in less than 2 minutes depending on landscaping, soil type and topography.
☐ ☐	✓ 1G. Adjust the watering schedule seasonally to reflect reduced winter water demand.
☐ ☐	✓ 1H. Do not water when rain is predicted, or when the ground is already moist from rainfall.
	.

2. <u>Comply with water conservation, drought response and waste prohibition regulations of the water district.</u>

☐ ☐	✓ 2A. When scheduling irrigation application durations, consider the equipment's precipitation rates and the infiltration rate and slope of the soil to minimize runoff.
☐ ☐	✓ 2B. Adhere to the watering schedule restrictions designated by the water district, as appropriate to drought conditions. For more information on water district requirements contact Moulton Niguel Water District at (949) 831-2500 or visit their website at www.mnwd.com.
☐ ☐	✓ 2C. Only irrigate as much as is needed. Adjust irrigation frequencies seasonally and in response to rain.
☐ ☐	✓ 2D. Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed.
☐ ☐	✓ 2E. Adjust sprinkler head spray patterns to minimize over spray while achieving necessary coverage.
☐ ☐	✓ 2F. If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.
☐ ☐	

3. Other Tips & Techniques: <u>Consider upgrading irrigation system components to increase irrigation efficiency and reduce the potential for runoff.</u>	
☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____	✓ 3a. Consider retrofitting popup sprinkler heads in areas with a lot of activity or where there is a chance the pipes may be broken. (HYD, SED) ✓ 3b. Consider the use of mechanisms that reduce water flow to sprinkler heads if broken. (HYD, SED) • 3c. If recycled water is used for irrigation, ensure that runoff from the landscaped area(s is minimized to the maximum extent practical. (HYD, BACT, NUT) • 3d. Consider retrofitting raised edgings, berms or other measures to reduce runoff. (HYD, BACT, NUT, PEST) • 3e. Consider retrofitting to an evapotranspiration-driven controller. (HYD) • 3f. Consider retrofitting to lower-precipitation-rate sprinkler heads, or to a drip system where appropriate. (HYD) • 3g. Install sprinkler heads with a low precipitation rate and/or a more adjustable spray pattern or radius as needed. • 3h. Install popup sprinkler heads in areas with a lot of activity and/or where risers may be broken. • 3i. Install water-efficient drip irrigation systems for trees, shrubs and flowers. • 3j. Install a sensor that will reduce flow in case of breakages in the system. • 3k. Install an automatic rain shut-off sensor. • 3l. Install check valves for sprinkler heads at the bottom of slopes to eliminate low-head drainage.

4. Other Tips & Techniques: Consider reducing the need for irrigation.

☐ _____ ☐

☐ _____ ☐

☐ _____ ☐

☐ _____ ☐

☐ _____ ☐

Planting

- 4a. Where feasible and appropriate, retain and/or plant selected native vegetation whose features are determined to be beneficial. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting ornamental vegetation. (PEST, NUT, HYD, BACT)
- 4b. When planting or replanting consider retrofitting with low water use or inert groundcovers, and/or drought-tolerant, pest-resistant shrubs or trees. (PEST, NUT, HYD, BACT).
- 4c. Add 2-3 inches of mulch around trees and plants to minimize runoff and reduce evaporation
- 4d. Replace turf areas adjacent to pavement and/or other impervious areas with drought tolerant shrubs and groundcover

FP-2B: INTEGRATED PEST MANAGEMENT INCLUDING PESTICIDES, HERBICIDES, & FERTILIZERS

The checklist below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for Integrated Pest Management activities, including pesticide, herbicide and fertilizer applications, based on priorities determined by site location and operational characteristics. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and to limit impact on stormwater surface water quality to the maximum extent practicable. Below each list of BMPs is a listing of Other Tips & Techniques that may be utilized where appropriate. Information on the latest IPM information including management of new pests in the landscape is obtained from local UC Cooperative Extension Advisors, UC IPM Regional Advisor, or the Statewide UC IPM Web Site at www.ipm.ucdavis.edu.

I. PREVENTION

A. Landscape Design Procedures - *Minimum Designated BMPs*

☐ Drainage, soil characteristics, water quality and availability are considered during plant selection. Native plants and ecologically adapted species are utilized where compatible with site functional requirements.

☐ Sun exposure, heat, and high temperature conditions are considered during plant selection.

☐ Nursery stock is inspected and rejected if not healthy (injuries, diseased, circling roots/potbound, poor staking and/or pruning).

Other Tips and Techniques

☐ Pest resistant species and cultivars are selected.

☐ Plants with similar growth characteristics and irrigation requirements are grouped together..

☐ Adequate space is allowed for root growth, especially trees.

B. Site Preparation and Planting Procedures - *Minimum Designated BMPs*

☐ Assess soil drainage properties and improve compacted soils prior to planting.

☐ Follow proper planting procedures for particular plant species to avoid planting too deeply or too shallow.

Other Tips and Techniques

☐ Nursery tree stakes are removed at planting and replaced with staking that allows trunk to flex; removing these stakes after 1 to 1.5 years.

☐ Conduct a soil analysis to determine chemical and physical properties of the existing soil and then add appropriate amendments such as organic matter.

C. Water Management – *Minimum Designated BMPs*

☐ Utilize evapotranspiration (ET) data or 'smart' clock technology to schedule irrigation to occur only as needed, and at appropriate times of the day/week.

Other Tips and Techniques

☐ Adjust sprinklers to avoid application of water directly to the trunk of trees (can promote disease) or on to concrete surfaces where it can enter storm drains.

☐ Plants are examined weekly for symptoms of water stress and to assist in determining irrigation scheduling.

☐ Monitor soil moisture with a soil probe or soil moisture sensors to assist in scheduling irrigation.

D. Fertilizing Procedures - *Minimum Designated BMPs*

☐ Fertilizer application occurs in accordance with schedules in the City's Landscape Maintenance Subcontractor Specifications, adjusted as deemed necessary by the Contract Manager.

☐ Fertilizer is not applied within 48 hours of a rain event to avoid losses below the root zone and in surface runoff.

☐ Unused fertilizers are collected in a central location for future use or proper disposal or recycling. Off-target fertilizer applications or spills are cleaned up immediately by sweeping up and applying to landscape or turf or replacing in spreader or bag to ensure material does not enter storm drains.

Other Tips and Techniques

☐ Soil analyses may be conducted in order to determine existing nutrient levels in the soil prior to fertilizing.

☐ Turf grass fertilizer maintenance guidelines are based on UC recommendations found online at UC Guide for Healthy Lawns.

http://www.ipm.ucdavis.edu/TOOLS/TURF/MAINTAIN/fertilize.html

☐ Sports turf grass fertilizer maintenance guidelines are based on UC recommendations found in *Establishing and Maintaining the Natural Turf Athletic Field (UCR ANR Publication Number: 21617).*

☐ Overfertilization, especially of trees and shrubs, is avoided to ensure plant growth is not excessively succulent making it more susceptible to pest infestations.

E. Pruning Procedures – *Minimum Designated BMPs*

☐ Damaged or diseased wood is regularly pruned from landscape plants.

☐ Trees are pruned according to standards set forth by a professional tree care organization such as the International Society of Arboriculture.

☐ Replace plants too large for a space instead of pruning them severely.

☐ Unnecessary pruning is avoided as wounds are entry sites for decay and disease organisms.

☐ Tree height reduction is discouraged. When deemed necessary by a licensed arborist, the crown reduction method approved by a professional tree care organization is utilized. Topping is never done to reduce tree size. NO TOPPING OR 'HAT RACKING' IS PERMITTED.

Other Tips and Techniques

☐ The age and species of the plant is taken into account when determining the time of year to prune. For example, eucalyptus should be pruned in December and January when long-horned beetles are not active.

II. PEST AND SYMPTOM IDENTIFICATION

A. Insects, Mites, and Snails and Slugs – ***Minimum Designated BMPs***

☐ Field personnel are trained to recognize basic pests found in the landscape in the following groups: insects, mites, and mollusks.

☐ Field personnel are trained to utilize disease life cycles to apply treatments when the organism can be controlled most effectively.

☐ Field personnel are trained to distinguish between beneficial insects and actual pests found in the landscape (e.g. parasitizing wasps).

☐ Unknown samples are submitted to the Orange County Agricultural Commissioner for identification by the county entomologist or plant pathologist.

☐ Abiotic or nonliving factors (wind, sunburn, air pollution, etc…) are considered as possible causes of observed symptoms as well as biotic (living) factors.

B. Weeds – *Minimum Designated BMPs*

☐ Field personnel are trained to identify common weeds in the landscape.

☐ Field personnel are trained to utilize weed life cycles to properly control weeds such as controlling crabgrass utilizing a pre-emergent herbicide applied in mid-January.

C. Diseases – *Minimum Designated BMPs*

☐ Field personnel are trained to recognize common diseases or their signs/symptoms in the landscape.

☐ Field personnel are trained to utilize disease life cycles to apply treatments when the organism can be controlled most effectively.

☐ Field personnel are trained to recognize the difference between biotic and abiotic problems.

☐ Field personnel are trained to understand how common diseases are spread throughout the landscape.

☐ Photographs of disease signs and symptoms are taken and compared to reference guides such as UC IPM's *Pests of Landscape Trees and Shrubs*.

Other Tips and Techniques

☐ Disease signs and symptoms are sampled and submitted to the Orange County Agricultural Commissioner for identification by the county plant pathologist.

D. Vertebrates – *Minimum Designated BMPs*

☐ Field personnel are trained to recognize vertebrate pests and the damage they cause in the landscape.

☐ Field personnel are trained to utilize vertebrate behavior to properly control the pest most effectively.

☐ At least one field staff member is trained in vertebrate baiting and trapping.

III. MONITORING FOR PESTS AND PROBLEMS

A. Insect/Mollusk Monitoring Procedures – *Minimum Designated BMPs*

☐ Insects are dislodged from plants by shaking over a collection surface usually consisting of a clipboard with a white sheet of paper.

☐ Soil-dwelling turf insects are brought to the surface for monitoring by flushing a specific area of soil (i.e. 2' x 2' grid) with plain water or a soapy water mixture.

☐ The amount of honeydew (aphids) and frass (caterpillars) present is utilized as an indicator of population levels.

Other Tips and Techniques

☐ Visually inspect plants for insects, mites, snail and slug damage at least monthly; recording results utilizing a method conducive to tracking changes and easy recall of data.

☐ Yellow sticky traps are utilized to assess populations of insects.

☐ If available for a particular insect, phermone-baited traps are utilized.

B. Weed Monitoring Procedures – *Minimum Designated BMPs*

☐ Landscapes are inspected at least 4 times a year (early winter, early spring, summer and early fall) for weeds in order to determine if and when a weed problem exists.

☐ Count and record the number of weeds encountered at periodic intervals (e.g. every 1 to 2 feet) along a straight line transecting a landscapes area or within a selected area, for example 4 sq. ft. samples done in random places in a bed or turf area.

Other Tips and Techniques

☐ Utilize site surveys to record the location, date, and severity of weed problem; recording results utilizing a method conducive to tracking changes and easy recall of data.

C. Disease Monitoring Procedures – *Minimum Designated BMPs*

☐ Landscapes are regularly checked for conditions, such as overwatering and injuries, which promote disease.

☐ Landscapes are checked monthly, at a minimum, for disease symptoms and signs. Disease prone plants are checked more frequently.

Other Tips and Techniques

☐ Records are kept utilizing a method conducive to tracking changes and easy recall of data of each landscape inspection noting, date when disease signs and symptoms were first noticed and the current environmental conditions and soil moisture levels.

D. Vertebrate Monitoring Procedures – *Minimum Designated BMPs*

☐ Landscapes are regularly inspected for vertebrate presence either by damage caused by animal, actual animal sightings, and/or droppings.

☐ Records are kept of the absence or presence of actual vertebrates, the damage caused, the treatment implemented, and/or the presence or absence of droppings.

Other Tips and Techniques

☐ Maps are created and updated at least twice a year, recording area of high vertebrate damage or signs (such as gopher mounds).

IV. ACTION THRESHOLDS AND GUIDELINES

A. Insect/Mollusk Thresholds and Guidelines – *Minimum Designated BMPs*

☐ Insect tolerance levels are established based on the public's acceptance of damage to the landscape or a certain level of nuisance pests (i.e. ants), the actual plant species in the landscape, and long-term monitoring and knowledge of pests causing the damage.

☐ Thresholds are based on levels were reasonable control of the pest can be achieved with minimum impact on the environment.

Other Tips and Techniques

☐ Insect monitoring records are utilized to establish threshold levels for the implementation of control strategies. For example, the threshold for the presence of aphids on a rose garden at City Hall is low, while in a native shrub border it might be considerably higher.

B. Weed Thresholds and Guidelines – ***Minimum Designated BMPs***

☐ Weed tolerance levels are established based on public safety or the public's acceptance and the resources available to manage the landscape at that level.

☐ Public areas are ranked according to high, medium, or low level of weed control and management conducted according to levels set for each rank (see Appendix A)

Other Tips and Techniques

☐ Weed monitoring records are utilized to rank the percentage of the landscape area infested (none, light, moderate, heavy, or very heavy) with weeds.

C. Disease Thresholds and Guidelines – *Minimum Designated BMPs*

☐ Disease tolerance levels are established based on the public's acceptance and the resources available to manage the landscape at the level required.

Other Tips and Techniques

☐ Disease monitoring records are utilized to establish threshold levels for the implementation of control strategies. For example, the threshold for the presence of powdery mildew on roses at City Hall is much lower than the threshold for its presence on Euonymus in a parking lot at a city sports park.

D. Vertebrate Thresholds and Guidelines – *Minimum Designated BMPs*

☐ Vertebrate tolerance levels are established based on public safety, the public's acceptance and the resources available to manage the landscape at the level required.

Other Tips and Techniques

☐ Vertebrate monitoring records are utilized to establish threshold levels for the implementation of control strategies. For example, the threshold for the presence of gopher mounds in a sport field is zero, while in a native shrub border it might be two before a trapping strategy is implemented.

V. SELECTION OF APPROPRIATE MANAGEMENT METHODS

A. Insect/Mollusk Management Methods

Cultural/Mechanical/Physical Control Methods – Minimum Designated BMPs

☐ Plant canopies are thinned to increase light penetration to exposure certain soft-bodied insects (soft-scale) as well as snails and slugs to heat.

☐ Avoid use of plants that snails and slugs use for shelter.

Other Tips and Techniques

☐ Avoid irrigating at sensitive locations between 5pm and 5am when moisture remains on plant material for several hours.

☐ Sticky barriers are applied to trunks of trees and large shrubs to prevent ants and other wingless invertebrates from plant canopies.

☐ Small insect infestations are removed by pruning infested plant parts.

☐ Copper bands are installed around base of trees or planting areas where snail and slug infestations are prevalent.

☐ Strong streams of water are used to dislodge insects such as aphids and whiteflies, from leaves.

Biological Control Methods – Minimum Designated BMPs

☐ Persistent broad-spectrum insecticides are avoided, especially if biological control of an insect has been established by UC researchers. Examples include parasitoid wasps controlling Eugenia Psyllids, Giant Whitefly, and Ash Whitefly.

Other Tips and Techniques

☐ Natural predators (beneficial insects) are augmented with purchases of additional predators from commercially available resources.

Pesticide Control Methods – Minimum Designated BMPs

☐ The most selective, rather than broad-spectrum, pesticide is used

☐ Pesticides are only utilized when the potential for impacts to the environment, especially water quality, are minimized.

☐ Equipment is calibrated prior to the application of the insecticide to avoid excess material being applied to the landscape environment.

☐ Applicators are trained to not apply pesticides to hard surfaces and to not allow any pesticide to enter the storm drain system

☐ Spot treatments are utilized rather than broadcast methods

☐ Insecticide/fertilizer combinations are only used if appropriate timing for BOTH the insecticide application and the fertilizer application.

Other Tips and Techniques

☐ If available for controlling a particular insect, biological and botanical pesticides are selected

☐ Insecticidal soaps are utilized to control infestations of soft-bodied insects such as aphids, thrips, and immature scales.

☐ Horticultural oils (neem oil and narrow-range refined oils) are utilized to control infestations of soft-bodied immature and adult insects such as aphids, scales, and whiteflies.

B. Weed Management Methods

Cultural, Mechanical, and Physical Control Methods – Minimum Designated BMPs

☐ Timers are set to avoid overwatering as weeds establish in areas where soil moisture is excessive.

☐ Drainage is managed to avoid wet areas.

☐ Weeds are removed from a site prior to planting.

☐ Mower height is adjusted to turf species and time of year.

☐ Hand-pulling, mowing, trimmers/brushcutters, flaming, hoeing, and rototilling around landscape plants are the main methods utilized to control annual weeds and young perennial weeds.

☐ Bare soil areas are covered with a thick layer of mulch to suppress weeds and conserve soil moisture.

☐ Soil, mulch, and plant material is weed-free before it is introduced into the landscape.

Other Tips and Techniques

☐ Mower is washed after mowing a weedy site.

☐ Soil solarization is utilized to control some annual and perennial weed species.

Pesticide Control Methods – Minimum Designated BMPs

☐ Spot treatments are utilized rather than broadcast methods.

☐ Herbicide/fertilizer combinations are only used if appropriate timing for BOTH the herbicide application and the fertilizer application.

☐ Herbicides are utilized according to established thresholds (see Appendix A).

☐ Herbicides are applied to the stage of weed growth most susceptible to the chemical.

☐ Equipment is calibrated prior to the application of the herbicide to avoid excess material being applied to the landscape environment.

Other Tips and Techniques

☐ Organically acceptable herbicides (shown to be effective through science-based research) are used where appropriate.

C. Disease Management Methods

Cultural, Mechanical, and Physical Control Methods – Designated Minimum BMPs

☐ Prune out and dispose of localized areas of diseased plants.

☐ Pruning tools are sterilized (e.g. a diluted bleach solution) between plants to prevent the spread of pathogen to other plants.

☐ Proper irrigation and fertilization are maintained to prevent plant stress, water-logging, and subsequent susceptibility to disease.

☐ Mulch is kept at least 6" from base of plants to avoid excessive moisture around crown possibly resulting in crown rots and is no deeper than 4"

☐ Replace disease-prone plants with non-susceptible species.

Other Tips and Techniques

☐ Pathogen-infested plant parts are removed from the soil surface area to reduce certain pathogens (e.g. Camellia Petal Blight).

☐ Soil solarization is utilized to control soil pathogens in annual beds where it is most effective.

Pesticide Control Methods – Minimum Designated BMPs

☐ Preventative fungicides and bactericides are only used where diseases can be predicted from environmental conditions and applied prior to infection or the appearance of symptoms.

☐ Synthetic fungicides are used sparingly in the landscape and only in high visibility areas in order to minimize development of resistance.

☐ Organic fungicides and bactericides are utilized in combination with cultural, mechanical, and physical control methods in order to improve their effectiveness.

Other Tips and Techniques

☐ Copper-based fungicides are only utilized in situations where its entry into surface runoff and storm drains is virtually impossible and after consultation with PCA and IPM coordinator.

☐ Mycopesticides, commercially available beneficial microorganisms, are used where appropriate.

☐ Fungicides classes are rotated to avoid resistance.

D. Vertebrate Management Methods

Cultural and Physical Control Methods – Minimum Designated BMPs

☐ Groundcovers are maintained such that they do not harbor rats.

☐ Sources of drinking water removed (leaky faucets, puddles).

☐ Trash cans have lids and are emptied daily (rats).

☐ Habitat modification, based on pest biology is used to reduce shelter.

☐ Trapping is used for gophers when safe and practical.

☐ Kill traps used for ground squirrels and rabbits, are checked daily, and in places not accessible by children or non-target animals.

☐ Gas cartridges are used for ground squirrels according to UC recommendations.

Other Tips and Techniques

☐ Shrubs pruned at least 1 foot from the ground (rats).

☐ Screens or other barriers installed under structures that have a space between soil and floor (rabbits).

Pesticide Control Methods – Minimum Designated BMPs

☐ Anti-coagulant baits are used and applied according to label and UC recommendations.

☐ Bait is applied in a manner that non-target animals do not access to it.

Other Tips and Techniques

☐ Restricted use rodenticides are used only after applicator has been trained for that product or only by a wildlife management contractor.

VI. GENERAL PESTICIDE MANAGEMENT PRACTICES – *Minimum Designated BMPs*

☐ A licensed Pest Control Adviser is on staff or hired to properly identify pests and the symptoms caused by pests, and to make recommendations for appropriate management, including proper application of mechanical, biological and chemical controls.

☐ Restricted use pesticides are only used when no other alternatives are practical.

☐ If pesticides are necessary, CAUTION-labeled pesticides are considered before more toxic alternatives.

☐ Only small quantities of pesticides or herbicides are purchased, reducing or eliminating the need for stockpiling. Any unused pesticides and herbicides are securely stored under cover for future use, or are collected in a central location for proper disposal as

hazardous waste, or are transferred to the County's hazardous material recycling center, as appropriate.

☐ MSDSs are regularly updated to reflect new pesticides or label changes to pesticides in storage.

Appendix A

Ranking public areas for weeds (or other pest) management:

Areas ranked as **HIGH** may include areas that the public sees and expects to be well-maintained. Examples are entrances to public buildings such as city hall and libraries.

Areas ranked as **MEDIUM** may include areas the public sees but does not expect a high level of maintenance. Examples are landscaped areas away from the entrance, recreational and picnic areas. These areas can tolerate a higher lever of weeds.

Areas ranked as **LOW** may include areas the public rarely sees or does not expect a high level of maintenance. Examples are medians, landscaped areas in parking lots, wildlands. These areas can tolerate a higher lever of weeds.

FP-3
ROADS, STREETS, AND HIGHWAYS OPERATION AND MAINTENANCE



The matrix below identifies activity-specific required Minimum Designated Best Management Practices (BMPs) and required Pollution Prevention Methods (PPMs) for Municipal Roads, Streets, and Highways Operation and Maintenance activities, based on priorities determined by site location and operational characteristics. Roads, streets and highways are always considered High priority. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and to limit impact on stormwater surface water quality to the maximum extent practicable. Below the matrix is a listing of Suggested Implementation Strategies for each required BMP.

DESIGNATED MINIMUM BMPs	LOW	MEDIUM	HIGH	303(d)	ESA
Sweeping and Cleaning					
___ Sweep streets at least monthly.			X	X	X
___ Notify citizens of sweeping schedules.			X	X	X
Repair and Maintenance					
___ Keep materials and wastes out of MS4.			X	X	X
___ Conduct repairs in dry weather			X	X	X
___ Prevent washwater and sediment from entering MS4.			X	X	X
Bridge and Structure Maintenance					
___ Conduct maintenance in dry weather.			X	X	X
___ Keep materials and waste out of MS4.			X	X	X
___ Prevent washwater and sediment from entering MS4.			X	X	X
POLLUTION PREVENTION MEASURES					
___ Require maintenance personnel to be trained in relevant BMPs.			X	X	X
___ Incorporate relevant BMPs into contractual requirements for maintenance subcontractors.			X	X	X
___ Regularly inspect municipal vehicles and equipment for leaks.			X	X	X

PROGRAM/FACILITY BEING INSPECTED: _____

Inspector Name: _____

When completed, the checklist should be attached to the General Inspection Form Cover Sheet and copies should be provided to the Supervisor of the Facility/Program being inspected.

SUGGESTED IMPLEMENTATION STRATEGIES

This list of Suggested Implementation Strategies is divided between basic potential strategies suitable for general application (notated with checkmarks and capital letters) and more specific potential strategies (notated with bullet points and lower case letters) that may be applicable under certain circumstances, especially where there are certain Pollutant Constituents of Concern. The specific target constituents are notated parenthetically as:

Bacteria (BACT) *Sediment (SED)* *Nutrients (NUT)* *Oil and Grease (O&G)* *Pesticides (PEST)*
Other Toxic Compounds (TOX) *Trash (TRASH)* *Hydrological Impacts (HYD)* *Any/All or General (ANY)*

SUGGESTED IMPLEMENTATION STRATEGIES

1. Sweeping and Cleaning

Sweeping Frequency and Timing

- ✓ 1A. Maintain a consistent sweeping schedule. Provide minimum monthly sweeping of streets.
- ✓ 1B. Perform street cleaning during dry weather if possible.
- ✓ 1C. Avoid wet cleaning or flushing of streets, and utilize dry methods where possible.
- ✓ 1D. If flushing of a street is absolutely necessary, sweep and remove debris before flushing. Do not let wash water enter storm drain inlets. Collect wash water and direct to a dirt or vegetated area, or pump into a tank and dispose of properly.
- 1a. Consider increasing sweeping frequency based on factors such as traffic volume, land use, field observations of sediment and trash accumulation, proximity to water courses, etc. (TRASH, SED, BACT)
- 1b. Consider retrofitting catch basin grate screens or catch basin inserts in locations where trash/debris problems are especially persistent. (TRASH, SED)

Equipment Operation and Selection

- ✓ 1E. Maintain cleaning equipment in good working condition and purchase replacement equipment as needed.
- ✓ 1F. Operate sweepers at manufacturer requested optimal speed levels to increase effectiveness.
- ✓ 1G. Regularly inspect vehicles and equipment for leaks, and repair promptly.
- 1c. Old sweepers should be replaced as needed with new technologically advanced sweepers (preferably regenerative air sweepers) that maximize pollutant removal. (TRASH, SED, BACT)
- 1d. Clean sweepers at a wash rack that drains to the sanitary sewer. The wash rack area should be covered and bermed and wash water should drain to a clarifier prior to entering the sanitary sewer. (SED, BACT)
- 1e. If possible, use vacuum or regenerative air sweepers in the high sediment and trash areas (typically industrial/ commercial). (SED, TR)

Management of Material Removed by Sweeping

- ✓ 1H. Dispose of street sweeping debris and dirt at a landfill.
- ✓ 1I. Do not store swept material along the side of the street or near a storm drain inlet.
- ✓ 1J. If dewatering of saturated materials is necessary it should be conducted in a designated area away from storm drain inlets and the water contained for proper disposal.
- ✓ 1K. If authorized by the local sanitation agency, water may be discharged to the sanitary sewer only after passing through a clarifier. As an alternative, dewatering can be conducted in a containment area in which saturated materials are placed on a tarp or impervious surface and allowed to dry. Dry debris is then disposed of properly.
- 1f. Keep debris storage to a minimum during the wet season or make sure debris piles are contained (e.g. by berming the area) or covered (e.g. with tarps or permanent covers). (TRASH, SED)

	Maximize Access for Sweepers ✓ 1L. Sweeping should be conducted as close to the curb line as possible. ✓ 1M. Notify residents of street sweeping schedules. (SED, TRASH, BACT) • 1g. Consider instituting a parking policy to restrict parking in problematic areas during periods of street sweeping. (SED, TRASH, BACT) 1h. Consider posting street sweeping signs in problematic areas or the use of temporary signs. (SED, TRASH, BACT)

2. Repair and Maintenance

Pavement Marking

- ✓ 2A. Develop paint handling procedures for proper use, storage, and disposal of paints. Mix indoors if feasible, or within a contained area.
- ✓ 2B. Transfer and load paint and hot thermoplastic away from storm drain inlets.
- ✓ 2C. Sweep up thermoplastic grindings. Yellow thermoplastic grindings may require special handling as they may contain lead.
- ✓ 2D. Properly store leftover paints if they are to be kept for the next job, or dispose of properly.
- ✓ 2E. See *Spill Control procedure sheet* for guidance on the proper cleanup of paint spills.
- 2a. Where practical, replace paints containing lead and tributyltin with less toxic alternatives. (TOX)
- 2b. Use water based paints where applicable. Clean application equipment in a sink that is connected to the sanitary sewer. (TOX)

Concrete Installation and Repair

- ✓ 2F. Avoid mixing excess amounts of fresh concrete or cement mortar on-site. Only mix what is needed for the job.
- ✓ 2G. Wash concrete trucks off site or in designated areas on site, such that there is no discharge of concrete wash water into storm drain inlets, open ditches, streets, or other stormwater conveyance structures.
- ✓ 2H. Store concrete materials under cover, away from drainage areas.
- ✓ 2I. Return leftover materials to the transit mixer if practical. Dispose of small amounts of hardened excess concrete, grout, and mortar in the trash.
- ✓ 2J. Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile, or dispose in the trash.
- ✓ 2K. When washing poured concrete areas to remove fine particles and expose the aggregate, contain the wash water for proper disposal; do not discharge water to the storm drain system.
- ✓ 2L. Do not allow excess concrete to be dumped on-site, except in designated areas.
- ✓ 2M. Apply concrete, asphalt, and seal coat during dry weather to allow the material to adequately dry prior to a rain event.
- ✓ 2N. When making saw cuts in pavement, use as little water as possible and perform during dry weather. Cover each nearby or appropriate storm drain inlet completely with filter fabric or plastic during the sawing operation and contain the slurry by placing straw bales, sandbags, or gravel dams around the inlets. After the liquid drains or evaporates, shovel or vacuum the slurry residue from the pavement or gutter and remove from site. Alternatively, a small on-site vacuum may be used to pick up the slurry as this will prohibit slurry from reaching storm drain inlets.

Concrete Installation and Repair (cont.)

- ✓ 2O. Place sandbags or other protective device around inlets or water courses if needed to protect them during the maintenance operation.

Patching, Resurfacing, and Surface Sealing

- ✓ 2P. Pre-heat, transfer or load hot bituminous material away from storm drain inlets.
- ✓ 2Q. Apply concrete, asphalt, and seal coat during dry weather to allow the material to adequately dry prior to a rain event.
- ✓ 2R. Where applicable, cover and seal each nearby or appropriate storm drain inlet (with waterproof material, plastic or mesh) and maintenance holes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from covered manholes and storm drain inlets when the job is complete.
- ✓ 2S. Use only as much water as necessary for dust control, to avoid runoff.
- 2c. Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly. (O&G)
- 2d. Prior to a rain event or at the completion of a project, sweep the project area by hand or with a street sweeper. (SED)

Equipment Cleaning, Maintenance, and Storage

- ✓ 2T. Clean equipment including sprayers, sprayer paint supply lines, patch and paving equipment, and mudjacking equipment at the end of each day. If equipment can be cleaned and materials reapplied at the job site, do so in compliance with the laws and regulations. Clean in a sink or other area (e.g. vehicle wash area) that is connected to the sanitary sewer.
- ✓ 2U. If refueling or repairing vehicles and equipment must be done on-site, conduct the activity away from storm drain inlets and watercourses.
- ✓ 2V. Clean paint brushes and tools covered with water-based paints in sinks connected to sanitary sewers. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.
- 2e. Place drip pans or absorbent materials under heavy equipment when not in use. (O&G)
- 2f. Conduct cleaning at a corporation or maintenance yard if possible. (SED, O&G)
- 2g. When practical perform major equipment repairs at the corporation yard. (O&G)

3. Bridge and Structure Maintenance

Painting and Paint Removal

- ✓ 3A. Transport paint and materials to and from job sites in containers with secure lids and tied down to the transport vehicle.
- ✓ 3B. Do not transfer or load paint near storm drain inlets or watercourses.

- ✓ 3C. Test and inspect spray equipment prior to starting to paint. Tighten all hoses and connections and do not overfill paint container.
- ✓ 3D. If sand blasting is used to remove paint, cover nearby storm drain inlets prior to starting work.
- ✓ 3E. Recycle paint when practical (e.g. paint may be used for graffiti removal activities). Dispose of paint at an appropriate household hazardous waste facility.
- ✓ 3F. See *Spill Control procedure sheet* for guidance on the proper cleanup of paint spills.
- 3a. If the bridge crosses a watercourse, perform work on a maintenance traveler or platform, or use suspended netting or tarps to capture paint, rust, paint removing agents, or other materials, to prevent discharge of materials to surface waters. If sanding, use a sander with a vacuum filter bag. (TOX, SED)

Graffiti Removal

- ✓ 3G. Avoid graffiti abatement activities during rain events.
- ✓ 3H. Protect nearby storm drain inlets prior to removing graffiti from walls, signs, sidewalks, or other structures needing graffiti abatement. Clean up afterwards by sweeping or vacuuming thoroughly, and/or by using absorbent and properly disposing of the absorbent.
- ✓ 3I. Note that care should be taken when disposing of waste since it may need to be disposed of as hazardous waste.
- ✓ 3J. When graffiti is removed by painting over, implement the procedures under *Painting and Paint Removal* above.
- ✓ 3K. Direct runoff from sand blasting and high pressure washing (with no cleaning agents) into a landscaped or dirt area.
- ✓ 3L. If a graffiti abatement method generates wash water containing a cleaning compound (such as high pressure washing with a cleaning compound), plug nearby storm drains and collect wash water and dispose of properly.
- 3b. Consider using a waterless and non-toxic chemical cleaning method for graffiti removal (e.g. gels or spray compounds).

Guardrail and Fence Repair

- ✓ 3M. When cleaning guardrails or fences follow the appropriate surface cleaning methods (depending on the type of surface) outlined in the *Sidewalk, Plaza, and Fountain Maintenance and Cleaning* procedure sheet.
- ✓ 3N. If painting is conducted, follow the *Painting and Paint Removal* procedures above.
- ✓ 3O. If graffiti removal is conducted, follow the *Graffiti Removal* procedures above.
- ✓ 3P. If construction takes place, see the procedure sheet for *Minor Construction*.

Guardrail and Fence Repair (cont.)

- 3c. Consider placing a protective barrier around the work perimeter, or around drain inlets.
- 3d. Recycle materials whenever practical.

FP-4
SIDEWALK, PLAZA, AND PARKING LOT MAINTENANCE, AND CLEANING



The matrix below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for Municipal Sidewalk, Plaza, and Parking Lot Maintenance and Cleaning activities based on priorities determined by site location and operational characteristics. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and to limit impact on stormwater surface water quality to the maximum extent practicable. Below the matrix is a listing of Suggested Implementation Strategies for each required BMP.

DESIGNATED MINIMUM BMPS	LOW	MEDIUM	HIGH	303(d)	ESA
Surface Cleaning:					
___ Prevent rinsewaters from cleaning of pavements from entering the MS4.	X	X	X	X	X
___ Remove pet or other animal feces by scooping, sweeping or wiping.			X	X	X
___ Sweep or vacuum parking areas at least monthly.	X	X	X	X	X
___ Clean out parking lot drain inlets as needed and at least once before the wet season.	X	X	X	X	X
___ If cleaning oily deposits or other spills, use absorbent materials and prevent any dischare to parking lot drain inlets or MS4.	X	X	X	X	X
Graffiti Cleaning:					
___ Prevent cleaning agents or graffiti cleaning wastes from entering the MS4.	X	X	X	X	X
Sidewalk Repair:					
___ Conduct repairs in dry weather.					X
___ Prevent repair materials, construction wastes or sediment from entering the MS4.	X	X	X	X	X
Litter Control:					
___ Provide covered litter receptacles in busy pedestrian areas.	X	X	X	X	X
___ Clean out litter receptacles frequently to prevent overflow.	X	X	X	X	X
Fountain Maintenance:					
___ When draining fountains, discharge to sanitary sewer, or dechlorinate and discharge to landscaped area, if feasible.	X	X	X	X	X
POLLUTION PREVENTION METHODS			X	X	X
___ Train all maintenance personnel in appropriate BMPs.	X	X	X	X	X
___ Incorporate appropriate BMPs into maintenance subcontracts.	X	X	X	X	X

PROGRAM/FACILITY BEING INSPECTED: _____

Date: _____ Inspector Name: _____

When completed, the checklist should be attached to the General Inspection Form Cover Sheet and copies should be provided to the Supervisor of the Facility/Program being inspected.

SUGGESTED IMPLEMENTATION STRATEGIES:

The following list of Suggested Implementation Strategies is divided between basic potential strategies suitable for general application (notated with checkmarks and capital letters) and more specific potential strategies (notated with bullet points and lower case letters) that may be applicable under certain circumstances, especially where there are certain Pollutant Constituents of Concern. The specific target constituents are notated parenthetically as:

Bacteria (BACT) *Sediment (SED)* *Nutrients (NUT)* *Oil and Grease (O&G) Pesticides (PEST)*
Other Toxic Compounds (TOX) *Trash (TRASH)* *Hydrological Impacts (HYD)* *Any/All or General (ANY)*

1. Surface Cleaning

Discharges of wash water to the storm water drainage system from cleaning or hosing of impervious surfaces is prohibited.

Sidewalks and Plazas

- ✓ 1A. Do not discharge wash water from cleaning or hosing of impervious surfaces to the storm water drainage system.
- ✓ 1B. Use dry methods (e.g. sweeping, backpack blowers, vacuuming) whenever practical to clean sidewalks and plazas rather than hosing, pressure washing, or steam cleaning. DO NOT sweep or blow material into curb; use devices that contain the materials.
- ✓ 1C. If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.
- 1a. To remove pet or wildlife feces, scoop, sweep or wipe it up and dispose in trash, sanitary sewer or compost pile. If still needed, direct any hose-down water to landscaped areas. (BACT)
- 1b. Consider retrofitting with more permeable pavement type. (HYD)

Parking Areas, Driveways, Drive-thru

- ✓ 1D. Parking facilities should be swept/vacuumed on a regular basis. Establish frequency of parking lot sweeping based on usage and field observations of waste accumulation.
- ✓ 1E. If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.
- ✓ 1F. Sweep all parking lots at least once before the onset of the wet season.
- ✓ 1G. Use absorbents to pick up oil; then dry sweep.
- ✓ 1H. Appropriately dispose of spilled materials and absorbents.
- 1c. Consider increasing sweeping frequency based on factors such as traffic volume, land use, field observations of sediment and trash accumulation, proximity to water courses, etc. (SED, TRASH, BACT)

Building Surfaces, Decks, etc., without loose paint

- ✓ 1I. If water must be used, block storm drain inlets as needed and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.
- 1d. Consider using high-pressure water, with no soap. (TOX

Unpainted Building Surfaces, Wood Decks, etc.

- ✓ 1J. Water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.
- 1e. Use a biodegradable cleaning agent or acid wash to remove deposits, wood restorer, or other chemicals. Screen wash water using an appropriate filtering device (e.g. filter fabric), if needed, to catch debris. (TOX, SED)
- 1f. Make sure pH is between 6.5 and 8.5 THEN discharge to landscaping (if cold water without a cleaning agent) otherwise dispose of properly.

2. Graffiti Cleaning

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	**Graffiti Removal** ✓ 2A. Avoid graffiti abatement activities during rain events. ✓ 2B. When graffiti is removed by painting over, implement the procedures under *Painting and Paint Removal* in the *Roads, Streets, and Highway Operation and Maintenance* procedure sheet. ✓ 2C. Protect nearby storm drain inlets prior to removing graffiti from walls, signs, sidewalks, or other structures needing graffiti abatement. Clean up afterwards by sweeping or vacuuming thoroughly, and/or by using absorbent and properly disposing of the absorbent. ✓ 2D. Note that care should be taken when disposing of waste since it may need to be disposed of as hazardous waste.

☐ _____ ☐ _____	• 2a. Consider using a waterless and non-toxic chemical cleaning method for graffiti removal (e.g. gels or spray compounds). (TOX).
3. Sidewalk Repair	
☐ _____ ☐ ☐ _____ ☐ ☐ _____ ☐	**Surface Removal and Repair** ✓ 3A. Schedule surface removal activities for dry weather if possible. ✓ 3B. Avoid creating excess dust when breaking asphalt or concrete. ✓ 3C. Take measures to protect nearby storm drain inlets prior to breaking up asphalt or concrete (e.g. place hay bales or sand bags around inlets). Clean afterwards by sweeping up material.
☐ _____ ☐	✓ 3D. Always dry sweep first to clean up tracked dirt. Use a broom, street sweeper or vacuum truck. Do not dump vacuumed liquid in storm drains. Once dry sweeping is complete, the area may be hosed down if needed. Discharge wash water to landscaping, pump to the sanitary sewer if permitted to do so or contain and dispose of properly.
☐ _____ ☐	• 3a. Designate an area for clean up and proper disposal of excess materials. (TOX)
☐ _____ ☐	• 3b. Remove and recycle as much of the broken pavement as practical. (TRASH)
☐ _____ ☐	• 3c. When making saw cuts in pavement, use as little water as possible. Cover each storm drain inlet with filter fabric during the sawing operation and contain the slurry by placing straw bales, sandbags, or gravel dams around the inlets. After the liquid drains shovel or vacuum the slurry, remove from site and dispose of properly. (TOX)
☐ _____ ☐	• 3d. Consider retrofitting with a more permeable pavement type. (HYD).
	Concrete Installation and Repair ✓ 3E. Avoid mixing excess amounts of fresh concrete or cement mortar on-site. Only mix what is needed for the job.
☐ _____ ☐	✓ 3F. Wash concrete trucks off-site or in designated areas on-site, such that there is no discharge of concrete wash water into storm drain inlets, open ditches, streets, or other storm water conveyance structures.
☐ _____ ☐	✓ 3G. Store dry and wet concrete materials under cover, protected from rainfall and runoff and away from drainage areas. After job is complete remove temporary stockpiles (asphalt materials, sand, etc.) and other materials as soon as possible.
☐ _____ ☐	✓ 3H. When washing concrete to remove fine particles and expose the aggregate, contain the wash water for proper disposal.
☐ _____ ☐	✓ 3I. Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stock pile, or dispose in the trash.
☐ _____ ☐	• 3e. Return leftover materials to the transit mixer. Dispose of small amounts of excess concrete, grout, and mortar in the trash. (TOX)
	Concrete Installation and Repair (cont.)
☐ _____ ☐	• 3f. Protect applications of fresh concrete from rainfall and runoff until the material has hardened. (TOX)
☐ _____ ☐	• 3g. Consider retrofitting with a more permeable pavement type. (HYD)

4. Litter Control	
☐ _____ ☐ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐	✓ 4A. Enforce anti-litter laws. ✓ 4B. Provide litter receptacles in busy, high pedestrian traffic areas of the community, at recreational facilities, and at community events. ✓ 4C. Cover litter receptacles and clean out frequently to prevent leaking/spillage or overflow. • 4a. Post "No Littering" signs. (TRASH).
5. Fountain Maintenance	
☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ _____ _____	✓ 5A. Do not use copper-based algaecides. Control algae with chlorine or other alternatives, such as sodium bromide. ✓ 5B. When draining fountains, never discharge water to a street or storm drain; discharge to the sanitary sewer or to the landscaping. ✓ 5C. If discharging to landscaping, allow chlorine to dissipate for a few days and then recycle/reuse water by draining it gradually onto a landscaped area. Water must be tested prior to discharge to ensure that chlorine is not present (concentration must be less than 0.1 ppm).

FP-5
SOLID WASTE HANDLING



The matrix below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for Municipal Solid Waste activities based on priorities determined by site location and operational characteristics. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and to limit impact on stormwater surface water quality to the maximum extent practicable. Below the matrix is a listing of Suggested Implementation Strategies for each required BMP.

DESIGNATED MINIMUM BMPS	LOW	MEDIUM	HIGH	303(d)	ESA
General					
___ Repair or replace damaged solid waste containers.	X	X	X	X	X
___ Prevent any solid waste container rinsewater from entering the MS4.	X	X	X	X	X
Waste Reduction and Recycling:			X	X	X
___ Facilitate opportunities for materials recycling.	X	X	X	X	X
___ Use commercial vehicle maintenance facilities that recycle used motor oil.	X	X	X	X	X
Hazardous Waste Collection:					
___ Facilitate opportunities for collection of household hazardous waste.	X	X	X	X	X
Litter Control:					
___ Provide litter receptacles in busy pedestrian areas, and clean out frequently to prevent overflow.	X	X	X	X	X
POLLUTION PREVENTION MEASURES			X	X	X
___ Train personnel handling solid waste in relevant BMPs.	X	X	X	X	X
___ Incorporate appropriate BMPs into solid waste handling subcontracts.	X	X	X	X	X

PROGRAM/FACILITY BEING INSPECTED: _____

Date: _____ Inspector Name: _____

When completed, the checklist should be attached to the General Inspection Form Cover Sheet and copies should be provided to the Supervisor of the Facility/Program being inspected.

SUGGESTED IMPLEMENTATION STRATEGIES:

The following list of Suggested Implementation Strategies is divided between basic potential strategies suitable for general application (notated with checkmarks and capital letters) and more specific potential strategies (notated with bullet points and lower case letters) that may be applicable under certain circumstances, especially where there are certain Pollutant Constituents of Concern. The specific target constituents are notated parenthetically as:

Bacteria (BACT) *Sediment (SED)* *Nutrients (NUT)* *Oil and Grease (O&G)* *Pesticides (PEST)*
Other Toxic Compounds (TOX) *Trash (TRASH)* *Hydrological Impacts (HYD)* *Any/All or General (ANY)*

1. Preparation/Prevention

☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____	✓ 1A. Implement procedures, where applicable, to collect, transport, and dispose of solid waste at appropriate disposal facilities in accordance with applicable federal, state, and local laws and regulations. Optional disposal options include the reuse and recycling of appropriate materials. ✓ 1B. Regularly inspect solid waste containers for structural damage. Repair or replace damaged containers as necessary. ✓ 1C. Remove all debris from waste containers prior to cleaning with water. Only clean out containers in a designated area that drains to a landscaped area or a washrack that is connected to a sanitary sewer, or use other methods to capture washwater and dispose properly. ✓ 1D. Minimize spillage/leaking from solid waste containers. For larger solid waste containers (especially compactors) that utilize a hydraulic fluid pump system, regularly inspect and replace faulty pumps or hoses to minimize the potential of releases and spills. ✓ 1E. Educate the public and verify that employees and subcontractors are trained to ensure that only appropriate solid wastes are disposed of. Certain wastes such as hazardous wastes, appliances, fluorescent bulbs, pesticides, etc. may not be disposed of in solid waste containers. • 1a. Consider retrofitting trash storage areas to cover the receptacles and to minimize run-on and run-off.
2. Waste Reduction and Recycling *Although many types of waste can be recycled, recycling options for each waste type may be limited. All gasoline, antifreeze, waste oil, and lead-acid batteries can be recycled. Latex and oil-based paint can be reused, as well as recycled. Materials that cannot be reused or recycled should be disposed of properly.*	
☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐	✓ 2A. Provide opportunities for the collection and storage of recyclable materials. ✓ 2B. Do not mix liquid wastes, this can cause chemical reactions or make recycling impossible and complicate disposal. ✓ 2C. Recycle used motor oil.
3. Hazardous Waste Collection *Household hazardous wastes (HHW) are defined as waste materials commonly found in homes, institutions or businesses, which exhibit characteristics such as: corrosivity, ignitability, reactivity, and/or toxicity, or are listed as hazardous materials by EPA.*	
☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____	✓ 3A. Follow proper storage and disposal measures for hazardous waste materials as identified on packaging or Material Safety Data Sheets. ✓ 3B. Emergencies related to hazardous waste spills should be reported to 911. • 3a. Identify and promote use of non-hazardous alternatives. • 3b. Promote household hazardous waste (HHW) reuse and recycling.

4. Litter Control	
☐ _____ ☐ ☐ _____ ☐ _____ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ ☐ _____ ☐ _____ _____	✓ 4A. Enforce anti-litter laws. ✓ 4B. Provide litter receptacles in busy, high pedestrian traffic areas of the community, at recreational facilities, and at community events. ✓ 4C. Clean out litter receptacles frequently to prevent overflow. ✓ 4D. Increase litter control for events generating substantial quantities of litter. ✓ 4E. Place trash receptacles next to transit stop benches and maintain as necessary. • 4a. Consider retrofitting "No Littering" signs. • 4b. Participate in and/or organize additional clean up programs (e.g. "Coastal Clean Up Day", "Pride Days", "Volunteer Connection Days").

FP-6

WATER AND SEWER UTILITY OPERATION AND MAINTENANCE



The matrix below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for Municipal Water and Sewer Utility Maintenance activities. Water and Sewer Utility Facilities are considered High Priority regardless of location. The City of Laguna Niguel does not provide maintenance of water and sewer utilities but coordinates with the District responsible for these activities. Minimum Designated (required) BMPs are implemented to eliminate prohibited discharges and to limit impact on stormwater surface water quality to the maximum extent practicable. Below the matrix is a listing of Suggested Implementation Strategies for each required BMP.

MINIMUM DESIGNATED BMPS	LOW	MEDIUM	HIGH	303(d)	ESA
When observed or notified of sewage leaks or spills, assist separate Sewering Agency to keep sewage from entering the MS4.			X	X	X
Develop and implement notification procedures for sewage spills to the MS4 from sewer system and private laterals.			X	X	X
POLLUTION PREVENTION METHODS					
Require emergency response personnel to be trained in relevant BMPs.			X	X	X

PROGRAM/FACILITYBEING INSPECTED: _____

Inspector name: _____ Date: _____

When completed, the checklist should be attached to the General Inspection Form Cover Sheet and copies should be provided to the Supervisor of the Facility/Program being inspected.

SUGGESTED IMPLEMENTATION STRATEGIES

1. Water Line Maintenance

☐ _____ ☐
☐ _____ ☐
_____
☐ _____ ☐
☐ _____ ☐
_____
_____
_____
_____
_____
_____
☐ _____ ☐
_____
_____
_____

Planned Discharges

✓ For planned discharges use one of the following options:
- Reuse water for dust suppression, irrigation, or construction compaction
- Discharge to the sanitary sewer system with approval
- Discharge to the storm drain system or to a creek using applicable pollution control measures listed below (this option is ONLY applicable to uncontaminated pumped ground water, water line flushing, discharges from potable water sources other than water main breaks) and may require a permit from the Regional Water Quality Control Board.

✓ If water is discharged to a storm drain inlet (catch basin), control measures must be put in place to control potential pollutants (i.e. sediment, chlorine, etc.). Examples of some storm drain inlet protection options include:

- Silt fence – appropriate where the inlet drains a relatively flat area.
- Gravel and wire mesh sediment filter – Appropriate where concentrated flows are expected.
- Wooden weir and fabric – use at curb inlets where a compact installation is desired.

✓ Prior to discharge, inspect discharge flow path and clear/cleanup any debris or pollutants found (i.e. remove trash, leaves, sediment, and wipe up liquids, including oil spills).

✓ Select appropriate pollution control measure(s) considering the receiving system (i.e. curb inlet, drop inlet, culvert, creek, etc.) and ensure that the control device(s) fit properly.

✓ General design considerations for inlet protection devices include the following:

- The device should be constructed such that cleaning and disposal of trapped sediment is made easy, while minimizing interference with discharge activities.
- Devices should be constructed so that any standing water resulting from the discharge will not cause excessive inconvenience or flooding/damage to adjacent land or structures.

✓ The effectiveness of control devices must be monitored during the discharge period and any necessary repairs or modifications made as needed.

- Sediment removal may be enhanced by placing filter fabric, gravel bags, etc. at storm drain inlets.

Unplanned Discharges

✓ Stop the discharge as quickly as possible by turning off water source.

✓ Inspect flow path of the discharged water:

- Control erosion along the flow path.
- Identify areas that may produce significant sediment or gullies, use sandbags to redirect the flow.
- Identify erodible areas which may need to be repaired or protected during subsequent repairs or corrective actions

✓ If repairs or corrective action will cause additional discharges of water, select the appropriate procedures for erosion control, chlorine residual, turbidity, and chemical additives. Prevent potential pollutants from entering the flow path and ensure that no additional discharged water enters storm drain inlets.

2. Sanitary Sewer Maintenance

Sewer System Cleaning

✓ Sewer lines should be cleaned on a regular basis to remove grease, grit, and other debris that may lead to sewer backups.

✓ Establish routine maintenance program. Cleaning should

	be conducted at an established minimum frequency and more frequently for problem areas such as restaurants that are identified ✓ Cleaning activities may require removal of tree roots and other identified obstructions.
	Preventative and Corrective Maintenance ✓ During routine maintenance and inspection note the condition of sanitary sewer structures and identify areas that need repair or maintenance. Items to note may include the following: • cracked/deteriorating pipes • leaking joints/seals at manhole • frequent line plugs • line generally flows at or near capacity • suspected infiltration or exfiltration ✓ Document suggestions and requests for repair and report the information to the appropriate manager or supervisor. ✓ Prioritize repairs based on the nature and severity of the problem. Immediate clearing of blockage or repair is required where an overflow is currently occurring or for urgent problems that may cause an imminent overflow (e.g. pump station failures, sewer line ruptures, sewer line blockages). These repairs may be temporary until scheduled or capital improvements can be completed. ✓ Review previous sewer maintenance records to help identify "hot spots" or areas with frequent maintenance problems and locations of potential system failure.
3. Spill/Leak/Overflow Control, Response, and Containment	
	Control ✓ Refer to countywide *Illicit Discharge Detection and Elimination Program*. Components of this program include: • Investigation/inspection and follow-up • Elimination of illicit discharges and connections • Enforcement of ordinances • Respond to sewage spills

Unsatisfactory	OK
☐ _____	☐
☐ _____	☐
☐ _____	☐
☐ _____	☐
☐ _____	☐
☐ _____	☐
☐ _____	☐
☐ _____	☐
☐ _____	☐

Control (cont.)

- Facilitate public reporting of illicit discharges and connections. A citizen's hotline for reporting observed overflow conditions should be established to supplement the field screening efforts being conducted by the Principal Permittee.

Response and Containment

- ✓ Establish lead department/agency responsible for spill response and containment. Provide coordination within departments.
- ✓ When a spill, leak, and/or overflow occurs, keep sewage from entering the storm drain system to the maximum extent practicable by covering or blocking storm drain inlets or by containing and diverting the sewage away from open channels and other storm drain facilities (using sandbags, inflatable dams, etc.).
- ✓ If a spill reaches the storm drain notify County of Orange Health Care Agency through Control One at (714) 628-7208.
- ✓ Remove the sewage using vacuum equipment or use other measures to divert it back to the sanitary sewer system.
- ✓ Record required information at the spill site.
- ✓ Perform field tests as necessary to determine the source of the spill.
- ✓ Develop additional notification procedures regarding spill reporting as needed.

FP-8: POWER WASHING AND SURFACE CLEANERS



The checklist below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for power washing and surface cleaning activities, based on priorities determined by site location and operational characteristics. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and to limit impact on stormwater surface water quality to the maximum extent practicable. Below the Minimum Designated BMPs is a listing of Other Tips & Techniques that may be utilized where appropriate.

A surface cleaning business is considered to be any operation that provides the following services:

- Cleaning (e.g., power sweeping, washing) driveways and parking lots
- Cleaning building exteriors (except sand blasting, window cleaning)
- Driveway cleaning (e.g., power sweeping, washing) services
- Parking lot cleaning (e.g., power sweeping, washing) services
- Power washing building exteriors
- Pressure washing (e.g., buildings, decks, fences)
- Steam cleaning building exteriors

Minimum Designated BMPs: Wastewater or wash water from exterior power washing or other exterior surface cleaning activity shall not be discharged to the street and/or storm drain system.

SUGGESTED IMPLEMENTATION STRATEGIES

The suggested implementation strategies presented below are intended ensure compliance with the Minimum Designated BMP. The following strategies, or equivalently protective techniques, must be observed by all surface cleaners, regardless of the surface to be cleaned or the type of cleaning operation to be performed:

What needs to be done prior to conducting a job?

- Evaluate the chemicals and compounds used for cleaning and reduce or eliminate the use of those that contain solvents, heavy metals, high levels of phosphates, or very high/very low pH.
- Walk through the area where the cleaning will occur prior to the start of the job and identify all area drains, yard drains, and catch basins where wastewater could potentially enter the street or storm drain system.
- Block/seal off identified drains or catch basins using sand bags, plugs, rubber mats, or temporary berms.
- Collect all trash and debris from the area and place in a trash bin for disposal.
- Clean the area of debris prior to cleaning to minimize the amount of suspended solids, soil, and grit in the resulting wastewater.

- Identify where surface washing will occur. Avoid washing whole areas; spot clean where feasible and necessary.
- Identify the wastewater disposal option that will be used. Whether you are discharging to landscaping or sanitary sewer, make sure that the requirements will be met and/or the necessary contacts have been made, as discussed below.
- Inventory spill cleanup equipment to ensure that it is available for immediate use, if needed.
- Conduct surface cleaning in accordance with all operating instructions provided by the equipment supplier. Maintain equipment in good working order and routinely check and test all safety features.

What methods can be used to collect wastewater at a site?

There is no specific containment method that must be used for wastewater collection/diversion. However, the system must be adequately designed so that the wastewater does not flow into an on-site or off-site storm drain inlet or into the street. All surface cleaners should use one of the following methods, regardless of the surface to be cleaned or the type of cleaning operation to be performed:

- Portable containment areas can be made from waterproof tarps, heavy-duty plastic, or rubber matting equipped with berms to prevent wastewater from running into on-site or off-site storm drain inlets or into the street. Materials that have been used for berms include sand bags or water-filled tubing. Whatever containment material is used, it must seal tightly to the ground so that none of the wastewater can pass under or over the berms.
- When power washing smaller pieces of equipment, containment devices to use may include portable vinyl swimming pools, plastic 55-gallon drums on casters, and flat metal or plastic containment pads.
- Depending on the volume of wastewater generated, it may be necessary to use a pump system, which may range in size from a wet-dry vacuum to a sump pump. A basin from which to pump wastewater can also be created by establishing a slightly sloped containment area.
- Stationary or more permanent containment areas can be constructed with cement. Berms and pump systems may be used to contain wastewater and divert it to a holding tank.
- Commercial wastewater collection systems are also available for power washing. These systems can range from portable wash pits to self-contained water recycling systems. A list of companies selling this type of equipment can usually be found in the telephone book under “Pressure Washing Services and Equipment”.
- Storm drain covers can be made of an impermeable barrier such as a heavy-duty vinyl or plastic secured in place with materials such as concrete blocks, gravel bags, or sand bags. Storm drain covers may also be available though commercial vendors.

Note: Blocking storm drain inlets in the public right-of-way is prohibited as a method of containment, unless expressly permitted by the municipality, typically through an encroachment permit process. Wastewater should be contained on-site prior to entering the public right-of-way. Contact the local municipality for more information.

Wastewater Disposal Options

How can wastewater be safely disposed?

Wastewater generated by surface cleaners is not allowed in the storm drain or street. However, the wastewater may be discharged to a landscaped area, the sanitary sewer, or it may be picked up and disposed of by a waste hauler. Please note that laboratory chemical analysis of wastewater may be required

to establish the proper disposal method. A wastewater disposal option should be selected based on the conditions outlined below:

Discharge Wastewater to a Landscaped Area

The wastewater must meet the following requirements if discharging to landscaping:

- The pH must be between 6.5 and 8.5. This can be checked quickly and easily through the use of pH paper test strips.
- The wastewater should not contain large volumes or concentrations of:
    - Toxic materials
    - Degreasers
    - Pollutants that may create a fire or explosion hazard (e.g., gasoline, diesel)
    - Solid or viscous pollutants in amounts sufficient to cause obstruction or blockage of flow
    - Petroleum oil, or other products of mineral oil origin
    - Paint
- Prior to surface washing, you must exercise any reasonable means to eliminate large volumes or concentrations of the above listed pollutants. Common methods to eliminate standing pools of pollutants include the placement of absorbent to adsorb the pollutant, dry-sweeping the absorbent, and disposing of the absorbent properly.
- Wastewater from cleaning food-related vehicles or areas, vehicle exteriors or engines, and buildings with lead- or mercury-based paint should not be discharged to landscaping.
- Filter the wastewater if it contains debris, fibers, or other suspended solids.
- Ensure that the wastewater is fully contained within the landscaped area and will fully infiltrate into the ground prior to leaving the job site.

Sanitary Sewer

If discharging to the sanitary sewer, the following conditions apply:

- The wastewater temperature must be less than 140°F (60°C).
- The pH must be between 6.0 and 12.0. This can be checked quickly and easily through the use of pH paper test strips. Adjust the wastewater to a pH that is between 6.0 and 12.0. Dilution is not an effective or acceptable pretreatment method.
- The wastewater quality must comply with the sanitary sewer facility's local discharge limits and should not contain:
    - Pollutants that may create a fire or explosion hazard (e.g., gasoline, diesel).
    - Solid or viscous pollutants in amounts sufficient to cause obstruction or blockage of flow.
    - Petroleum oil, non-biodegradable cutting oil, or other products of mineral oil origin.
    - Oil based paint.
- No wastewater shall be discharged into any publicly owned manholes that directly or indirectly connect to the sanitary sewer system without express authorization from the appropriate agency.

When discharging to the sanitary sewer:

- Filter the wastewater if it contains debris, fibers, or other suspended solids.
- If chemicals (e.g., solvents or acids) are used during the cleaning process, additional precautions may be needed. Contact your local sanitation district to learn if wastewater containing these chemicals

requires pretreatment before discharge to the sanitary sewer or if it needs to be treated as hazardous waste.

- Ensure that the wastewater is released at a flow rate and/or concentration that will not cause problems, pass through, or interference with the sanitary sewer facilities.
- Utilize an approved discharge point such as:
    - Privately owned cleanout (or sink, toilet or floor drain), oil/water separator, or below ground clarifier at the client's property where the wastewater is generated,
    - Privately owned industrial sewer connection at the client's property where the wastewater is generated,
    - Wastehauler station at sanitary sewer facility, and
    - Any other disposal points approved by sanitary sewer facility.
- Maintain a logbook of all discharges.

Waste Hauler

If using a waste hauler, the following types of wastewater may be disposed if it:

- Is corrosive (as indicated by a pH value of less than 5.5) or caustic (as indicated by a pH value of greater than 10.0).
- Contains a pollutant that may create a fire or explosion hazard (e.g., gasoline, diesel).
- Contains solid or viscous pollutants in amounts sufficient to cause obstruction or blockage of flow.
- Contains petroleum oil, non-biodegradable cutting oil, or other products of mineral oil origin.

When using a waste hauler:

- Ensure that the waste hauler is certified by appropriate sanitary sewer and local health care agencies, is Hazardous Waste DOT certified, and complies with applicable discharge regulations, which may include obtaining necessary permits and conducting water quality monitoring requirements.
- Identify the wastes involved and determine if a hazardous waste has been generated. Examples of situations that may potentially generate hazardous wastes include:
    - Power washing old paint off a building. Old paint stripped off commercial buildings may contain metals (e.g., lead, chromium, cadmium, and mercury), causing it to be a regulated hazardous waste. Paint chips cannot be left on the ground at the job site. Paint chips need to be collected, evaluated, and disposed of properly.
    - The use of certain solvents as degreasing agents, which may cause the wastewater to be classified as a listed or characteristic hazardous waste.
- Maintain a logbook of all discharges and hazardous waste manifests, if applicable.

EXHIBIT 5.III

BMPS BY FACILITY AND PROGRAM WITH INSPECTION CHECKLIST

EXHIBIT 5.III Municipal BMPs by Facility

CITY OF LAGUNA NIGUEL	LOCATION INFORMATION								APPLICABLE NON-STRUCTURAL BMPS														
									FF-10	FF-2	FF-9	FP-2	FP-2A	FP-2A	FF-13	DF-1	FF-3	FF-12	FF-11	FF-7	FF-6	FF-8	FP-3
FACILITIES AND PROGRAMS	Street Number	Street Name		acres	sqft	Watershed	Longitude	Latitude	Spill Prevention Control	Building and Maintenance Repair	Parking Lot Maintenance	Landscape Maintenance	Irrigation Runoff Elimination	Irrigation Runoff Elimination	Waste Handling and Disposal	Drainage O&M	Equip Maint	Vehicle Storage	Vehicle Cleaning	Material Storage	Material Loading	Minor Construction	Road Maint
									Sed., Nut., Trash, Metals, Bact., O&G, Org., Pest.	Sed., Trash, Metals, O&G, Org.	Sed., Trash, Metals, Bact., O&G	Sed., Nut., Trash, Bact., Pest.	Sed., Nut., Trash, Bact., Pest.	Sed., Nut., Trash, Bact., Pest.	Trash, Metals, O&G, Org.	Metals, O&G, Org.	Metals, O&G, Org.	Metals, O&G, Org.	Sed., Nut., Trash, Metals, O&G, Org.	Sed., Trash, Metals, O&G, Org., Pest.	Nut., Trash, Metals, O&G, Org., Pest.	Sed., Trash, Metals, O&G, Org.	Sed., O&G, Metals, Trash
MUNICIPAL SITES - PARKS																							
Beacon Hill Park	24472	Beacon Hill	Road	4.75	206,911	K-Salt Creek	-117.70253	33.50307	x			x	x	x	x	x							
Bear Brand Park	32385	Bear Brand Park	Road	16.60	723,055	K-Salt Creek	-117.70369	33.49400	x	x	x	x	x	x	x	x							
Chapparosa Park	25191	Chapparosa Park	Avenue	66.88	2,913,174	K-Salt Creek	-117.69222	33.51233	x	x	x	x	x	x	x	x				x	x	x	x
Clipper Cove Park	29325	Clipper	Way	4.72	205,735	J-Aliso Creek	-117.71775	33.53688	x			x	x	x	x	x							
Crown Valley Community Park	29751	Crown Valley		59.18	2,577,804	J-Aliso Creek	-117.70867	33.53008	x	x	x	x	x	x	x	x	x	x		x	x	x	x
El Lazo Basketball Courts	23804	El Lazo				J-Aliso Creek					x		x			x	x						
Hidden Hills Park	27802	Springwood	Drive	2.43	105,938	J-Aliso Creek	-117.68567	33.53016	x			x	x	x	x	x							
Juañeno Park	25068	Hidden Hills	Road	2.86	124,713	J-Aliso Creek	-117.69211	33.52684	x	x		x	x	x	x	x							
La Hermosa Park	24462	La Hermosa	Drive	0.29	12,632	J-Aliso Creek	-117.70222	33.52775	x			x	x	x	x	x							
La Plata Park	25006	La Plata	Drive	5.11	222,549	J-Aliso Creek	-117.69274	33.53346	x			x	x	x	x	x							
Lilly Shapell Park	NSA	Drakes	Way	0.86	37,244	J-Aliso Creek	-117.71961	33.54604	x			x	x	x	x	x							
Longview Park	NSA	Old Ranch	Road	2.85	124,103	K-Salt Creek	-117.69009	33.49358				x	x	x	x	x							
Marina Hills Park	24802	Marina Hills	Drive	7.54	328,226	K-Salt Creek	-117.69746	33.51952	x	x	x	x	x	x	x	x							
Niguel Heights Park	27804	Niguel Heights	Boulevard	2.80	121,751	K-Salt Creek	-117.70496	33.55827	x			x	x	x	x	x							
Niguel Road Park	30983	Killini		4.80	208,871	J-Aliso Creek	-117.70739	33.51233	x			x	x	x	x	x							
Niguel Woods Park	29883	White Otter	Drive	4.12	179,511	J-Aliso Creek	-117.72159	33.52940	x			x	x	x	x	x							
Ocean Breeze Park	32311 1/2	Charles	Road	1.70	74,227	K-Salt Creek	-117.70679	33.49431	x			x	x	x	x	x							
Parc Vista Park	30618	Parc Vista	Drive	2.53	110,120	K-Salt Creek	-117.69227	33.51760	x			x	x	x	x	x							
Parc Vista Overlook Park	NSA	Parc Vista	Drive	3.24	140,917	K-Salt Creek	-117.69604	33.51293	x			x	x	x	x	x							
Parc Vista View Park	31114	Parc Vista	Drive	1.10	47,916	K-Salt Creek	-117.70040	31.51267	x			x	x	x	x	x							
Pooch Park	NSA	Golden Lantern		3.34	145,447	K-Salt Creek	-117.68820	33.50584	x		x	x	x	x	x	x							
Rancho Niguel Park	28333	Crown Valley		3.81	165,746	J-Aliso Creek	-117.68937	33.55060	x	x		x	x	x	x	x							
Redondo View Node Park	25575 1/2	Redondo		1.63	70,872	K-Salt Creek	-117.68391	33.51398	x			x	x	x	x	x							
Reef View Node Park	25326 1/2	Reef		3.34	145,317	K-Salt Creek	-117.68822	33.51154	x			x	x	x	x	x							
Ridgeview Park	29061	Ridgeview	Drive	0.99	43,299	K-Salt Creek	-117.72243	33.54189	x			x	x	x	x	x							
Seminole Park	30802	Seminole	Drive	2.27	99,012	K-Salt Creek	-117.71074	33.51574	x			x	x	x	x	x							
Yosemite Park	24481	Yosemite	Road	5.44	236,793	J-Aliso Creek	-117.70328	33.55265	x			x	x	x	x	x							
Laguna Niguel Alicia Skate and Soccer Park	27745	Alicia Parkway				J-Aliso Creek	-117.71768	33.55835	x	x	x	x	x	x	x	x							
La Paz Sports Park	NSA	La Paz	Road	6.93	301,741	J-Aliso Creek	-117.71108	33.55381	x	x	x	x	x	x	x	x	x			x	x		
Vista Plaza Park	29541	Vista Plaza	Drive	0.61	26,659	J-Aliso Creek	-117.69755	33.53397	x			x	x	x	x	x							
Oso Creek Trail						L-San Juan Creek																	
MUNICIPAL FACILITY SITES - OTHER																							
Crown Valley Community Center and Pool	29751	Crown Valley		1.02	44,620	J-Aliso Creek	-117.71001	33.53056	x	x	x	x	x		x	x	x					x	
Sea Country Senior and Community Center	24602	Aliso Creek	Road	0.33	14,547	J-Aliso Creek	-117.70018	33.55611	x	x	x	x	x	x	x	x						x	
LN/MV Commuter Rail Station	28200	Forbes	Road	8.65	376,624	L-San Juan Creek	-117.67504	33.55104			x	x	x	x		x		x				x	
Storage Yard for Materials	25191	Chapparosa Park		n/a	n/a	K-Salt Creek	n/a	n/a	x						x	x		x		x	x		
City Hall	30111	Crown Valley				J-Aliso Creek																	
City maintained Streetscape & Slopes (14)	n/a	various		n/a	n/a	J, K, L	n/a	n/a				x	x	x	x	x							
MUNICIPAL OFF-SITE TREATMENT CONTROL BMPS																							
Catch basin debris screens in streets		various				J, K, L									x	x	x						
WetCAT West Alicia Treatment Wetland		Alicia Parkway				J-Aliso Creek	-117.716524	33.546669				x			x	x							
WetCat East Alicia Treatment Wetland		Alicia Parkway				J-Aliso Creek	-117.716444	33.550112				x			x	x							
WetCAT North Alicia Treatment Wetland		Alicia Parkway				J-Aliso Creek	-117.714984	33.544503				x			x	x							
Crown Valley Parkway Widening @I-5						L-San Juan Creek																	
Oso Creek Trail Bioretention facility						L-San Juan Creek																	

EXHIBIT 5.IV

TREATMENT CONTROL BMPS INVENTORY AND TRACKING

Exhibit 5.IV Muncipal Treatment Control BMPS Inventory

CITY OF LAGUNA NIGUEL **LOCATION INFORMATION**

FACILITIES AND PROGRAMS	TREATMENT CONTROL BMPS	WQMP/PRIORITY/ Const. date	Street Number	Street Name		acres	sqft	Watershed	Longitude	Latitude
MUNICIPAL SITES - PARKS										
El Lazo Basketball Courts	Catch basin debris screen (1)	2001. No WQMP.	23804	El Lazo				J-Aliso Creek		
Laguna Niguel Alicia Skate and Soccer Park		2003 WQMP	27745	Alicia Parkway				J-Aliso Creek	-117.71768	33.55835
	Debris separator unit (1)	High priority						J-Aliso Creek		
La Paz Sports Park		2001. No WQMP.	NSA	La Paz	Road	6.93	301,741	J-Aliso Creek	-117.71108	33.55381
	Drain inlet filter inserts (2)	High priority						J-Aliso Creek		
	Biofiltration basins (3)	High priority						J-Aliso Creek		
Oso Creek Trail	Biofiltration basins (1)	High priority						L-San Juan Creek		
	Pervious Pavement	High priority						L-San Juan Creek		
MUNICIPAL FACILITY SITES - OTHER										
Sea Country Senior and Community Center		2010 WQMP.	24602	Aliso Creek	Road	0.33	14,547	J-Aliso Creek	-117.70018	33.55611
	Catch basin debris screen (1)	High priority						J-Aliso Creek		
	Debris separator unit (1)	High priority						J-Aliso Creek		
City Hall		2010 WQMP.	30111	Crown Valley				J-Aliso Creek		
	Debris separator units (2)	High priority						J-Aliso Creek		
MUNICIPAL OFF-SITE TREATMENT CONTROL BMPS										
Catch basin debris screens in streets	Catch basin debris screen (124)	2001-2011. No WQMP		various				J, K, L		
WetCAT West Alicia Treatment Wetland	Low-flow treatment wetland	2003. No WQMP		Alicia Parkway				J-Aliso Creek	-117.716524	33.546669
	Debris separator unit (1)	High priority						J-Aliso Creek		
WetCat East Alicia Treatment Wetland	Low-flow treatment wetland	2003. No WQMP		Alicia Parkway				J-Aliso Creek	-117.716444	33.550112
	Drain inlet filter inserts (6) at Jaeger and Brant	High priority						J-Aliso Creek		
WetCAT North Alicia Treatment Wetland	Low-flow treatment wetland	2002. No WQMP		Alicia Parkway				J-Aliso Creek	-117.714984	33.544503
Crown Valley Parkway Widening @I-5		2011 WQMP.						L-San Juan Creek		
	Biofiltration planter & swale	Medium priority						L-San Juan Creek		
Oso Creek Trail Bioretention facility	Bioretention planter	High priority						L-San Juan Creek		
	Permeable pavements	2015. No WQMP						L-San Juan Creek		
	Drain inlet screens							L-San Juan Creek		

EXHIBIT 5.V

MUNICIPAL SEPARATE STORM SEWER SYSTEM MAP

L E G E N D

- CITY BOUNDARY
- CATCH BASIN
- STORM DRAIN PIPE
- RECEIVING WATERS

Pacific Park Drive
Aliso Creek Road
La Paz Road
Crown Valley Parkway
Cabot Road
Highlands Avenue
Marion Hills Drive
Pacific Island Drive
Niguel Road
Golden Lantern
Camino Del Avion

Q:\GIS\GISPROJECTS\PWGISPROJECTS\CITY_DRAINAGE_SYSTEM

City of Laguna Niguel
Drainage System

EXHIBIT 5.VI

MUNICIPAL FACILITY INSPECTION FORM

MUNICIPAL PROCEDURES GENERAL INSPECTION FORM
COVER SHEET

(Required for all inspections)

Inspection Performed by: Jean Jambon **Time of Inspection:** _____
Date: _____ **Weather at Time of Inspection:** _____

***Program or Facility Information*:**
Name of Facility/Program: **Staff Contact Name:**
Staff Title: **Phone Number**
Is this a: ☐ leased facility or ☐ subcontracted program? **Is this a:** ☐ lessor **or** ☐ subcontractor self-inspection?

***Lessor/Subcontractor Information*:**
Company Name: _____ **Contact Name:** _____
Address: _____ **Contact Title:** _____
City/State/Zip: _____ **Phone Number:** _____

***Type of Facility*:**
☐ Public Building ☐ Roads, Streets and Highways ☐ Landfill/Waste Disposal Site ☐ Airport/Airfield
☐ Parks/Cemetery ☐ Storage/Maintenance/Corporate Yard ☐ Public Parking Facility ☐ Sports Facility
☐ Drainage System ☐ Publicly Owned Treatment Works ☐ Stable/Animal Shelter ☐ Other: _____

***Type of Activities/BMP Procedures Checklist*:**

☐ DF-1 Drainage System O&M
☐ FF-1 Bay/Harbor Activities
☐ FF-2 Building Maintenance and Repair
☐ FF-3 Equipment Maintenance and Repair
☐ FF-4 Fueling
☐ FF-6 Material Loading and Unloading
☐ FF-7 Material Handling, Storage, Disposal
☐ FF-8 Minor Construction
☐ FF-9 Parking Lot Maintenance
☐ FF-10 Spill Prevention and Control
☐ FF-11Vehicle and Equipment Cleaning
☐ FF-12 Vehicle and Equipment Storage
☐ FF-13 Waste Handling, Storage, Disposal
☐ FF-14 Special Events
☐ FP-1 Lake Management
☐ FP-2 Landscape Maintenance
☐ FP-2A Irrigation Runoff
☐ FP-2B Integrated Pest Management
☐ FP-3 Road, Streets and Highways O&M
☐ FP-4 Sidewalk, Plaza and Fountain Maintenance
☐ FP-5 Solid Waste Handling
☐ FP-6 Water/Sewer Utility O&M
☐ FP-7 Fire Department Activities
☐ FP-8 Power Washing/Surface Cleaning

***Reason for Inspection*:**
☐ Routine Inspection ☐ Follow-up Inspection
☐ First Inspection ☐ Complaint Inspection
☐ Other: _____

***Outcome of Inspection*:**

	BMP's Checklists	Unsatisfactory BMP's	Comments	Detail Att'd.
☐ No Corrective Action Necessary				
☐ Verbal Warning	_____	_____	_____	☐
☐ Written Warning	_____	_____	_____	☐
☐ NOV - Notice of Violation	_____	_____	_____	☐
☐ Other: _____	_____	_____	_____	☐

Additional Comments: _____

Next Inspection Date: _____

EXHIBIT 5.VII

ORANGE COUNTY FIRE AUTHORITY
WASTE WATER DISCHARGE/BEST MANAGEMENT PRACTICE
STANDARD OPERATING PROCEDURES

WASTE WATER DISCHARGE/BEST MANAGEMENT PRACTICE (BMP)

Prepared By: *Property Management*

PURPOSE

This procedure describes the Best Management Practices (BMPs) for water pollution control. The goal of the procedure is to comply with federal, state, and local regulations and to minimize the discharge of pollutants into receiving waters or storm water drainage systems caused by wastewater run off from emergency and non-emergency activities.

BACKGROUND

This procedure describes the Best Management Practices (BMPs) for water pollution control. The goal of the procedure is to comply with federal, state, and local regulations and to minimize the discharge of pollutants into receiving waters or storm water drainage systems caused by wastewater run off from emergency and non-emergency activities.

DEFINITIONS

Routine Activities: Daily actions and procedures in the normal course of the operations and maintenance of OCFA facilities and equipment.

Emergency Activities: Those activities directly associated with the OCFA emergency service response

PROCEDURE

Emergency Activities

Water runoff created as a result of an emergency is exempt from regulatory requirements. However, when and where possible and practicable, reasonable care shall be taken to minimize the impact upon the environment. The emergency exception to normal BMPs shall exist only as long as necessary as determined by the incident commander.

Discharges Associated with Fire Fighting

- If possible, avoid directing water flows directly onto surfaces that erode and where runoff may enter waterways or storm drains.

WASTE WATER DISCHARGE/BEST MANAGEMENT PRACTICE (BMP)

Prepared By: *Property Management*

- If possible, apply water flows in such a manner that runoff will flow over vegetated areas prior to entering waterways or storm drains.

- When practical, block the storm drains that will prevent debris from entering the storm drain system.

Discharges Associated with Trauma Scenes

Trauma scene wastes (i.e. blood, body parts, and human tissue) may be generated at various types of crime or accident scenes. These types of wastes can pose a serious human health risk to those who are responsible for overseeing and conducting the cleanup. It is important that the procedures described below be employed when feasible to protect personnel and prevent unnecessary discharge of material into the storm drain. The types of blood borne pathogens that may be encountered at a trauma scene include, but are not limited to, HIV, Hepatitis B, and Hepatitis C. See Attachment for specific clean-up procedures.

Non-Emergency Activities

Non-emergency activities must be conducted in a manner that prevents discharge of pollutants into the storm drain system and restricts to the maximum extent possible, runoff of water from OCFA facilities.

Training Activities

- Where possible, direct water flows to landscaped, green belt areas or biological swales.

- When flowing water cannot be contained in the landscaped areas, survey the area prior to the training exercise to ensure that debris and pollutants will not enter the storm water system as a result of the flows generated during the drill.

- Where possible, use fog streams for short durations, and/or low gpm nozzle settings.

- Foam should not be used for training except as specifically allowed within the RFOTC.

Regional Fire Operations Training Center and Fire Station Activities

Vehicle and Equipment Washing

- All washing of apparatus and other OCFA vehicles on OCFA facilities shall be confined to vehicle wash down locations connected to water interceptor/clarifier systems.

WASTE WATER DISCHARGE/BEST MANAGEMENT PRACTICE (BMP)

Prepared By: *Property Management*

- Vehicle and equipment washing at fire stations that are not equipped with interceptor/clarifier systems shall be accomplished only where clean water can be contained on site or directed into the storm drain system.
- Runoff water shall be prevented from leaving the site to the maximum extent possible.
- Washing of vehicles is prohibited on front driveway aprons (see exception below).
- The primary method of washing apparatus is bucket washing and wiping.
- The next preferred apparatus washing method is use of low volume, high pressure systems which allow evaporation on site, and prevent site runoff.
- When other methods of cleaning the unit are insufficient and thorough washing of equipment is necessary, the following procedures shall be followed:
    - Minimize use of water and utilize a shut off device at the hose end.
    - When possible, use only water and the minimum quantity of cleaning agents.
    - Steam cleaning of engines, greasy equipment, etc., shall be conducted at RFOTC Fleet Services only.
    - Only OCFA apparatus and vehicle may be washed on OCFA facilities.

Stations with Approved Wash Areas

Stations with vehicle wash areas are connected to water clarification systems that are designed and engineered to clean water runoff prior to entering the sanitary sewer system. For stations so equipped, all vehicle and equipment washing shall be confined to the wash down area.

Stations without Designed Wash Areas

Stations without a designed wash area shall select and identify a vehicle washing area at the rear of the fire station that includes the following:

- Areas that are relatively level and that allow for evaporation rather than draining to a storm drain

WASTE WATER DISCHARGE/BEST MANAGEMENT PRACTICE (BMP)

Prepared By: *Property Management*

- Areas that are free of petroleum, oils and distillates and that are swept clean of debris and potential pollutants that could be carried into the storm drain system

- Areas that allow for prevention of runoff into storm drains by flowing onto landscaped or green areas but that do not cause damage or erosion

Battalion Chiefs shall approve a station vehicle wash area for all stations without a wash area connected to the sanitary sewer. Each station shall prepare and post a site plan that clearly identifies the approved wash area.

Those fire stations that do not have a rear area to wash fire equipment are allowed to utilize the front driveway apron but shall make every effort possible to adhere to the other identified Best Management Practices.

Vehicle Fueling

- Automatic fueling shut off devices should not be defeated by "topping off" the fuel tank.

- Any fuel spills resulting from refueling shall be immediately cleaned.

- Maintain a spill control kit consisting of which contains at least absorbent cloth for minor wipe-up/clean-up, petroleum absorbent containment materials, granulated petroleum absorbent materials, shovel, and broom. A metal can, with a tight fitting lid, should be used to contain any absorbent used to collect spilled fuel.

- Washing down the fueling area is prohibited.

Washing Hose, Salvage Covers, and Hall Runners

- Sweep the area to be used before starting.

- Direct water flows to landscaped/green areas that will not cause erosion or damage.

- Where practical, allow water to evaporate rather than run off.

- Prevent any contaminates, such as cleaning agents, from entering the storm drain system.

- Use methods that employ minimal water.

WASTE WATER DISCHARGE/BEST MANAGEMENT PRACTICE (BMP)

Prepared By: *Property Management*

Facility Maintenance

- Monitor and maintain irrigation systems to minimize volume, runoff and erosion.
- Maintain landscaped areas to prevent introduction of leaves and other landscape waste into the storm water system.
- Hydraulic/hose washing of hardscape is prohibited. Hardscape areas shall be swept and collected debris placed into a proper receptacle.
- Vehicle parking areas should be periodically inspected and significant accumulations of materials and substances (oil, fuel, grease, leaves, etc.) removed and disposed of. When oil and grease accumulations cannot be cleaned with absorbents, towels, etc., Property Management may be contacted for assistance.

General Equipment Clean Up and Decontamination at the Fire Station Following a Trauma Incident

Decontaminate all equipment that has been contaminated with bodily fluids by using one of the following methods:

- Wash with soap and hot water in an approved area connected to the sanitary sewer.
- Soak in germicidal solution for a period of time recommended in the manufacturer's instructions and rinse well in an approved area that is connected to a sanitary sewer.
- Spray with germicide and wipe, re-spray, and wipe clean. All decontamination wipes that are saturated with liquid blood must be placed in a red biohazard bag and disposed of in an approved medical waste container at the hospital.

RELATED REFERENCES

SOP HR.02.02 Communicable Disease Exposure

SOP HR.02.03 Communicable Disease Exposure Prevention

WASTE WATER DISCHARGE/BEST MANAGEMENT PRACTICE (BMP)

Prepared By: *Property Management*

LEGAL CITES/REFERENCES

None

ATTACHMENTS

- Trauma Scene Clean-Up

Trauma Scene Clean-Up

General Trauma Scene Cleanup Guidelines

- Trauma scene cleanup operations must be performed in accordance with the Medical Waste Management Act, *California Health and Safety Code, Sections 117600 – 118360.* Fire Departments on emergency calls who clean up a scene themselves are not required to have a Biowaste Hauling Permit to remove liquid or solid trauma scene waste from the scene for temporary storage or disposal. The County of Orange Medical Waste Section Emergency Response through Control 1 after hours (714) 628-7008 is available for consultation/assistance with trauma scene management.

- A Registered Trauma Scene Management Practitioner (RTSMP) is necessary when a scene requires decontamination and cleanup beyond the capability of Public Agency personnel on scene. RTSMP's are registered with the Department of Health Services pursuant to Section 118321 of the Medical Waste Management Act. A list of RTSMP's can be obtained from the California Department of Health Services. Additional information may be obtained by calling the Department of Health Services at (916) 327-6904.

- Additional information and guidance to be implemented may be obtained 24 hours a day by contacting the County of Orange Public Facilities and Resources Department for Waste Water Run Off BMP at (714) 567-6363 or Orange County Environmental Health for Trauma Scene Clean-up (BMP) at (714) 667-3784. Orange County Communication (Control 1) has 24-hour contacts with both agencies.

Trauma Scene Clean-up Public Property (BMP)

Non-Fatality Trauma Scene Requiring Minor Trauma Scene Cleanup.
Determine if on-scene personnel can handle the trauma scene cleanup without the services of a RTSMP. If the IC/Company Officer determines the trauma scene clean-up can be performed by on scene personnel, then proceed using the following procedures:

- Assure SOP HR.02.02 *Communicable Disease Exposure* and SOP HR.02.03 *Communicable Disease Exposure Prevention* are followed

- Stabilize scene to prevent blood, body tissue, or body parts from entering the storm drain, follow same procedures used to prevent hazardous materials from entering storm drain

- Place any body tissue or body parts in appropriate red biohazard bags; these bags are to be taken to appropriate hospital for disposal

- All blood on ground must be cleaned up by spraying 10% bleach to water solution on the blood and letting stand for 10 minutes. After the bleach/water solution has been on the blood for 10 minutes, it can then be washed down the gutter to the storm drain inlet. All debris is to be removed from the gutter leading to the storm drain prior to washing down.
  - The 10% bleach/water solution must be mixed daily or mixed when needed. The bleach/water solution is not to be carried on units pre-mixed for more than 24 hours at a time.

Trauma Scene Clean-Up

Non-Fatality Trauma Scene Requiring the Use of an RTSMP

In the event the IC/Company Officer determine that the trauma scene clean-up exceeds the capabilities of the emergency personnel on scene, (i.e. exceeds the amount of trauma scene cleanup supplies carried on the unit such as red biohazard bags, bleach solution, etc.), then follow these procedures:

- Request through ECC a representative from the jurisdiction where the trauma scene has occurred to respond to the scene
  1. Contract City - Request Public Works official
  2. Unincorporated Areas – Request Orange County Environmental Health official
  3. Freeways – Orange County Environmental Health, California Highway Patrol should standby until they arrive.

- Standby until the appropriate official arrives on scene. If law enforcement has a need to remain on scene for investigation, etc., the IC/Company Officer may coordinate with them as to who will remain waiting for the appropriate official. Once the appropriate official arrives, they will make contact with an approved RTSMP to arrange for cleanup and make arrangements for payment.

Fatality Trauma Scene Cleanup

When a fatality occurs, requiring blood, body tissue, or body parts clean up, the then follow these procedures:

- Stabilize scene to prevent blood, body tissue, or body parts from entering the storm drain. Follow the same procedures to prevent hazardous materials from entering storm drain. IC/Company Officer must coordinate closely with law enforcement officials to assure that any stabilization efforts do not interfere with their investigation and possible destruction of evidence.

- Law enforcement personnel should standby while waiting the arrival of the Coroner.

- The Coroner will be responsible for the trauma scene cleanup.

Trauma Scene Cleanup Private Property (BMP)

Non-Fatality Trauma Scene Cleanup

When an incident occurs on private property and has the potential for allowing blood, body tissue, or body parts to enter the storm drain system, the same procedures are to be followed as on public property.

Fatality Trauma Scene Cleanup

When a fatality on private property occurs requiring trauma scene cleanup, the procedures will be the same as for a fatality on public property.

6.0 TRAINING AND PUBLIC EDUCATION

This section summarizes the staff training and public education activities implemented by the City and by the County as Principal Permittee, in order to maintain compliance with Provision E.7 of the Fifth Term Permit. The combined education and training programs strive to measurably increase knowledge regarding MS4s, impacts of runoff on receiving waters, Best Management Practices (BMPs); and to measurably change the behavior of target audiences and communities. Target audiences include:

- Municipal Departments, Personnel, Subcontractors, and Appointed/Elected Officials
- Developers and Project Applicants
- Construction Site Owners, Builders and Contractors
- Industrial and Commercial Site Owners and Operators and Mobile Businesses
- Residents and Homeowners Associations

6.1 PRINCIPAL PERMITTEE COUNTY-WIDE PROGRAMS

6.1.1 Model Public Education Program

Through its NPDES cost-share agreement with the County, the City supports and participates in a strong County-wide public education program using appropriate regional media, which provides program consistency and promotes sharing of resources, resulting in efficient program implementation specifically targeted for effectiveness and Permit compliance. The Countywide program continues to provide and improve upon existing educational materials and resources developed under previous NPDES Permits under the guidance of Public Education Subcommittee representatives from the Co-permittee Cities. The County maintains a robust education and outreach website (www.ocwatersheds.com/PublicEd) where all current resources can be viewed and downloaded. Training sessions and educational materials and activities targeted for municipal staff, and educational materials for general public communities of concern, that are developed and delivered by the Principal Permittee, are summarized in Exhibit 6.1 and are further detailed in Appendix B of the DAMP.

The City supports *H_2OC*, the dynamic Countywide outreach campaign. This campaign is built upon a foundation of cooperative Permittee development of programs and materials, implementation at Countywide and city levels, and the validation of its success through the use of opinion surveys and other direct measures of public behavior.

Education efforts of *H_2OC* follow a two-pronged approach comprising large-scale broad residential and business outreach as part of a foundational campaign and small-scale behavior-based action campaigns to build a base of residents from which the Education Program can document adoption of specific BMPs.

The NPDES Public Education Sub-Committee (Committee) comprised of Copermittee representatives meets monthly to collaboratively direct *H_2OC*. The City participates in the Committee to ensure program strategies and materials developed are appropriate to residents and businesses within the City.

6.1.2 Related County Programs

Household Hazardous Waste: The County operates regional Household Hazardous Waste Collection Centers for all County residents, which are publicized via the www.oclandfills.com website and linked from the City website.

Used Oil Recycling: The County Department of Resources Recycling and Recovery utilizes the City's share of CalRecycle grant funding to support and promote local used oil recycling. There are three certified used oil recycling centers in the City that recycle residential used oil and oil filters for no charge. The City and County jointly advertise this service through public education materials and at local events. Information on this program can be found at www.calrecycle.ca.gov/UsedOil/.

Food Facility Inspections: The Orange County Health Care Agency (OCHCA) conducts NPDES inspections at food facilities throughout the City as part of their routine restaurant inspections for compliance with health and safety regulations. The City does educational and enforcement follow-up for any food facilities where problems are identified.

6.1.3 Foundational Campaign Elements

The foundational campaign forms the underpinning of *H_2OC* based on maintaining a consistent water quality message and includes overall program branding, school and business outreach, pollutant-specific and residential program outreach and annual development and implementation of a media plan. The primary goal of the foundational campaign is to achieve permit compliance by increasing knowledge of residents and businesses and changing behavior over time. The success of these efforts is measured through the achievement of impressions and building engagement in *H_2OC*.

School Outreach

H_2OC uses agreements and relationships with organizations that outreach to school-aged children to deliver messaging on pollution prevention. These organizations, such as the Orange County Department of Education (OCDE), Discovery Science Center (DSC), the Pacific Marine Mammal Center, and the Ocean Institute, provide an avenue for disseminating materials and messages in a format conducive to student learning. Materials developed to inform children of stormwater pollution prevention behaviors are designed to encourage adoption of BMPs at school and in the home, as well as meet California Content Standards.

Business Outreach

The City will continue to distribute materials developed specifically for food service establishments (FSEs), mobile businesses, automotive service centers and detailing establishments, pet care businesses, pest control operators, landscape service companies, gasoline service stations and the land development and construction industry.

Previously developed outreach to the construction industry will be supplemented by materials promoting residential and commercial implementation of LID techniques, retrofitting of existing development and encouragement of infiltration.

Pollutant-specific Outreach

Outreach materials are developed for residents and businesses in Orange County regarding specific pollutants of concern and reviewed annually and updated by *H_2OC* as needed. City-specific materials supplement these efforts ensuring that pollution issues specific to the city are adequately addressed. Pollutant-specific outreach include proper use and disposal of pesticides and fertilizers, proper disposal of pet waste, residential automobile washing and proper disposal of household hazardous waste. Pollutant-specific outreach to businesses will focus on water conservation, reduction of metals in runoff and proper use and disposal of chemicals and other hazardous wastes.

Residential Program

The Residential Program includes recommendations (*"Tips"*) for pollution-prevention methods for residential areas. Specific pollution prevention practices identified for each residential activity that poses a threat to water quality are provided in the activity fact sheets presented in Exhibit 9.I. In addition, the City will facilitate proper management and disposal of used oil, toxic materials and other household hazardous wastes (HHWs) by providing educational materials describing the operation of the County's principal Household Hazardous Waste Collection Centers.

Speakers Bureau

A speakers' bureau was developed for *H_2OC* to supplement the previous outreach efforts through local Chambers of Commerce. On behalf of the Permittees the County as Principal Permittee distributes requests for presentations to local groups such as Chambers of Commerce, Rotary Clubs, Kiwanis Clubs, Key Clubs, National Honor Society groups and environmental groups (e.g. Sierra Club).

Common Interest Areas/Homeowner Association Activities Program

The Common Interest Area (CIA) / Homeowner Association Area (HOA) Activities Program includes specifications for pollution-prevention methods for CIA/HOA areas and is described in DAMP Section 9.6.

6.1.4 Action Campaigns

To document sustainable behavior change, *H_2OC* pairs general pollution prevention outreach (via the Foundational Campaign) with localized action campaigns that focus on changing specific behaviors in small, community-based target groups. The action campaigns utilize

Community-Based Social Marketing (CBSM)[1] techniques to document behavior change on a more frequent scale.

Community-Based Social Marketing involves four basic steps:

1. Identifying barriers and motivators to an activity;

2. Developing a strategy that utilizes tools to leverage those barriers and motivators in order to affect behavior change;

3. Pilot the strategy; and

4. Evaluate the strategy and refine it for future implementation.

By simplifying campaign messaging and requesting adoption of specific BMPs, *H_2OC* seeks to remove the uncertainty caused by offering a large number of stormwater pollution-preventing behaviors in favor of one single high-impact action.

Overwatering is Out

The ultimate goal of the *Overwatering is Out* action campaign is to improve water quality through eliminating residential irrigation runoff. This is accomplished by encouraging residents to sign up for program messaging (i.e. tips to reduce overwatering) and to commit to making changes to their irrigation habits or landscape to reduce runoff. Built into the program is also the ability to quantify behavior changes that are the direct result of the action campaign.

6.2 CITY EDUCATIONAL PROGRAMS

6.2.1 Municipal Personnel Education

The City's municipal education program includes training and education for all levels of personnel. City managers and staff attend training sessions that are organized and presented by the County, as well as relevant meetings, workshops and conferences offered by professional organizations and other partner agencies such as the State and local/regional water purveyors. Specialized in-house departmental training targets understanding of the principles of the Permit and the procedures that are affected by specific departmental roles. Regular municipal site and field program inspections by the NPDES Authorized Inspector provide for compliance back-check and a feedback loop for iterative BMP improvement. Training topics, targeted staff, and sources of training are summarized in Exhibit 6.1.

6.2.2 City Subcontractor Education

Many City operations and maintenance activities, emergency response, and municipal construction projects are carried out by subcontractors. Appropriate educational background, continuing education, and professional or trade certifications are requirements for the hiring/retention of operational and maintenance subcontractors. For both maintenance and

[1] McKenzie-Mohr, Doug & Smith, William (1999). *Fostering sustainable behavior: An introduction to community-based social marketing.* Gabriola Island, B.C.: New Society (www.CBSM.com)

construction subcontractors, specific contractual obligations for implementing required BMPs are spelled out in their subcontract specifications documents. City operations management staff and City construction project managers and inspectors provide BMP briefings and explanations of environmental issues at the start of contracts and inspect for compliance with specifications regularly throughout the contract terms. Regular municipal site and field program inspections by the NPDES Authorized Inspector provide for compliance back-check and a feedback loop for iterative BMP improvement. Appropriate City staff and emergency response subcontractors are also regularly trained on controls and procedures for sewage spills and preventing infiltration of seepage from the sewer (which is owned by a separate agency) into the MS4 system.

6.2.3 Private Developer and Construction Contractor Education

As early in the planning and development process as possible and all through the permitting and construction process, the City educates project applicants, developers, contractors, property owners, and other responsible parties for new development, redevelopment, and retrofit projects on pollution prevention, BMPs, and environmental drivers. The City's planning and building counter staff provides outreach to the development community by:

- Requiring the incorporation of water quality protections into Conditions of Approval for all discretionary project approvals.
- Ensuring that appropriate water quality protection notes are included on design plans prior to approval of grading project permits.
- Distributing construction activity-specific BMP checklists and the construction BMP guidance manual with building and grading permits.
- Distributing fact sheets and one-on-one review during plan check, preconstruction and construction inspection.
- Sending pre-rainy season reminders to all construction sites with grading permits.
- Participating in pre-rainy season training with developers/contractors.

6.2.4 Industrial and Commercial Site Owner and Mobile Business Education

The City proactively outreaches to businesses within the community by:

- Discussing environmental responsibility and distributing BMP information to business owners / operators during inspections of high-priority commercial business sites, and during operational inspections of identified mobile businesses.
- Presenting information to various local business associations such as the Chamber of Commerce and Rotary Club.
- Intermittent mailings of any updated BMP information to all affected businesses as appropriate

6.2.5 Homeowners Association and Resident Outreach

The City communicates with residents by:

- Regularly publishing articles on pollution prevention and runoff water quality protection in the City's e-newsletter, quarterly recreation brochure, senior center newsletter, and/or public safety newsletters;
- Publishing information about urban runoff and stormwater pollution issues on the City's website and providing links to other related websites such as the County website, www.ocwatersheds.com;
- Maintaining a supply of brochures and promotional materials at public buildings including City Hall and community centers;
- Participating in community events by hosting a booth with information and promotional materials;
- Participating in and promoting clean-up events such as the annual Inner Coastal/Watershed Cleanup Day;
- Presenting information to community or social groups or schools, as requested;
- Writing and distributing news releases with seasonal tips or notices of events;
- Storm drain stenciling reminding residents that materials entering the storm drain wind up in the ocean;
- Publicizing the countywide 24-hour water pollution reporting hotline number 1-877-89SPILL, which handles water pollution complaints as well as inquiries about stormwater and public education materials.

The City educates homeowners associations by:

- Contacting HOA subcontractors who have been observed (or reported via hotline or other tip) in a behavior that could negatively affect water quality, and educating them on potential environmental and enforcement consequences.
- Providing information about water quality issues and BMPs appropriate for residential activities to Homeowners Associations that are willing to distribute this information with their newsletters or billings.
- Distributing BMP checklists appropriate for HOA activities within their Common Areas as an annual advisory and assessment tool to all HOA's in the City.

6.3 WATER/SEWER DISTRICT EDUCATIONAL PROGRAMS

The Moulton Niguel Water District (MNWD), which operates and maintains the sewage collection system in the City, implements an extensive Fats, Oil and Grease (FOG) program which includes restaurant and commercial-center grease control system inspections to prevent sewer backups and spills.

MNWD also promotes the elimination of irrigation runoff from existing developments throughout the City through its tiered billing rate structures that raise awareness of wasteful water use every time a water bill is sent out to municipal, residential, commercial and HOA customers. Financial penalties are imposed for customers that use more than their share of either potable or recycled irrigation water. Educational information is periodically inserted with the water bill explaining the tiered-penalty system and water district programs to assist individual customers in identifying and making runoff-reducing improvements to their landscape irrigation systems. The City and MNWD collaborate in publicizing the programs and in sharing program assessment data. Information on MNWD-led efforts is available at www.mnwd.com.

Additional publicity and rebate programs for water-conserving landscape irrigation improvements are sponsored through the Metropolitan Water District (www.bewaterwise.com) and administered through the regional Municipal Water District of Orange County (www.mwdoc.com). These agencies also intermittently offer educational workshops on water conservation techniques to landscape contractors, homeowners associations, and residents.

6.4 PUBLIC PARTICIPATION

The City encourages public participation through the following methods:

6.4.1 Facilitating Public Input/Feedback

The City website provides opportunities for residents to ask questions and give comments by including contact information people can use to communicate with municipal staff. City staff are encouraged to practice excellent customer service when talking with businesses or residents they encounter in their daily jobs. The City also collects feedback during various Commission, Advisory Committee and City Council meetings. Public notice of these meetings provides the opportunity for public input into the updating, development, and implementation of the City's urban runoff-related ordinances and programs. All City Council meetings are televised live and with weekly re-broadcasts on local access cable Channels 30 and 853.

6.4.2 Public Reporting

To receive complaints or tips of illegal discharges, the City operates a Complaint Response Tracking System, which may be accessed during working hours by calling City Hall Reception at 949-362-4300, or to Police Services Dispatch at 949-770-6011 outside of working hours for urgent complaints. Non-urgent complaints may also be made on-line to the Complaint Response System through the City's "City Hall Direct" link accessed via the City website, http://www.cityoflagunaniguel.org/. The City's mobile application "MyLagunaNiguel" is

another way complaints and tips are received. The application was launched in 2014 and is available for Apple iOS and Android devices.

6.4.3 Speakers Bureau

City staff are available and regularly speak to organizations such as the Chamber of Commerce, business groups, homeowners associations, schools, and service clubs. The County, through a consultant, outreaches to groups within the City offering to speak on Stormwater topics. These speaking engagements are handled by City staff, the County, or the consultant group as appropriate.

6.5 REPORTING

The City's Annual LIP PEA Report to the RWQCB endeavors to include available direct and indirect measurements and estimates of educational effectiveness, and may assess changes over time in such areas as:

- *Awareness demonstrated through BMP compliance:* Inspection results, enforcement outcomes, or illicit discharge investigations, etc.
- *Awareness demonstrated by participation in educational activities:* Data from opinion surveys, events participation rates, self-certification compliance processes, or meeting/workshop attendance, etc.
- *Awareness demonstrated through low-impact behavioral practices:* Public utilization rates for household hazardous waste/used oil recycling centers, water-smart landscape rebate programs, pet waste bag dispensers, use of hotlines, etc.
- *Opportunities for awareness estimated by exposure to messages:* Estimated number of "marketing impressions" created by newsletter articles, brochures distributed, press releases, catch basin labeling, or billing inserts, etc.
- *Awareness demonstrated by measured pollutant or flow load reductions:* Quantity or character of waste removed during cleanup events, and/or MS4 or treatment control BMPs maintenance and/or street sweeping; or potable and recycled water usage reduction relative to irrigated landscape acreage.

Some data sets may not correspond exactly to City boundaries, may not be consistently available every year, or may evolve to improve utility for program assessment/improvement. The county-wide Model Public Education Program will also be annually evaluated in the WQIP Annual Report.

EXHIBIT 6.I
TRAINING AND PUBLIC EDUCATION ACTIVITIES

MUNICIPAL STAFF AND SUBCONTRACTOR TRAINING

Type	Audience	Presenter	Frequency	Required Subtopics/Components	Methods	Topic Area
Staff Training	Municipal Planners Development Reviewers	Principal Permittee Professional Organizations State or Regional Boards	Ongoing	Federal, State, and local water quality laws and regulations applicable to Development Projects. Land use decisions and water quality impacts Methods to minimize development impacts	Countywide Committees, County Workshops, Professional conferences, State-sponsored workshops	Development Planning Review (New Development/Re-Development)
Staff Training	Municipal Staff: Construction Building Code Enforcement Grading Review Staff Inspectors any other responsible inspection and construction staff	Principal Permittee	Annual Prior to Oct. 1st	Federal, State, and local water quality laws and regulations applicable to construction and grading activities. The connection between construction activities and water quality impacts (i.e., impacts from land development and urbanization and impacts from construction material such as sediment). Proper implementation of erosion and sediment control and other BMPs to minimize the impacts to receiving water quality resulting from construction activities. Current advancements in BMP technologies. SSMP Requirements including treatment options, site design, source control, and applicable tracking mechanisms.	County Annual training Workshops, Countywide committees,	Municipal Construction and Municipal Construction Inspection on Private Property (Existing Development)
Training	Municipal Staff: Construction Building Grading Review Inspectors any other responsible	City Project Managers	Annual Prior to Oct. 1st	The City's inspection, plan review, and enforcement policies and procedures to verify consistent application. Topics of local importance, including local water quality conditions, impaired water bodies, environmentally sensitive areas, and public health and disease vector issues associated with runoff.	Presentation, consultations and in-house workshops	Municipal construction and municipal inspection of construction on private property (Existing Development)

Type	Audience	Presenter	Frequency	Required Subtopics/Components	Methods	Topic Area
	construction staff					
Training	Municipal Staff and subcontractors onducting field operations on the MS4 and Sanitary Sewer	City Staff Principal Permittee Sewer district	Ongoing	Goal of education is to limit infiltration of seepage from sanitary sewer to MS4. Train on the detection of sewage entering the MS4 and procedure for handling.	In-house trainings, County Model Program training workshops, field coordination activities	Municipal operations (Existing Development)
Training	Municipal Staff & subcontractors responsible for activities which generate pollutants and/or implementing BMPs in municipal areas	City operations managers Principal Permittee	Ongoing	selecting, implementing, and evaluating BMPs for municipal operations understand activity/pollutant specific BMPs for municipal operations	County Model Program training workshops, Subcontract specifications, contract manager inspections	Municipal operations (Existing Development)
Training	Municipal Staff & subcontractors responsible for application, storage, and disposal of pesticides, herbicides, and fertilizer	City operations managers City subcontractor Principal Permittee	Ongoing	Reducing pollutants from municipal areas to the MS4 and receiving waters by implementing appropriate BMPs for landscape chemicals management and minimization	Countywide Model IPM program & workshops, Subcontract specifications require pest advisor certifications	Municipal Pesticide, Herbicide & Fertilizer Management (Existing Development)
Training	Code Enforcement Officers and NPDES Authorized Inspectors Inspection subcontractors	Principal Permittee City subcontract manager	Annual Prior to Oct. 1st	Inspection and enforcement procedures at commercial/industrial sites BMP Implementation at commercial/industrial sites Review of Industrial Monitoring Data (if applicable)	County Model program Workshop Subcontract specifications	Inspection of commercial/industrial sites by municipal staff or subcontractors (Existing Development)

PUBLIC EDUCATION OF TARGET COMMUNITIES

Type	Audience	Delivered By	Frequency	Required Subtopics/Components	Methods	Topic Area
Program	Residents Under-served Audiences	Countywide Public Education committee & Principal	Ongoing	Laws, regulations, permits, and requirements BMPs General Runoff Concepts Existing water quality, local water quality	Presentations Brochures Advertising Website	Residential general water quality & runoff awareness (Existing Development)

Type	Audience	Delivered By	Frequency	Required Subtopics/Components	Methods	Topic Area
	CIA/HOA Managers & Residents High-Risk Behaviors & Discharges	Permittee City staff Local water district Regional water wholesalers		conditions, impaired waterbodies and ESAs Public reporting mechanisms Water Conservation/irrigation runoff elimination LID Techniques Public Health and Vector Control Issues associated with runoff	Local Events Newsletters News articles Public hearings Opinion surveys Signage Webpage link Letters & notifications Water bills Billing inserts Door hangers & field flags Field consultations Websites Conservation workshops	
Program	Residents	Principal Permittee City Staff Solid waste subcontractors	Ongoing	Proper disposal of used oil, toxic materials, and household hazardous wastes	Mailings Brochures Website Advertising HHW center Sharps & fluorescents/battery drop-off centers Subcontract specifications	Residential HHW disposal (Existing Development)
Program	Commercial Owners/Operators Industrial Owners/Operators	City Code Enforcement Officers Inspection subcontractor Local water district Regional water wholesalers	Ongoing	Impacts of activities to the MS4 and receiving water BMP Solutions Prohibited non-storm water discharges Laws, regulations, permits, & requirements General runoff concepts Public reporting mechanisms Water conservation/irrigation runoff elimination	Brochures Posters Inspections, Mailings Water bills Billing inserts	Commercial/Industrial BMP requirements (Existing Development)

Type	Audience	Delivered By	Frequency	Required Subtopics/Components	Methods	Topic Area
				LID techniques		
Program	Project Applicants Developers Contractors Property Owners Construction Site Owners/Operators Other Resp. Parties	City Plan reviewers City inspectors Principal Permittee	Ongoing	Increase knowledge regarding MS4s, impacts of runoff on receiving waters, potential BMP solutions Importance of educating all construction workers in the field about storm water issues and BMPs through formal or informal training Federal, State, and local water quality laws and regulations applicable to new development and redevelopment activities Site design, source control, pollution prevention, and treatment BMPs General runoff concepts Local water quality conditions Impaired waterbodies & ESAs Retrofitting education and information	Brochures Workshops Public hearings WQMP template Site Plan Conditions of Approval Grading & building permit requirements Inspections during & post-construction	Development Planning & Mitigation (New Development) Construction BMPs (Construction) Encouraging Retrofitting of Structural Controls and LID (Existing Development)
Program	Mobile Businesses	Principal Permittee City subcontract inspector, & City Code Enforcement officers	Ongoing	Outreach and education targeting mobile businesses on topics including minimum standards, BMP requirements and local ordinances.	Letters Brochures Advertising Inspections	Mobile Business BMPs implementation(Existing Development)
Program	Food facility owner/managers	County Health Care Agency inspectors MNWD inspectors City Code Enforcement	Ongoing	Education when grease and/or trash facilities are shared by multiple facilities	Brochures Posters Letters Inspections	Food facility BMP implementation(Existing Development)

7.0 DEVELOPMENT PLANNING COMPONENT

7.1 INTRODUCTION

Pursuant to the Fifth Term Permit this Development Planning Component establishes City requirements and guidelines for pollution prevention methods that must be implemented as part of proposed development projects to protect water quality from project discharges and related activities. For a detailed description of program management responsibilities, see Section 2 of the LIP.

7.1.1 Overview

Watershed urbanization can adversely impact waterways and coastal waters and give rise to the symptoms of Urban Stream Syndrome (see Section 1.1). To reduce these impacts, the City and Copermittees have established design standards for new development and significant redevelopment projects that require implementation of BMPs including Low Impact Development (LID) techniques, hydromodification controls, source controls and treatment controls. Implementation of these design standards ensures that the hydrologic impacts that can arise from watershed imperviousness are mitigated and consequently this key element of the Program addresses all of the HPWQCs identified in the WQIP.

7.2 PRIORITIZATION

In compliance with Provision E.3 of the Fifth Term Permit, development projects shall address the quality and quantity of runoff through the incorporation of pollution prevention methods as required according to prioritization as either a Priority Project or Non-Priority Project.

7.2.1 Priority Projects

During project review, approval, and permitting, the City shall require new development and significant redevelopment projects to address the quality and quantity of stormwater runoff through the incorporation of permanent (post-construction) BMPs in the project design phase. The City shall require project-specific Water Quality Management Plans (Project WQMPs) for all private and public projects that qualify as one of the Priority Project Categories listed in Table 7.1.

Table 7.1
Priority Project Categories

New development projects that create 10,000 square feet or more of impervious surfaces (collectively over the entire project site). This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land.
Redevelopment projects that create and/or replace 5,000 square feet or more of impervious surface (collectively over the entire project site on an existing site of 10,000 square feet or more of impervious surfaces). This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land.
New and redevelopment projects that create and/or replace 5,000 square feet or more of impervious surface (collectively over the entire project site), and support one or more of the following uses: (i) Restaurants. This category is defined as a facility that sells prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (SIC code 5812). (ii) Hillside development projects. This category includes development on any natural slope that is twenty-five percent or greater. (iii) Parking lots. This category is defined as a land area or facility for the temporary parking or storage of motor vehicles used personally, for business, or for commerce. (iv) Streets, roads, highways, freeways, and driveways. This category is defined as any paved impervious surface used for the transportation of automobiles, trucks, motorcycles, and other vehicles.
New or redevelopment projects that create and/or replace 2,500 square feet or more of impervious surface (collectively over the entire project site), and discharging directly to an Environmentally Sensitive Area (ESA). "Discharging directly to" includes flow that is conveyed overland a distance of 200 feet or less from the project to the ESA, or conveyed in a pipe or open channel any distance as an isolated flow from the project to the ESA (i.e. not commingled with flows from adjacent lands).
New development projects, or redevelopment projects that create and/or replace 5,000 square feet or more of impervious surface, that support one or more of the following uses: (i) Automotive repair shops. This category is defined as a facility that is categorized in any one of the following Standard Industrial Classification (SIC) codes: 5013, 5014, 5541, 7532-7534, or 7536-7539. (ii) Retail gasoline outlets (RGOs). This category includes RGOs that meet the following criteria: (a) 5,000 square feet or more or (b) a projected Average Daily Traffic (ADT) of 100 or more vehicles per day.
New or redevelopment projects that result in the disturbance of one or more acres of land and are expected to generate pollutants post construction

The primary difference between a Priority Project and a Non-Priority Project is that Priority Projects are required to fully evaluate and incorporate LID BMPs to meet the quantitative requirements of the Permit and/or demonstrate infeasibility and participate in alternative compliance options, whereas Non-Priority Projects must incorporate all applicable source control BMPs and incorporate to the extent possible site design BMPs, LID BMPs and implement LID BMPs where applicable and feasible.

Project WQMP Requirements

The purpose of the Project WQMP is to define project features and BMPs that will mitigate the project's impact on water quality and the environment. In order to complete a Project WQMP, the following steps will need to be performed:

1. Determine discretionary permits and WQ conditions that may apply – Model WQMP Section 2.1

2. Describe the project – Model WQMP Section 2.2

3. Assess the site – Model WQMP Section 2.3

4. Develop and select BMPs, including LID BMPs, site design BMPs, hydromodification control BMPs, and source control BMPs – Model WQMP Section 2.4, 2.5 and 2.6.

5. Determine any applicable alternative compliance approaches – Model WQMP Section 3.0

6. Identify parties responsible for BMP maintenance and funding sources – Model WQMP Section 2.8

The steps are discussed in further detail in the Model WQMP and Technical Guidance Document (TGD) which can be found on the City's website at http://www.cityoflagunaniguel.org/index.aspx?nid=27. The Model WQMP and TGD contain all the information specified for the BMP Design Manual and should for purposes of compliance be considered to be a BMP Design Manual (referred to as the Standard Storm Water Mitigation Plan under the Fourth Term Permit).

7.2.2 Non-Priority Projects

The City shall require completion of a project-specific Non-Priority Project Water Quality Checklist for all public and Private Projects that do not qualify as one of the Priority Project Categories but meet one of the following criteria:

- Fall under the planning and building authority of the city
- Do not meet any of the Priority Development Project categories, and
- Have a significant nexus to water quality.

Additional information regarding Non-Priority Projects can be found in the Model WQMP Section 1.3.2.

Public Works Projects

City Public Works projects that have similar functions or characteristics or may conduct similar activities after construction is completed as the priority new and redevelopment projects described above are considered Priority Projects. Such projects may include but are not limited to:

- Parks and recreation facilities
- Public Buildings
- Streets and roadways
- Drainage facilities
- Utility and other infrastructure projects

WQMPs are not required for Public Works projects consisting of routine maintenance or emergency construction activities required to protect public health and safety; interior remodeling with no outside exposure of construction materials or construction waste to storm water; mechanical permit work; electrical permit work; sign permit work, and; projects which will have a de minimis post-development impact on the quality of runoff.

7.3 PROJECT REVIEW AND APPROVAL

Development project compliance with applicable water quality requirements shall be demonstrated during the planning process and prior to permit issuance. In compliance with the Fifth Term Permit, required post-construction BMPs shall be implemented prior to occupancy and/or the intended use of any portion of the project.

7.3.1 Discretionary Review

For development projects subject to discretionary land use review, conceptual plans submitted as part of the project application shall incorporate required post-construction BMPs. For Priority Projects, a project-specific preliminary WQMP shall also be submitted.

At the City's discretion, as part of the discretionary review process, conditions of approval may be required to protect receiving water quality from potential short-term and long-term development impacts. For reference, the City's list of standard water quality conditions of approval is included as Exhibit 7.I.

7.3.2 Plan Check: Issuance of Grading or Building Permits

Prior to issuance of grading or building permits, detailed construction plans showing the locations and design details of all proposed post-construction BMPs shall be submitted. Priority Project submittals shall also include a project-specific final WQMP.

Detailed construction plans shall be consistent with any applicable CEQA documentation, the project conditions of approval, approved final WQMP, and the BMP design criteria and guidance provided in the Model WQMP.

If use of alternative treatment control BMPs is proposed, detailed construction plans shall include the certification of the project's engineer of record that the alternative treatment control BMPs are equally or more effective in pollutant reduction than comparable BMPs found in the Model WQMP.

7.3.3 Permit Closeout, Certificates of Use and Certificates of Occupancy

Prior to permit closeout and issuance of Certificates of Use and Occupancy, at the City's discretion, the project applicant/owner shall:

- Demonstrate that all required structural BMPs have been constructed and installed in conformance with approved plans and specifications
- Prepare, submit for City review and obtain approval of an Operation and Maintenance (O&M) Plan for all structural BMPs
- Demonstrate that the applicant/owner is prepared to implement all non-structural BMPs
- Demonstrate that a mechanism or agreement acceptable to the City has been executed for the long-term funding and performance of BMP operation, maintenance, repair, and/or replacement
- For Priority Projects, record the terms, conditions and requirements of the project's WQMP with the County Recorder's office, including, but not limited to, any easements necessary for BMP maintenance and/or inspection
- For Priority Projects, demonstrate that an adequate number of copies of the WQMP are available onsite
- For industrial facilities subject to California's General Industrial Permit, demonstrate that coverage has been obtained by providing a copy of the Notice of Intent (NOI) submitted to the State Water Resources Control Board and a copy of the notification of the issuance of a Waste Discharge Identification (WDID) Number

Operation and Maintenance (O&M) Plan

The O&M Plan for structural BMPs shall describe and/or include:

- All structural BMPs employed
- Employee responsibilities and training for BMP operation and maintenance
- Operating schedule
- Maintenance frequency and schedule
- Specific maintenance activities
- Required permits from resource agencies, if any
- Forms to be used in documenting maintenance activities
- Record keeping requirements (at least 5 years)

At a minimum, annual inspection and maintenance of all structural BMPs is required.

Private Development Projects

Following satisfactory inspection, those structural BMPs identified during the planning process to be within City right-of-ways, or on land to be dedicated to City ownership, will be accepted by the City. Upon acceptance, responsibility for operation and maintenance will transfer from the developer or contractor to the appropriate City department, including the related funding mechanism.

If a property owner or a private entity, such as a homeowners association (HOA), retains or assumes responsibility for operation and maintenance of structural BMPs, the HOA, through an agreement, shall grant the City access for inspection purposes. Any structural BMPs on private property, for which the City assumes operating and maintenance responsibilities, shall require the granting of an access easement for such purposes. Such access easements shall be binding throughout the life of the project, or until the BMPs requiring access are acceptably replaced with BMPs not requiring access. Funding for the long-term operation and maintenance of structural BMPs will be front-funded, or otherwise guaranteed via mechanisms such as approved assessment districts, or other funding mechanisms.

Public Works Projects

For City Public Works projects, maintenance of the structural BMPs will transfer from the contractor to the appropriate City department upon completion of construction, when contract close-out occurs. At the City's discretion, structural BMPs may be transferred to any other public entity within its jurisdiction subject to satisfactory operation and maintenance standards, including acceptance of operation and maintenance responsibilities. Alternatively, the City may opt to transfer the responsibility for the operation and maintenance of structural BMPs to a private entity through contracts or lease agreements. Any such transfer agreement shall identify the City as a third-party beneficiary empowered to enforce maintenance agreements.

7.4 BMP MAINTENANCE TRACKING

Upon issuance of Certificates of Use and Occupancy, Priority Projects are added to the City's development inventories as appropriate. Per the City's existing development program, described in Section 9 of the LIP, the City annually inspects private Priority Projects to ensure appropriate BMP maintenance and implementation. As detailed in Section 5 of the LIP, public Priority Projects are also annually inspected.

7.5 REPORTING

In addition to any reporting requirements previously discussed, the City submits an annual progress report each year to RWQCB discussing City activities conducted pursuant to the Development Planning Component. At a minimum, the report includes the following information:

- Summary of post-construction BMP implementation
- Summary of water quality enforcement actions
- Any updates to this LIP Component and related exhibits

Exhibit 7.I

STANDARD CONDITIONS OF APPROVAL

EXHIBIT 7.I
STANDARD CONDITIONS OF APPROVAL

At the City's discretion, the following standard conditions of approval may be required to protect receiving water quality from the short-term and long-term impacts of new development and redevelopment:

Water Quality Conditions:

- Prior to the issuance of any grading or building permits for projects that will result in soil disturbance of one or more acres of land, the applicant shall demonstrate that coverage has been obtained under California's General Construction Permit by providing a copy of the Notice of Intent (NOI) submitted to the State Water Resources Control Board and a copy of the subsequent notification of the issuance of a Waste Discharge Identification (WDID) Number. Projects subject to this requirement shall prepare and implement a Stormwater Pollution Prevention Plan (SWPPP). A copy of the current SWPPP shall be kept at the project site and be available for City review on request.

- Prior to the issuance of any grading or building permits or prior to recordation upon subdivision of land, if determined applicable by the Community Development Director, the applicant shall submit to the City for review and approval a Final Water Quality Management Plan that:

  a. Incorporates approved plans, requirements of preliminary WQMP, conditions of approval and any applicable CEQA mitigation measures;

  b. Incorporates applicable Source Control and Site Design BMPs;

  c. Incorporates applicable Treatment Control BMPs;

  d. Generally describes the long-term operation and maintenance requirements for the Treatment Control BMPs;

  e. Identifies the entity that will be responsible for long-term operation and maintenance of the Treatment Control BMPS; and,

  f. Describes the mechanism for funding the long-term operation and maintenance of the Treatment Control BMPs.

  g. Ensures that the proposed development project complies with applicable hydromodification criteria;

- Prior to grading or building permit close-out and/or the issuance of a certificate of use or a certificate of occupancy, the applicant shall:

a. Demonstrate that all structural best management practices (BMPs) described in the project's WQMP have been constructed and installed in conformance with approved plans and specifications;

b. Demonstrate that the applicant is prepared to implement all non-structural BMPs described in the project's WQMP;

c. Demonstrate that an adequate number of copies of the project's approved WQMP are available onsite; and,

d. Submit for review and approval by the City an Operations and Maintenance (O&M) Plan for all structural BMPs.

e. Record the terms, conditions and requirements of the project's WQMP with the County Recorder's office, including, but not limited to, any easements necessary for BMP maintenance and/or inspection;

Industrial Facilities

- For industrial facilities subject to California's General Industrial Permit as defined by Standard Industrial Classification (SIC) code, prior to grading or building permit close-out and/or the issuance of a certificate of use or a certificate of occupancy, the applicant shall demonstrate that coverage under the permit has been obtained providing a copy of the Notice of Intent (NOI) submitted to the State Water Resources Control Board and a copy of the notification of the issuance of a Waste Discharge Identification (WDID) Number.

Eating and Drinking Establishments

- To prevent pollution generated from site specific activities, pursuant to Section 9.2 of the City of Laguna Niguel Local Implementation Plan, the applicant shall implement Best Management Practices (BMPs) for Eating and Drinking Establishments (BMP Checklist IC-20), including but not limited to, the use and maintenance of grease interceptors, in accordance with the requirements of the Moulton Niguel Water District, and the use of a dedicated cleaning area with a drain which is plumbed to the sanitary sewer system. All equipment, including floor mats, grease filters, grills, garbage cans, etc., shall be cleaned in a wash area that is plumbed to the sanitary sewer system (i.e. mop sink or wash water containment basin). Wash water from the cleaning of outdoor eating areas, "drive-thru" areas, sidewalks, parking lots and dumpster storage areas must be contained and disposed of properly and shall not be allowed to enter the storm drain system including the gutter and storm-drain inlets.

Special Conditions

- Prior to the issuance of any building permits, the applicant shall include in the plans any runoff control measures deemed necessary by the Building Official.

- Prior to issuance of certificates of use and occupancy or building permits for individual tenant improvements or construction permits for a tank or pipeline, uses shall be identified and, for specified uses, the applicant shall propose plans and measures for chemical management (including, but not limited to, storage, emergency response, employee training, spill contingencies and disposal). The chemical management measures shall be incorporated as an element of a Water Quality Management Plan and shall be subject to the approval of the City Building Official and other specified agencies such as the Fire Authority/Fire Department, the Orange County Health Care Agency and sewering agencies to ensure implementation of each agency's respective requirements. Certificates or permits may be ministerially withheld if features needed to properly manage chemicals cannot be incorporated into a previously completed building, center or complex.

Construction Related Conditions

- Water-Quality Notes - The following water-quality notes shall be added to the project's building plans:

  a. Sediments from areas disturbed by construction shall be retained on site using an effective combination of erosion and sediment controls to the maximum extent practicable; and stockpiles of soil shall be properly contained to minimize sediment transport from the site to streets, sidewalks, gutters, drain inlets or adjacent properties via runoff, vehicle tracking or wind.

  b. All sediment and construction debris which is tracked or deposited onto public or private sidewalks, gutters or paved roads shall be removed on a daily basis by sweeping or vacuuming and disposed of properly. Sediment and construction debris shall not be washed into the storm-drain system, including the gutter and storm-drain inlets.

  c. Sandbags, gravelbags or other effective filter or trap-type barriers shall be used where appropriate to intercept and slow the flow of runoff from the construction site and to trap sediment before it enters the storm-drain system, including gutters and inlets. All on-site storm-drain inlets shall be protected and off-site inlets shall be protected in areas where construction activity tracks sediment on paved areas or where inlets receive runoff from disturbed areas.

  d. Water and/or other dust palliative and stabilization methods should be used to prevent or alleviate dust nuisances (dust control) generated by construction activities. Covering small stockpiles of soil and debris or areas with unstabilized soil is an alternative to applying water or other dust palliatives.

e. Construction-related materials, wastes, spills or residues shall be retained on site to minimize transport from the site to streets, sidewalks, gutters, drain inlets or adjoining properties by wind or runoff.

f. To prevent the discharge of pollutants from material delivery and storage to the storm-water system or watercourses, all materials shall be properly stored to prevent soil contamination and contact with storm-water runoff, which may include appropriate covers, containment areas or surfaces and indoor storage.

g. Stockpiles of soil, paving materials, and pressure-treated wood shall be managed to prevent air and water pollution. Stockpiles should be located 50 feet away from concentrated flows of storm water, watercourses and drain inlets. Prior to the onset of precipitation, stockpiles shall be covered and protected by a temporary perimeter sediment barrier at all times.

h. Hazardous-material waste, including but not limited to petroleum products, roofing tar, paints, solvents, stains, acids, wood preservatives, septic wastes and asphalt products, shall not be allowed to enter the storm-drain system or watercourses and shall be properly transported, used, stored and disposed as required by federal and state law. Paint brushes and equipment for water- and oil-based paints shall be cleaned within a contained area and shall not be allowed to contaminate site soil, watercourses or storm-drain systems. Water-based paints shall be rinsed into the sanitary-sewer system; and thinners, solvents, excess oil-based paints and sludge shall be disposed as hazardous waste.

i. Cementaceous products such as concrete, mortar or stucco from concrete trucks, potable mixers and miscellaneous containers shall not be washed-out into the storm-drain system or watercourses. Designated washout areas shall be located at least 50 feet from concentrated flows of storm water, watercourses and storm-drain inlets, and runoff from washout-areas shall be contained by constructing a temporary pit or berm area large enough to capture the liquid and solid waste materials.

j. Saw-cut-cement concrete and asphalt-concrete slurry shall not be allowed to enter the storm-drain system or watercourses. Residue from grinding operations shall be picked up by means of a vacuum attachment to the grinding machine and not allowed to flow across the pavement or be left on the surface of the pavement.

EXHIBIT 7.II

MODEL WATER QUALITY MANAGEMENT PLAN (MODEL WQMP)

FOR

SOUTH ORANGE COUNTY

April 1, 2017

Second Draft for Review

TABLE OF CONTENTS

SECTION 1. INTRODUCTION 1-1
1.1. Purpose 1-1
1.2. Regulatory Basis 1-1
1.3. Project Categorization 1-2
1.3.1. Priority Development Project Categories 1-2
1.3.2. Non-Priority Projects 1-3
1.3.3. Exemptions from Stormwater Management Requirements 1-3
1.4. Intended Use of the Model WQMP with Other Documents 1-4
1.5. Applicability of Previous MS4 Permit Requirements 1-5
1.6. Public Agency Projects 1-5
1.7. WQMP Development Process 1-6

SECTION 2. PROJECT WQMP REQUIREMENTS 2-1
2.1. Discretionary Permits and Water Quality Conditions 2-1
2.2. Project Description 2-1
2.3. Site and Watershed Assessment 2-2
2.4. Site Design, Source Control, and Drainage Plan 2-2
2.5. Low Impact Development BMPs 2-3
2.6. Hydromodification BMPs 2-5
2.7. WQMP Preparation and Associated Exhibits 2-6
2.8. Operations and Maintenance Manual and Requirements 2-7

SECTION 3. ALTERNATIVE COMPLIANCE APPROACHES 3-1
3.1. Introduction 3-1
3.2. Prerequisite Elements for Alternative Compliance 3-1
3.2.1. Water Quality Equivalency Guidance 3-1
3.2.2. Watershed Management Area Analysis 3-1
3.2.3. In Lieu Fee Structure 3-2
3.2.4. Alternative Compliance Water Quality Credit System Option 3-2
3.3. Alternative Compliance Pathways Currently Available 3-2
3.3.1. Project Applicant Proposed Alternative Compliance Projects 3-2
3.4. Potential Future Alternative Compliance Pathways 3-4

SECTION 4. WQMP REVIEW AND VERIFICATION PROCESS 4-1
4.1. Overview 4-1
4.2. Required Certifications for Preparation and Review of Project WQMPs 4-1
4.3. Conceptual or Preliminary WQMP Stage 4-2
4.4. Final Project WQMP Stage 4-3
4.5. Permit Closeout Requirements 4-4
4.6. WQMP Recordation and Transfer 4-4

4.7. Updates to Project WQMPs and O&M Plans 4-5
4.7.1. Changes in Ownership or Maintenance Responsibility 4-5
4.7.2. Changes in Site Uses 4-5
4.7.3. Minor Changes in BMPs 4-5
4.7.4. Significant Changes in BMPs 4-6
4.8. Guidance Specific to Phased Projects 4-6
4.8.1. Tiered Approvals at Multiple Scales 4-6
4.8.2. Phased Completion of a Single Project 4-7
4.8.3. Interim Uses During Construction Phase 4-8

Note: For a List of Acronyms and a Glossary, please refer to the Technical Guidance Document (Exhibit 7.III)

SECTION 1. INTRODUCTION

1.1. Purpose

This Model Water Quality Management Plan (Model WQMP) has been developed to aid the County of Orange, the Orange County Flood Control District, the cities in South Orange County under the jurisdiction of the San Diego Regional Water Quality Control Board (Permittees) and project proponents with addressing post-construction urban runoff and stormwater pollution from new development and significant redevelopment projects that qualify as Priority Development Projects.

1.2. Regulatory Basis

The development of this Model WQMP and the accompanying Technical Guidance Document is required by the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit held jointly by the Permittees in South Orange County (Order No. R9-2013-0001 as amended by Orders R9-2015-0001 and R9-2015-0100). As authorized by the Federal Clean Water Act (CWA), the NPDES permit program controls water pollution by regulating sources that discharge pollutants into waters of the United States.

South Orange County is defined as the area under the jurisdiction of the San Diego Regional Water Quality Control Board (SDRWQCB), including:

- County of Orange Unincorporated Area
- Orange County Flood Control District
- City of Aliso Viejo
- City of Dana Point
- City of Laguna Beach
- City of Laguna Hills
- City of Laguna Woods
- City of Laguna Niguel
- City of Mission Viejo
- City of Rancho Santa Margarita
- City of San Clemente
- City of San Juan Capistrano
- City of Lake Forest[1]

[1] At the time that 5th Term North Orange County MS4 Permit goes into effect, the City of Lake Forest will be covered solely within the North Orange County MS4 Permit with respect to land development planning requirements of Provision F.2.b. Until that time, the City of Lake Forest is within both Permit Regions depending on the location within the City.

Provision F.2.b requires the "BMP Design Manual" to be prepared to incorporate the requirements of Provision E.3a-d which describe requirements that apply to post-construction stormwater management for development projects. The Model WQMP and TGD collectively serve as the BMP Design Manual.

Per Provision E.3.e, each Copermittee must implement a program that requires and confirms structural BMPs on all Priority Development Projects are designed, constructed, and maintained to remove pollutants in storm water to the MEP.

1.3. Project Categorization

Each Copermittee must use their land use and planning authorities to implement a development planning program that applies to all development projects and Priority Development Projects. Development projects are defined by the MS4 Permit as "construction, rehabilitation, redevelopment, or reconstruction of any public or private projects". Priority Development Projects are a subset of development projects that exceed certain thresholds.

CEQA defines a project as: a discretionary action being undertaken by a public agency that would have a direct or reasonably foreseeable indirect impact on the physical environment. This includes actions by the agency, financing and grants, and permits, licenses, plans, regulations or other entitlements granted by the agency. CEQA requires that the project include "the whole of the action" before the agency. This requirement precludes "piecemealing," which is the improper (and often artificial) separation of a project into smaller parts to avoid preparing EIR-level documentation.

For the purpose of project categorization, the "project" is the "whole of the action" which has the potential for adding or replacing or resulting in the addition or replacement of, roofs, pavement, or other impervious surfaces and thereby resulting in increased flows and/or storm water pollutants. "Whole of the action" means the project may not be segmented or phased into small parts either onsite or offsite if the effect is to reduce the quantity of impervious area and fall below thresholds for applicability of storm water requirements.

1.3.1. Priority Development Project Categories

Projects that fall under the planning and building authority of the Copermittee and meet one or more of the categories defined in Permit Provision E.3.b must implement site design, source control, LID, and hydromodification BMPs. Additionally, clarifications for project categorization described in Section 1.2 of the TGD apply.

MS4 Permit Reference: Priority Development Project categories are described in Provision E.3.b of the MS4 Permit including special considerations and exemptions.

TGD Reference: Section 1.2 of the TGD describes these categories and provides additional guidance for project categorization. The balance of the TGD is intended to support Project WQMP development for Priority Development Projects.

1.3.2. Non-Priority Projects

Projects that (1) fall under the planning and building authority of the Copermittee, (2) do not meet any of the categories defined in Permit Provision E.3.b, and (3) have a significant nexus to stormwater quality are defined as Non-Priority Development Projects and must implement site design and source control BMPs.

MS4 Permit Reference: Requirements that apply to all development projects, including Non-Priority Development Projects are prescribed in Provision E.3.a. As part of the land use and development planning process, each Copermittee must prescribe that site design and source control BMPs (Provision E.3.a) be applied for all development projects where local permits are issue.

TGD Reference: The TGD provides guidance for incorporation of site design and source control BMPs. Specifically, Steps 1 through 4 of the TGD process (Sections 2.1 through 2.4), Sections 3 (Site Design) and Section 6 (Source Control) provide guidance that is applicable to Non-Priority Development Projects.

Other Supporting Documents: The Non-Priority Development Project Water Quality Checklist template can be used to evaluate project applications. Local jurisdictions may provide an alternative template or a checklist to fulfill requirements.

1.3.3. Exemptions from Stormwater Management Requirements

The Copermittees have the discretion to exempt site activities that are not development projects, do not have exposure to stormwater, or otherwise pose a de minimus risk to stormwater quality. The following types of site activities, or activities of an equivalent nature, may be exempted.

- Replacement of impervious surfaces that are part of a routine maintenance activity, such as:
    - Replacing roof material on an existing building
    - Rebuilding a structure to original design after damage from earthquake, fire or similar disasters
    - Restoring pavement or other surface materials affected by trenches from utility work
    - Resurfacing existing roads and parking lots, including slurry, overlay and restriping
    - Routine replacement of damaged pavement, including full depth replacement, if the sole purpose is to repair the damage
    - Constructing new sidewalk, pedestrian ramps or bike lanes on existing roads

(within existing street right-of-way)
    - Restoring a historic building to its original historic design
- Repair or improvements to an existing building or structure that do not alter the size:
    - Plumbing, electrical and HVAC work
    - Interior alterations including major interior remodels and tenant build-out within an existing commercial building
- Exterior alterations that do not change the general dimensions and structural framing of the building (does not include building additions or projects where the existing building is demolished)
- A WQMP or Non-Priority Project checklist is not required for a project which, in its entirety, is necessary to mitigate an emergency.
- Other categories of site activities identified as exempt as part of the local water quality ordinance or identified as part of a standard project categorization process implemented by the local jurisdiction
- Activities identified on a case-by-case basis that have de minimus exposure to stormwater and/or de minimus potential to contribute stormwater pollutants.

1.4. Intended Use of the Model WQMP with Other Documents

There are five documents that describe requirements and/or provide guidance for developing Project WQMPs in South Orange County in substantial conformance with Provision E.3 of the MS4 Permit. These documents are listed in Table 1-1.

Table 1-1. Intended Purpose and Integration of Planning Documents

Document	Intended Purposes
South Orange County Model WQMP (DAMP Section 7.II)	Describes core performance criteria underlying the development of Project WQMPs Describes requirements that are specific to the South Orange County Permit Region Describes requirements and procedures for WQMP development, review, approval, verification, and ongoing implementation
Technical Guidance Document (DAMP Section 7.III) (serves North and South Orange County)	Provides technical guidance for: • Determining applicability of requirements • Developing Project WQMPs that incorporate applicable requirements • Conducting and documenting associated investigations and calculations • Designing BMPs that meet applicable requirements Provides examples and worksheets

Hydromodification Management Plan for South Orange County (DAMP Section 7.IV)	Provide technical guidance for developing hydromodification management designs for projects in South Orange County
WQMP Template	Provides a standardized format, organizational structure, and embedded guidance for developing a project WQMP for a Priority Development Project.
Non-Priority Development Project Checklist	Local jurisdictions may provide a checklist or alternative method for determining applicable site design and source control BMPs for non-priority development projects.

As indicated in Table 1-1, the Model WQMP is intended to serve an important but limited role in guiding the implementation of BMPs to address urban runoff and stormwater pollution. For most projects, the TGD is intended to provide comprehensive guidance and a standard design procedure for using on-site BMPs, including a complete description of the requirements that apply. However, where it is necessary to deviate from standard approaches for on-site BMPs or a project needs to pursue off-site or alternative approaches (Section 3), the Model WQMP can be consulted for a description of the core requirements that apply.

1.5. Applicability of Previous MS4 Permit Requirements

Where a project was previously prepared to comply with a previous MS4 Permit, special conditions may apply. Permit Provisions E.3.e.(1)(a)(i)-(ii) provide criteria for determining whether BMP requirements of earlier MS4 Permits may apply to the project. See Permit Provisions E.3.e.(1)(a)(i)-(ii) for additional information.

1.6. Public Agency Projects

Public agency projects should be categorized according to the same definitions, limitations, and exemptions as apply to private projects. Clarifications about types of public agency projects that may be exempted from either WQMP or NPP WQP requirements are included in Section 1.2 of the TGD.

Public agency projects may have different permitting and project development requirements than private land development projects. The local implementation plans (LIPs) and Jurisdictional Runoff Management Plans (JRMPs) define how each jurisdiction will ensure that applicable post-construction BMPs are implemented and maintained for these projects.

Individual Permittees may elect to develop a separate "Master Project WQMP" for anticipated future projects with similar characteristics based upon the requirements outlined in this document. A Master Project WQMP document would need to list the public agency projects that are anticipated to occur within the Permittee's jurisdiction over a given time period and the proposed methods of compliance with the Model WQMP and TGD.

1.7. WQMP Development Process

Section 2 of the TGD describes a recommended WQMP development process for the most common case where project comply with applicable requirements via on-site LID and hydromodification BMPs (where applicable). The core requirements underlying this process are described in Section 2 of this Model WQMP.

Section 3 of this Model WQMP describes specific options and associated criteria in the case that a regional/off-site compliance approach is selected as a preferred option or is determined to be necessary based on infeasibility of achieving full compliance with applicable criteria on site.

Section 4 of this Model WQMP describes the process for WQMP preparation, approval, implementation, inspection, closeout, and record keeping.

SECTION 2. PROJECT WQMP REQUIREMENTS

The purpose of a Project WQMP is to define project features and BMPs that will mitigate the project's impacts on receiving water quality and hydromodification in conformance with applicable standards.

Section 2 of the TGD describes an eight-step process for development of Project WQMPs utilizing on-site LID and hydromodification BMPs to meet applicable requirements. The TGD also identifies applicable standards, expected activities, and expected content associated with Project WQMP development. These expectations are intended as guidelines; alternative methods and approaches could be acceptable.

To complement the TGD, this section of the Model WQMP identifies the underlying MS4 Permit criteria and other core requirements associated with each step of WQMP development. This is intended to serve as a reference where a project proposes a project-specific deviation from the standard TGD processes or methods.

Sections 2.1 through 2.8 of the Model WQMP correspond to Sections 2.1 through 2.8 (Step 1 through 8) of the TGD.

Sections 2.1 through 2.6 of the Model WQMP and TGD correspond to Section 1 through 6 of the WQMP Template.

2.1. Discretionary Permits and Water Quality Conditions

Core Requirement(s): The Project WQMP shall identify and detail all project-specific requirements pertaining to water quality or hydromodification that have been applied to the project from prior approvals or other permitting processes. The intent of this section is of the Project WQMP is to full detail all requirements and commitments, beyond those described in the Model WQMP and TGD.

MS4 Permit Reference: The MS4 Permit does not specifically define how discretionary permits and water quality conditions must be documented.

TGD Reference: Section 2.1 provides guidance on expected Project WQMP content associated with this section.

2.2. Project Description

Core Requirement(s): The Project WQMP shall describe the project in a manner that matches the legal description of the project used as part of project approval. It shall also identify project features and attributes relevant for water quality and hydromodification management planning.

MS4 Permit Reference: The MS4 Permit does not specifically define how the project must be described.

TGD Reference: Section 2.2 provides guidance on expected Project WQMP content related to this section.

2.3. Site and Watershed Assessment

Core Requirement(s): The project proponent shall conduct appropriate investigations to characterize the site and watershed in a manner that supports informed and appropriate decisions about site design, source control, LID, and hydromodification BMPs as part of subsequent steps. The Project WQMP shall clearly and comprehensively document the investigations completed and describe the site and watershed conditions in a manner that provides appropriate support for subsequent selection of site design, source control, LID and hydromodification BMPs.

MS4 Permit Reference: The MS4 Permit does not prescribe specific methods or approaches for site and watershed investigation. However, MS4 Permit requirements pertaining to site design, source control, LID, and hydromodification control each require appropriate and accurate information about the site in order to identify applicable requirements and support compliance with the requirements.

TGD Reference: Section 2.3 identifies expected activities and Project WQMP content associated with this section.

2.4. Site Design, Source Control, and Drainage Plan

Core Requirement(s): The project shall conduct and document a site design and drainage planning effort related specifically to stormwater quality management and hydromodification management (if applicable). The documentation of the site design and drainage planning provided in the Model WQMP must demonstrate that the following underlying criteria are met:

- BMPs are provided to remove pollutants from runoff prior to its discharge to any receiving waters, and as close to the source as possible.
- Structural BMPs must not be constructed within any Water of the United States.
- This effort must build clearly upon the relevant findings of the site and watershed investigation and must be conducted at the earliest practical phase of project development, such that stormwater management priorities can be considered in to the overall layout and planning of the site.
- All site design BMPs and source control BMPs that are applicable and feasible for the project must be identified and implemented. Where site design and source control BMPs are determined to be not applicable or not feasible, appropriate technical documentation must be provided to justify this finding.
- Water quality and hydromodification management BMPs (if applicable) must be considered at the earliest practical phase of project development. As part of this requirement, the plan must explain how the locations determined for LID BMPs were

identified to support the use of higher priority BMP types that maximize retention of stormwater. The Project WQMP must also identify critical coarse sediment areas.

- Space constraints and overriding considerations in site layout, BMP locations, and allocated area for BMPs must be presented based on technical justifications. This is mandatory for projects seeking modification of the LID BMP selection hierarchy on the basis of space constraints.

MS4 Permit References: The MS4 Permit does not prescribe a specific approach that must be used for overall project layout and drainage planning. However, several provisions directly or indirectly relate to site design, source control, and drainage planning:

Provision E.3.a of the MS4 Permit prescribes the use of all applicable and feasible site design and source control practices and identifies general requirements for all development projects.

Provision E.3.c(1) prescribes structural LID BMP selection and sizing requirements and directs the Model WQMP and TGD (collectively the "BMP Design Manual") to provide guidance and criteria for determining feasibility of retention BMPs and design of biofiltration BMPs to maximize stormwater retention and pollutant removal. This Model WQMP and TGD identify the role of site design and drainage planning efforts, including decisions about BMP siting and space availability, as integral elements of determining feasibility of retention BMPs and design of biofiltration BMPs to maximize stormwater retention and pollutant removal. In other words, it is not possible for a project applicant to justify decisions about LID BMP selection without also documenting the site design and BMP siting process that is integral to these decisions.

Provision E.3.c(2) requires the identification and avoidance or mitigation of critical coarse sediment areas. Identification of these areas and efforts to avoid impacts to sediment from these areas must be conducted as part of site design and drainage planning.

TGD Reference: Section 2.4 identifies expected activities and Project WQMP content.

2.5. Low Impact Development BMPs

Core Requirements: The Project WQMP shall document that the following narrative and numeric requirements for LID BMPs are satisfied. These core requirements include additional criteria beyond what is defined in the corresponding MS4 Permit provisions which are expected to result in equal or better performance than BMPs designed per the minimum MS4 Permit requirements. *Note: These requirements are referred to as "Storm Water Pollutant Control BMP Requirements" in the MS4 Permit but are referred to as "LID BMP Requirements" in this Model WQMP and TGD.*

LID BMP Selection and Sizing

LID BMPs must be selected and sized to maximize volume retention and pollutant retention according to the specific hierarchy described below.

LID BMPs must be implemented that are designed to retain stormwater onsite (i.e. intercept, store, infiltrate, evaporate, and/or evapotranspire) and meet one of the following equivalent criteria:

> Capture and retain the volume of stormwater runoff produced from a 24-hour 85th percentile storm event (design capture volume) **and** demonstrate that this DCV is drawn down within 48 hours or less following the end of precipitation.
>
> **OR**
>
> Capture and retain 80 percent of average annual runoff volume via either volume-based, flow-based, or combined approaches.

Where it is demonstrated based on substantial evidence that it is not feasible to fully comply with one of the sizing options above, LID BMPs must be implemented that are designed to meet the following criteria:

> 1) Maximize volume and pollutant retention through the incorporation of all the following design elements that apply:
>
> a) Use all applicable HSCs, **and**
> b) Design biofiltration BMPs with retention compartments, including gravel storage below the lowest point of treated discharge, amended soils and other features designed to achieve similar processes, where incidental infiltration is feasible. [Guidance: Where incidental infiltration is not feasible, this provision is not applicable.]
>
> **AND**
>
> 2) Size biofiltration BMPs to meet one of the following criteria:
>
> a) Biofilter 1.5 times the portion of the DCV that is not reliably retained.
> **OR**
> b) Determine the size required to capture and retain or biofilter 80 percent of average annual runoff volume, and apply a multiplier of 1.5 to the resultant required volume and footprint.
> **OR**
> c) Design a biofiltration BMP that has a static biofiltration volume (ponded water volume plus media pore spaces) of at least 0.75 times the portion of the DCV not reliably retained.

A process for determining feasibility, selecting, and design BMPs is provided in the TGD.

Section 3 of this Model WQMP describes compliance options should it be determined that it is not feasible to satisfy these criteria within the project site.

LID BMP Design

LID BMPs must be designed per accepted engineering standards and methods to:

- Provide safe and reliable operation based on actual conditions at the location of the BMP
- Avoid premature failure or nuisance conditions resulting from clogging, scour, extended standing water, or other factors, and
- Allow for inspection and maintenance activities.

As part of documenting conformance with these requirements, the Project WQMP shall provide clear and technically-based documentation of:

- Determinations of infiltration and harvesting feasibility that influence BMP selection including the relevant findings related to site investigation that support the determinations
- Sizing calculations
- Conformance with accepted design criteria or support for adaptations to achieve equivalent or better performance.
- Design checks related to clogging, scour, maintainability, and other relevant factors.

MS4 Permit Reference: Provision E.3.c(1) prescribes structural LID BMP selection and sizing requirements and directs the Model WQMP and TGD (collectively the "BMP Design Manual") to provide guidance and criteria for determining feasibility of retention BMPs and design of biofiltration BMPs to maximize stormwater retention and pollutant removal.

TGD Reference: Section 2.5 identifies expected activities and Project WQMP content associated with LID BMP selection, sizing and design. This section also provides a process for meeting these requirement and references to the specific technical criteria and methods that are expected to be used to support evaluation and documentation of compliance with these criteria.

2.6. Hydromodification BMPs

Core Requirements: The Project WQMP shall clearly identify whether hydromodification management requirements apply and provide supporting documentation of this determination including a comprehensive description of the flow path that water follows between each project discharge and the Pacific Ocean. Each reach along this flow path shall be identified as being susceptible or not susceptible to hydromodification. If hydromodification requirements apply, the Project WQMP shall document and provide supporting calculations to demonstrate that hydromodification management requirements are met. The core requirements for hydromodification management are stated below.

Hydrologic Control Requirement

All Priority Development Projects must ensure, at each point of compliance, that the post-project runoff flow rates and durations do not exceed pre-development, naturally occurring, runoff flow rates and durations by more than 10% of the time, for flow rates from 10% of the 2-year flowrate up to the 10-year flowrate. (See HMP Section 3). This must be evaluated using the South Orange County Hydrology Model which is a continuous simulation model or approved equivalent.

Coarse Sediment Management Requirement

Priority Development Projects must avoid critical sediment yield areas known by the Copermittee or identified in the Watershed Management Area Analysis, or implement measures that allow critical coarse sediment to be discharged to receiving waters, such that there is no impact to the receiving water.

MS4 Permit Reference: Provision E.3.c(2) prescribes hydromodification control performance criteria and requires the development of the HMP. It also identifies the Watershed Management Area Analysis conducted as part of the Water Quality Improvement plan as the basis for identifying exempted reaches.

Other Document References:

- The South Orange County HMP identifies performance criteria and methods associated with hydromodification management consistent with MS4 Permit requirements.
- The Watershed Management Area Analysis included as part of the Water Quality Improvement Plan identifies the current list of receiving waters that are exempt from hydromodification management requirements.
- Section 2.6 of the TGD identifies expected activities and Project WQMP content associated with hydromodification management and provides guidance for incorporating hydromodification management into BMP plans. Other sections are referenced from Section 2.6.

2.7. WQMP Preparation and Associated Exhibits

Core Requirements: The Project WQMP shall meet the following criteria:

- The Project WQMP shall adhere to a standard template or alternate organization acceptable to the reviewing jurisdiction.
- The WQMP shall document the complete BMP plan at a level of detail commensurate to the overall project design at each phase of approval, including locations and extents of source control and site design BMPs, and the location, type(s), and sizes of structural LID and hydromodification control BMPs, as applicable. Accompanying exhibits are expected to be necessary to provide this information.

- The WQMP shall clearly document conformance to each of the core requirements described in Section 2.1 through 2.6.

The following content are required for Final Project WQMPs and may also be required at with the Conceptual/Preliminary WQMP subject to the discretion of the reviewing agency:

- The Final Project WQMP shall be based on the results of design level investigations and final design parameters (if applicable)
- The Final Project WQMP shall be accompanies by design sheets and specifications that identify the precise design and details of all proposed BMPs.
- The Final Project WQMP shall be accompanied by an O&M Manual meeting the criteria identified in Section 2.8.

MS4 Permit Reference: There are not specific MS4 Permit requirements that directly prescribe Project WQMP content and review procedures. However, Provision E.3.e requires each Copermittee to implement a program that ensures that structural BMPs have implemented for Priority Development Projects consistent with MS4 Permit standards. The Project WQMP process and core requirements defined in this Model WQMP and TGD have been developed in conformance with this requirement and will be implemented by each jurisdiction as part of its development planning process.

TGD Reference: Section 2.7 identifies expected content of the Project WQMP and accompanying exhibits for Preliminary/Conceptual and Final Project WQMP submittals. Section 2.1 through 2.6 also identify expected Project WQMP content associated with each section of the Project WQMP.

2.8. Operations and Maintenance Manual and Requirements

Core Requirements: An O&M Manual must accompany the Final Project WQMP. A draft or preliminary version of the O&M Manual may be requested by the reviewing jurisdiction as part of the Conceptual/Preliminary WQMP.

The Final O&M Manual shall include:

- Identification of responsible parties
- Identification of specific and legally-binding funding mechanisms and demonstration of their adequacy
- Routine inspection and O&M activities including description of the activity, responsibilities, frequencies, and documentation requirements.
- Estimated lifespan of systems and triggers for rehabilitation or corrective maintenance activities
- Process and expected outcome of rehabilitation or corrective maintenance activities
- Emergency response activities

- Required qualifications and training requirements
- Applicable resource agency permits
- Required documentation and reporting

The reviewing jurisdiction may require other content necessary to ensure structural BMPs are adequately maintained, and continue to operate effectively to remove pollutants in storm water to the MEP. Parties responsible for the O&M plan shall retain records for at least 5 years. These documents shall be made available to the local jurisdiction for inspection upon request at any time.

MS4 Permit References: Provision E.3.c. requires that the project applicant submit proof of the mechanism under which ongoing long-term maintenance of all structural BMPs will be conducted. Provision E.3.d(4) identifies the requirement to provide Long-term maintenance criteria for each structural BMP listed in the BMP Design Manual. Provision E.3.e(3) requires each Copermittee to verify that structural BMPs on each Priority Development Project are adequately maintained, and continue to operate effectively to remove pollutants in storm water to the MEP. The requirement for an O&M Plan as part of the WQMP process is one mechanism by which this is achieved.

TGD Reference: Section 2.8 provides more detail about expected content of the O&M Manual and provides supporting guidance.

SECTION 3. ALTERNATIVE COMPLIANCE APPROACHES

3.1. Introduction

Alternative compliance refers to compliance activities conducted by choice or by necessity when the full LID and hydromodification performance criteria are not met through BMPs implemented within the Priority Development Project site. Alternative compliance generally consists of the implementing off-site projects in lieu of some or all on-site BMPs such that there is equal or greater benefit to water quality.

MS4 Permit Reference: Criteria and pathways for alternative compliance are defined in Provision E.3.c.(3) of the MS4 Permit.

3.2. Prerequisite Elements for Alternative Compliance

The MS4 Permit establishes several prerequisite efforts that must be completed prior to allowing Priority Development Projects to participate in certain alternative compliance pathways. The following sections identify these prerequisite efforts and describe the current status. This section of the Model WQMP may be updated from time to time.

3.2.1. Water Quality Equivalency Guidance

All potential alternative compliance pathways require the use of standardized water quality equivalency calculations.

On December 17, 2015, the San Diego Regional Water Quality Control Board accepted the Water Quality Equivalency Guidance Document for Region 9, including the portions of San Diego, Orange, and Riverside Counties within this region. This guidance document establishes a mechanism to correlate quantifiable Alternative Compliance Project water quality benefits with Priority Development Project water quality impacts and ultimately demonstrate that the ACP benefits outweigh the PDP impacts. Pursuant to the requirements set forth in Provision E.3.c.(3)(a) of the Permit, the methods presented within this guidance must be incorporated as part of any optional Offsite Alternative Compliance Program developed by a Copermittee or Project Applicant Proposed Alternative Compliance Projects allowed by the Copermittee.

The Water Quality Equivalency Guidance Document is available at this link: http://www.projectcleanwater.org/index.php?option=com_content&view=article&id=252&Itemid=210

3.2.2. Watershed Management Area Analysis

The Watershed Management Area Analysis conducted as part of the Water Quality Improvement Plan can identify candidate projects to which a project applicant could agree to fund, contribute funds to, or implement.

At this time, the Watershed Management Area Analysis does not define specific candidate projects. Therefore, alternative compliance pathways that rely on this prerequisite are cannot be allowed. Candidate projects may be included in subsequent updates of the Watershed Management Area Analysis.

3.2.3. In Lieu Fee Structure

If a Copermittee chooses to allow a Priority Development Project applicant to fund or partially fund a candidate project or an alternative compliance project, then the Copermittee must develop and implement an in-lieu fee structure. This may be developed individually or with other Copermittees and/or entities.

At this time, an in-lieu fee structure has not been developed. Project applicants are therefore not allowed to fund or partially fund an alternative compliance project. An in-lieu fee structure is not required for all ACP pathways.

3.2.4. Alternative Compliance Water Quality Credit System Option

The Copermittee may develop and implement an alternative compliance water quality credit system option, individually or with other Copermittees and/or entities, subject to review and acceptance by the Executive Officer as part of the Water Quality Improvement Plan or updates to this Plan. At this time, a water quality credit system option has not been developed and project are therefore not allowed to comply via the use of water quality credits.

3.3. Alternative Compliance Pathways Currently Available

At the discretion of each Copermittee, Priority Development Projects may be allowed to participate in an alternative compliance program as a means of reducing the required implementation of on-site structural BMPs. Based on the current status of prerequisite elements described in Section 3.2, the following subsection describes the alternative compliance pathway that may currently be acceptable, at the discretion of each Copermittee.

3.3.1. Project Applicant Proposed Alternative Compliance Projects

The Copermittee may allow a Priority Development Project applicant to propose and implement an alternative compliance project. This option is allowed provided the Copermittee determines that implementation of the alternative compliance project will have a greater overall water quality benefit for the Watershed Management Area than fully complying with the LID and hydromodification requirements on-site. Additionally, this pathway is subject to all of the following criteria:

- If the Priority Development Project applicant chooses to implement an applicant-proposed alternative compliance project, the project applicant must enter into a voluntary agreement with the Copermittee agreeing to this arrangement.

- The voluntary agreement to implement the alternative compliance project must include reliable sources of funding for operation and maintenance of the applicant-proposed project.
- The project applicant must provide adequate documentation, consistent with the Water Quality Equivalency Guidance Document and acceptable to the reviewing jurisdiction, demonstrating that that pollutant control and/or hydromodification management within the proposed alternative compliance project are sufficient to mitigate for impacts caused by not implementing structural BMPs fully on-site.
- Design of the applicant-proposed alternative compliance project must be conducted under an appropriately qualified engineer, geologist, architect, landscape architect, or other professional, licenses where applicable, and competent and proficient in the fields pertinent to the candidate project design.
- The applicant-proposed alternative compliance project must be completed prior to or concurrent with the first proposed Priority Development Project that will rely on it such that the alternative compliance project is operational prior to the certificate of occupancy of the Priority Development Project.

Note that these criteria are someone more stringent than the MS4 Permit in that they require the alternative compliance project to be completed at the same time or in advance of Priority Development Project relying on this project.

Additional Requirement to Provide Treatment Prior to Discharge to Waters of the US

If a Priority Development Project is allowed to utilize alternative compliance, treatment control BMPs must be implemented to treat the portion of the design capture volume that is not reliably retained onsite prior to discharge to Waters of the US.

Where the proposed alternative compliance project is located such that stormwater runoff from the Priority Development Project will be treated by the alternative compliance project prior to discharge to Waters of the US, separate requirements for treatment control BMPs do not apply. The requirement to treat stormwater is satisfied through treatment provided within the alternative compliance project. At the discretion of the Copermittee the project applicant may still be required to provide pre-treatment prior to discharge of water from the Priority Development Project site.

Where the proposed alternative compliance project is located such that the alternative compliance project treats a different drainage area than where the Priority Development Project is located, then separate treatment control BMPs are required for the Priority Development Project prior to discharge to Waters of the US. The amount of pollutants retained onsite via treatment control BMPs can be credited to reduce the amount of pollutant load reduction required to be achieved through the alternative compliance project.

Where flow thru treatment control BMPs are required to be used, they must be sized and designed to:

- Remove pollutants from storm water to the MEP;
- Filter or treat either:
    - the maximum flow rate of runoff produced from a rainfall intensity of 0.2 inch of rainfall per hour, for each hour of a storm event, or
    - the maximum flow rate of runoff produced by the 85th percentile hourly rainfall intensity (for each hour of a storm event), as determined from the local historical rainfall record, multiplied by a factor of two;
    - the required flowrate to result in capture of 80 percent of average annual runoff volume after accounting for the portion of the DCV retained on site.
- Be ranked with high or medium pollutant removal efficiency for the Priority Development Project's most significant pollutants of concern.

Guidance for sizing and design of treatment control BMPs is provided in Section 4.3.7 of the TGD.

3.4. Potential Future Alternative Compliance Pathways

In the future, subject to optional completion of the prerequisite activities defined in Section 3.2, additional options may become available for alternative compliance, including:

- Implementing candidate projects that were identified as part of a Watershed Management Area Analysis
- Funding or partially funding candidate projects from a Watershed Management Area Analysis via an in-lieu fee structure
- Funding or partially funding project applicant-proposed alternative compliance projects
- Participating in a water quality credit system option

SECTION 4. WQMP REVIEW AND VERIFICATION PROCESS

4.1. Overview

This section describes the process for local jurisdiction review, approval, and verification of the Project WQMP at each stage of project approval.

Project proponents are strongly encouraged to incorporate site design, source control, LID and hydromodification control BMPs, as applicable, at the earliest conceptual planning stages of a project for early review, to potentially avoid necessary project changes and delays during the subsequent review and approval process.

For all projects requiring discretionary or land use entitlement actions, a Conceptual or Preliminary WQMP should be submitted as part of the application for project approval during the environmental review phase (CEQA) and must be submitted prior to relevant project-level approval of entitlements and Planning Commission approval of a project or other public hearing.

The local jurisdiction will require that a final Project WQMP is submitted for review and approval prior to issuance of grading or building permits. The final Project WQMP must be prepared by or under the direction of a California Registered Civil Engineer and affixed with their stamp unless specifically exempted from this requirement by the local jurisdiction.

Prior to closeout of permits and issuance of certificates of use and occupancy, the local jurisdiction will require verification that BMPs have been implemented consistent with the Final Project WQMP and maintenance agreements associated with implementation of the O&M Plan have been executed.

4.2. Required Certifications for Preparation and Review of Project WQMPs

The following bullets identify required certifications associated with preparation, review, and verification of Project WQMPs:

- Project WQMPs must be prepared by or under the supervision of a California Registered Civil Engineer or licensed landscape architect.
- The Final Project WQMP must be prepared by or under the direction of a California Registered Civil Engineer and affixed with their stamp unless specifically exempted from this requirement by the local jurisdiction
- Supporting disciplines for WQMP preparation (e.g., geotechnical engineers, geologies, hydrogeologist) are required to have appropriate qualifications and registrations based on the nature of the support that is provided.

- Final project WQMPs must be approved by or under the supervision of a California Registered Civil Engineer acting on behalf, and with the expressed permission, of the Copermittee.
- As part of final approval and project closeout, BMP must be certified as constructed, serviceable, and satisfactory to the Copermittee or otherwise certified as such by a licensed professional engineer and by the project applicant.

4.3. Conceptual or Preliminary WQMP Stage

To facilitate early water quality planning and ensure that water quality protection and LID principles are considered in the earliest phases of a project, the local jurisdiction will recommend or require that the project proponent prepare a Conceptual or Preliminary WQMP prior to a complete or final Project WQMP for full review and approval. A Conceptual or Preliminary WQMP may be used by the local jurisdiction during the land use entitlement process or as part of a project application for discretionary project approval.

A Conceptual or Preliminary WQMP supports the CEQA process and provides documentation to support a checklist for an Initial Study and Negative Declaration or Mitigated Negative Declaration, or serves as the basis for the water quality section of an EIR. It should also serve as the basis for the Lead Agency and Responsible Agency to conclude that the MEP standard is being met, by serving as the basis that selected BMPs will not have the potential to cause significant effects and/or that the effects have been mitigated, and "are not significant with mitigation". The Conceptual or Preliminary WQMP should to be circulated with the CEQA document or summarized within the circulated CEQA document.

The level of detail in a Conceptual or Preliminary WQMP can vary somewhat upon the level of detail known at the time discretionary project approval is sought. Expected content is identified in Section 2.7 of the TGD.

Local jurisdiction staff will review and evaluate the Conceptual / Preliminary Project WQMP for general acceptance and conceptual or preliminary approval, and will offer guidance toward plan elements necessary for approval of the full Project WQMP. Additional information and submittals may be necessary for conceptual or preliminary approval. It is the responsibility of the project proponent to provide the additional information for consideration by the local jurisdiction.

If additional site investigation will be conducted following discretionary approval, the Conceptual/Preliminary Project WQMP should identify contingency elements that could be activated based on this information. Consideration of both the primary plan as well as contingency plans as part of the CEQA process can provide the flexibility to adapt the BMP plan based on additional information following discretionary approval.

4.4. Final Project WQMP Stage

A completed Final Project WQMP must fully detail site design, source control, LID, hydromodification BMPs (where applicable to the project) and be accompanied by a BMP plan and BMP details that define specifically how the required BMPs are incorporated into the project precise grading plans.

The Final Project WQMP, when prepared for submittal for approval, must be certified by the owner, and must include elements agreed upon at Conceptual or Preliminary WQMP acceptance and any revisions proposed.

The Final Project WQMP must be consistent with the Conceptual or Preliminary WQMP. If there are any substantial differences, the local jurisdiction must make a determination that the differences do not diminish the effectiveness of the BMPs to mitigate or address the project's potential impacts to water quality. Furthermore, any changes must not result in any new environmental impacts not previously disclosed in the local jurisdiction's circulated environmental document(s). If the changes diminish the project's ability to mitigate or address its water quality impacts, or result in previously undisclosed environmental impacts, the local jurisdiction should require that the project be subject to further environmental review.

Section 2.7 of the TGD identifies expected content for Final Project WQMPs.

The completed Project WQMP is to be submitted to the local jurisdiction for review and approval. Any changes to WQMP elements agreed upon at the Conceptual or Preliminary WQMP phase should be noted within the Project WQMP submitted for final approval.

Local jurisdiction staff will review the submittal for acceptance and approval. Reviews will be documented by the local jurisdiction. Additional information and submittals may be necessary for final approval. It is the responsibility of the project proponent to provide the additional information for consideration by the local jurisdiction.

Once a project reaches the plan check phase for construction plans, the project proponent must submit a completed Project WQMP. The plan checker must be able to verify that the construction plans submitted by the project proponent for plan check incorporate all of the structural BMPs identified in the Project WQMP. Local jurisdictions may encourage (but not necessarily require) project proponents to obtain approval of the Final Project WQMP prior to submitting construction plans for plan check. Building or grading permits will not be issued until the Project WQMP has been submitted and approved.

The Final Project WQMP may require certain construction-phase testing, such as infiltration testing in the as-graded condition. Any contingencies associated with construction phase testing must be detailed in the Final Project WQMP and reflected in construction plans and specifications. This is particularly relevant for BMPs that rely solely on infiltration. Proof of operation should be provided as part of project verification, which may including measurement

of actual infiltration rates depending on conditions of approval deemed appropriate by the reviewing agency. Therefore, project construction plans may require the ability to adapt to lower infiltration rates, such as by providing a greater footprint or converting to biofiltration with partial infiltration, should infiltration rates be less than used in design calculations.

4.5. Permit Closeout Requirements

The local jurisdiction will be responsible for determining that all requirements of the Project WQMP have been satisfactorily completed prior to close-out of permits and issuance of certificates of use and occupancy.

For discretionary projects, the method approved by local jurisdiction for stormwater BMP maintenance shall be incorporated into the project's permit, and shall be consistent with permits issued by resource agencies, if any.

For projects requiring only ministerial permits, the method approved by local jurisdiction for stormwater BMP maintenance shall be shown on the project plans before the issuance of any ministerial permits. Verification will occur similar to discretionary projects.

In all instances, the project proponent shall provide proof of execution of a method approved by local jurisdiction for maintenance, repair, and replacement before the issuance of construction approvals, permit closeout and issuance of certificates of use and occupancy.

For all projects, the verification mechanism includes the project proponent's signed statement, as part of the Project WQMP, accepting responsibility for all structural BMP maintenance, repair and replacement or agreeing to an alternative mechanism that is approved by the local authority regarding maintenance, repair and replacement of the structural BMP. Local authorities implementing public projects that are not required to obtain permits shall be responsible for ensuring that stormwater BMP maintenance, repair and replacement requirements are identified prior to the completion of construction and incorporated into the agency's Municipal Activities Program under the DAMP

As a condition of permit closeout, project proponent shall create an as-built version of the BMP plans and details to include with the Final Project WQMP and O&M Plan.

4.6. WQMP Recordation and Transfer

The Project WQMP, O&M Plan, BMP plan, and relevant as-built sheets will be stored within local jurisdiction files, and will continue with the property after the completion of the construction phase, and a local jurisdiction may require that the terms, conditions and requirements be recorded with the County Recorder's office by the property owner or any successive owner as authorized by the Water Quality Ordinance. In lieu of recordation, a local jurisdiction may require the Project WQMP to include a Notice of Transfer Responsibility Form,

which serves to notify the local jurisdiction that a change in ownership has occurred and notify the new owner of its responsibility to continue implementing the Project WQMP.

4.7. Updates to Project WQMPs and O&M Plans

Over the course of ongoing implementation of a Project WQMP, changes may occur that materially affect the content of the WQMP and associated O&M Plan.

The Project WQMP or associated conditions of approval should describe the requirement for the owner to seek approval from the reviewing jurisdiction for any substantive changes to BMPs or site uses that affect BMPs.

4.7.1. Changes in Ownership or Maintenance Responsibility

Changes in ownership or maintenance responsibility should be recorded using processes deemed appropriate by each jurisdiction with responsibility for the Project WQMP.

4.7.2. Changes in Site Uses

Changes in site uses do not typically trigger a process for requiring the use of different structural BMPs. However, where the change in use results in a change in classification as part of the commercial or industrial inspection program, additional or revised BMPs may be required through those programs.

4.7.3. Minor Changes in BMPs

Minor changes to the BMPs do not typically trigger a full revision and review of the Project WQMP. Minor changes could include activities such as:

- Minor revisions to BMP design details implemented as part of maintenance or rehabilitation efforts that are intended to improve operations or provide equivalent performance.
- Replacement of a proprietary BMP model with an equivalent proprietary BMP model that has the same level of third party certifications, consistent with Appendix J of the TGD.
- Minor changes in land cover tributary to a BMP, such that the total percent imperviousness does not change by an appreciable amount and does not otherwise trigger a WQMP or NPP WQP.

Prior to being implemented, any substantive change to the stormwater treatment approach change must be determined to have de minimus impact on stormwater quality and BMP operational requirements and documentation of this change must be recorded with the Project WQMP. The process of approving and memorializing these changes is as follows:

- The project owner should provide a letter transmittal and supporting information to describe the change and why it is not significant.

- This letter transmittal should be subject to review and approval by the Copermittee and should be filed with the Project WQMP and O&M Plan.
- If approval is granted, then the change may be implemented. The documentation of this change and the review of this change should be recorded with the Project WQMP

Each Copermittee has discretion to develop a process for reviewing and documenting minor changes to WQMPs.

4.7.4. Significant Changes in BMPs

Changes to the site or BMPs that have significant potential to change site runoff water quality and/or BMP design and operations include, but are not limited to:

- Changes in BMP locations, tributary areas, or sizes
- Significant changes in site land cover
- Changes in BMP types or major redesign of BMPs

These types of changes will typically require an update to the Project WQMP at the discretion of the Copermittee. If there are new potential impacts that qualify as a significant project under CEQA, then a discretionary approval process may be required.

4.8. Guidance Specific to Phased Projects

This section provides guidance for projects that are implemented in a phased approach.

4.8.1. Tiered Approvals at Multiple Scales

This section covers the scenario in which the Conceptual/Preliminary WQMP may be processed at a larger scale (e.g., a tract map) as part of discretionary approval. Subsequently, Final Project WQMPs may be processed for smaller planning areas or parcels within this overall project that was considered for discretionary approval. I this scenario, there would be multiple Final Project WQMPs within the project that was initial considered in the Conceptual Preliminary WQMP.

In any instance, each Final Project WQMP needs to stand alone and satisfy the respective portions of the overall project commitments that were considered as part of discretionary approval. Additionally, phased completion must always result that the overall project is in compliance with applicable criteria such that if a phased project was only partially completed, the completed portions would be in full compliance. The reviewing jurisdiction may impose additional requirements on phased projects to account for phasing issues.

The following guidelines apply to this case:

- Proposed LID and hydromodification BMPs must be demonstrated to comply with applicable criteria for the overall project at ultimate completion as well as at the time of

completion of each phase (i.e., the current phase plus previously completed phases). A tract-scale BMP planning approach could be used such that centralized LID and hydromodification BMP(s) serve multiple planning areas or parcels that are covered by individual Final Project WQMPs. If this approach is used, any centralized BMP needs to be constructed and verified operational with an executed maintenance agreement prior to occupancy and permit closeout of the first Final Project WQMP that relies on this system.

- The risk of sediment generation from the remaining tributary areas undergoing construction must be carefully considered; disturbed areas must be managed with applicable construction phase controls and routed separately during the construction phase such that no construction-phase stormwater enters the post-construction BMP.
- Where Final Project WQMP approval will occur at a finer scale than Conceptual/Preliminary WQMP approval, the quantity of BMPs attributable to each planning area or parcel must be defined in the Conceptual/Preliminary WQMP at the discretionary planning stage; this quantity of BMPs must be demonstrated to be provided in each Final Project WQMP for the respective planning area(s) or parcel(s) it covers.
- Where multiple phases will rely on a centralized facility, the maintenance funding mechanism must be adequate to provide O&M of the centralized facility even if all phases are not completed as planned.

4.8.2. Phased Completion of a Single Project

This section covers the scenario in which the Conceptual/Preliminary and Final Project WQMPs are prepared at the same scale, but portions of the project are proposed to be completed and placed into use prior to completion of the full project.

In any instance, the project needs to meet LID and hydromodification BMP requirements on a standalone basis at the time each portion of the project is placed into use such that if a phased project was only partially completed, the completed portions would be in full compliance. The reviewing jurisdiction may impose additional requirements on phased projects to account for phasing issues.

The following guidelines apply to this case:

- The proposed phase completion needs to be clearly defined in the Project WQMP.
- Proposed LID and hydromodification BMPs must be demonstrated to comply with applicable criteria for the overall project at ultimate completion as well as at the time of completion of each phase (i.e., the current phase plus previously completed phases).
- At the time of completion of each phase, the full suite of BMPs serving that phase must be completed and verified. The Final Project WQMP must identify the responsible parties for inspection and maintenance of BMPs during this interim condition. O&M activities must commence at the time post-construction BMPs are placed into service to serve the completed phase.

- Construction phase erosion and sediment must be managed with appropriate construction phase BMPs and must never be allowed to drain to completed post-construction BMPs that are serving completed phases.
- Where multiple phases will rely on a centralized facility, the maintenance funding mechanism must be adequate to provide O&M of the centralized facility even if all phases are not completed as planned.

4.8.3. Interim Uses During Construction Phase

This section covers the scenario in which planned interim uses of portions of the project have characteristics similar to final uses but that occur on a temporary basis as part of the construction phase of the overall project. For example, completion and showing of model homes on a portion of a site or completion of portions of the road network may have resemblance to final uses but occur on a temporary basis during the overall construction phase of the site.

Where a local jurisdiction requires that a certificate of use or occupancy is required to allow for the interim use to occur, then all post-construction BMPs serving the portion of the project must be placed into service and verified before this certificate of occupancy or use can be issued.

If a certificate of occupancy or use is not required for the interim uses to occur, the following guidelines apply to this case:

- Any proposed interim uses and time limits on these uses should be described in the planning and design documents considered as part of discretionary approval. An interim use should not be allowed on a perpetual basis.
- The construction phase stormwater pollution prevention plans should identify these interim uses and determine if specific construction phase BMPs are necessary to address potential water quality impacts associated with these uses. This should be verified by the permittee through a separate review process.
- Post-construction site design and source control BMPs should be put into service as part of the interim use, as applicable. In cases where LID or hydromodification BMPs serve the portion of the project proposed for the interim use (but not other areas undergoing construction), these BMPs should be put into service as part of the interim use.
- In no instance shall post-construction BMPs be placed into service that receive runoff from areas of the site undergoing construction.

EXHIBIT 7.III

TECHNICAL GUIDANCE DOCUMENT (TGD)

FOR THE PREPARATION OF CONCEPTUAL/PRELIMINARY AND/OR PROJECT WATER QUALITY MANAGEMENT PLANS (WQMPs)

in South ORANGE COUNTY

April 1 2017

SECOND DRAFT FOR REVIEW

Version Notes:

This release of the TGD is intended to be used to support project development in South Orange County. In combination with the Model WQMP, this document is intended to serve as the "Model BMP Design Manual" for South Orange County pursuant to the requirements of the San Diego Regional MS4 Permit (Order No. 2013-0001 as amended by Orders 2015-0001 and 2015-0100).

THIS DOCUMENT IS NOT FOR USE IN NORTH ORANGE COUNTY AT THIS TIME. A subsequent reissuance of this TGD is anticipated in the future to support project development in North Orange County upon adoption of the 5th Term MS4 Permit in the North Orange County Region. To aid in the future incorporation of the North Orange County MS4 Permit into this TGD once the new permit is adopted, placeholders have been incorporated throughout the TGD for the subsections, figures, tables, and appendices specific to North Orange County.

TABLE OF CONTENTS

SECTION 1. INTRODUCTION AND PROJECT APPLICABILITY CRITERIA 1-1
1.1. Orientation and How to Use this Document 1-1
1.1.1. What is a WQMP? 1-1
1.1.2. What types of projects require WQMPs? 1-1
1.1.3. Why is a WQMP required? 1-1
1.1.4. Which MS4 Permit Applies to a Project Site? 1-2
1.1.5. Who reviews WQMPs? 1-4
1.1.6. How should a WQMP be developed? 1-4
1.1.7. When should a WQMP first be prepared? 1-4
1.1.8. What is the difference between a Conceptual/Preliminary and Final Project WQMP? 1-5
1.1.9. What requirements are associated with a Project WQMP? 1-5
1.1.10. What requirements are associated with a Non Priority Project? 1-6
1.1.11. How should a project applicant use this TGD? 1-6
1.1.12. How do the various planning documents relate to each other? 1-6
1.2. Project Categorization to Determine Applicable Requirements 1-7
1.2.1. Overall Project Categories 1-7
1.2.2. General Criteria for Defining Priority Projects 1-8
1.2.3. Specific Criteria for Priority Project Categories in North Orange County 1-9
1.2.4. Specific Criteria for Priority Project Categories in South Orange County 1-9
1.2.5. Special Considerations and Common Issues with Project Categorization 1-12
1.3. Types and Applicability of Stormwater Best Management Practices 1-15
1.4. BMP Selection and Integration Principles 1-16
1.4.1. Integration of BMP Types 1-16
1.4.2. Use of Effective, Applicable and Feasible BMPs 1-17
1.4.3. Focus on Resiliency, Adaptability and Long Term O&M 1-18
1.5. Limits in Scope of the Technical Guidance Document 1-19
1.6. Organization of the Technical Guidance Document 1-20

SECTION 2. TECHNICAL GUIDANCE FOR PREPARING PROJECT WQMPS 2-1
2.0 Section Orientation and Stepwise Process 2-1
Frequent Questions 2-6
2.1. Step 1: Document Discretionary Permits and Water Quality Conditions 2-9
2.2. Step 2: Document the Project Description 2-10
2.3. Step 3: Characterize the Site and Watershed 2-10
2.3.1. Characterize Site Conditions 2-11
2.3.2. Characterize the Proposed Site Development Activities 2-19
2.3.3. Identify Receiving Waters 2-21
2.3.4. Determine Pollutants of Concern 2-21

2.3.5. Determine Potential Hydrologic Conditions of Concern 2-30
2.4. Step 4: Develop Site Design and Drainage Plan 2-34
2.4.1. Regulatory Criteria Applicable to Site Design and Drainage Planning 2-34
2.4.2. Expected WQMP Content 2-34
2.4.3. Guidelines and Techniques for Site Design and Drainage Planning 2-36
2.5. Step 5: Select, Size, and Design LID BMPs for Each Drainage Management Area 2-41
2.5.1. LID Selection and Sizing Criteria 2-42
2.5.2. LID Selection and Sizing Process 2-45
2.5.3. Expected WQMP Contents 2-49
2.5.4. Detailed Guidance on LID BMP Selection, Sizing and Design 2-51
2.5.5. Frequent Questions 2-51
2.6. Step 6: Select, Size and Design Hydromodification BMPs 2-53
2.6.1. Hydromodification Management Criteria 2-53
2.6.2. Design Resources and Examples 2-54
2.6.3. Expected WQMP Content 2-54
2.7. Step 7: Prepare WQMP and Associated Exhibits 2-56
2.7.1. Expected WQMP Content 2-56
2.7.2. Site Plan and Drainage Plan Sheet Set 2-56
2.8. Step 8: Prepare O&M Plan (Final Project WQMPs Only) 2-57
2.8.1. Expected O&M Manual Contents 2-58
2.8.2. Operation and Maintenance Activities 2-59
2.8.3. Roles and Responsibilities 2-60
2.8.4. Maintenance Mechanisms 2-61
2.9. Incorporating USEPA Green Streets Guidance to the MEP 2-62
2.9.1. Regulatory Context 2-63
2.9.2. Site and Watershed Assessment Considerations for Applicable Green Streets Projects 2-63
2.9.3. Site Design and Drainage Plan for Applicable Green Streets Projects 2-64
2.9.4. Selecting LID BMPs for Green Streets Projects 2-64
2.9.5. LID BMP and Hydromodification Sizing for Applicable Green Streets Projects. 2-66
2.9.6. Alternative Compliance Options for Applicable Green Streets Projects 2-67

SECTION 3. SITE DESIGN PRINCIPLES AND TECHNIQUES 3-1
3.1. Introduction 3-1
3.2. Site Planning and Layout 3-1
3.2.1. Minimize Impervious Area 3-1
3.2.2. Maximize Natural Infiltration Capacity 3-3
3.2.3. Preserve Existing Drainage Patterns and Time of Concentration 3-3
3.2.4. Disconnect Impervious Areas 3-4
3.3. Vegetative Protection, Selection Revegetation, and Soil Stockpiling 3-6

3.3.1. Protect Existing Vegetation and Sensitive Areas 3-6
3.3.2. Revegetate Disturbed Areas 3-7
3.3.3. Soil Stockpiling and Site Generated Organics 3-7
3.3.4. Firescaping 3-8
3.3.5. Water Efficient Landscaping 3-9
3.4. Slopes and Channel Buffers 3-10
3.5. Techniques to Minimize Land Disturbance 3-11
3.6. Integrated Water Resource Management Practices 3-13

SECTION 4. LID BMP SELECTION AND DESIGN 4-1
4.1. Introduction 4-1
4.2. LID BMP Selection 4-1
4.2.1. Detailed Process for LID BMP Selection 4-1
4.2.2. Infiltration Feasibility Criteria 4-4
4.2.3. Harvest and Use Feasibility Criteria 4-19
4.2.4. Demonstrated Space Constraints and Influence on LID BMP Selection 4-19
4.3. LID BMP Sizing and Design References 4-24
4.3.1. Hydrologic Source Controls 4-24
4.3.2. Fact Sheets for Miscellaneous Design Elements 4-26
4.3.3. Full Infiltration BMPs 4-26
4.3.4. Harvest and Use BMPs 4-28
4.3.5. Biotreatment BMPs with Partial Infiltration 4-29
4.3.6. Biotreatment BMPs without Infiltration 4-35
4.3.7. Treatment Control BMPs 4-35
4.4. Supplemental LID BMP Design Guidance 4-38
4.4.1. Clogging of Infiltration and Filtration Systems 4-38
4.4.2. Selection of Pretreatment BMPs 4-40
4.4.3. Design for Maximizing Incidental Volume Reduction in Biofiltration BMPs 4-42
4.4.4. Design for Trash Capture 4-42
4.4.5. Design to Accommodate Off-site Run-on 4-43
4.4.6. Design to Facilitate BMP Design and Maintenance 4-43
4.4.7. BMP Design Considerations for Facilities Built at a Larger Scale 4-45
4.4.8. Additional Design Guidance Materials 4-47

SECTION 5. HYDROMODIFICATION CONTROL SELECTION AND DESIGN 5-1
5.1. Introduction 5-1
5.2. General Guidelines for Hydromodification Design 5-2
5.3. Hydromodification Design Approaches in North Orange County 5-6
5.4. Hydromodification Design Approaches in South Orange County 5-6
5.4.1. Approach 1: Demonstrate that LID BMPs Eliminate HCOCs 5-7

5.4.2. Approach 2: Provide Supplemental Infiltration or Flow Duration Control within Combined Facilities 5-7
5.4.3. Approach 3: Provide Separate LID and Flow Duration Control Systems 5-8
5.4.4. Mitigate Impacts to Critical Coarse Sediment Yield Areas 5-8
5.5. Hydromodification Control BMP Types 5-9
5.5.1. On-Site / Distributed Controls 5-9
5.5.2. Combination Basins 5-9
5.5.3. Flow Control Basins or Vaults 5-9
5.5.4. In-Stream Controls 5-9

SECTION 6. SOURCE CONTROL MEASURES 6-1
6.1. Introduction 6-1
6.2. Non-Structural Measures 6-1
6.3. Structural Measures 6-4
6.3.1. S1 (SD-13) Provide Storm Drain System Stenciling and Signage 6-4
6.3.2. S2 (SD-34) Design Outdoor Hazardous Material Storage Areas to Reduce Pollutant Introduction 6-5
6.3.3. S3 (SD-32) Design Trash Enclosures to Reduce Pollutant Introduction 6-5
6.3.4. S4 (SD-12) Use Efficient Irrigation Systems and Landscape Design 6-6
6.3.5. Dry Weather Flow Source Prohibition for Areas Not Draining to LID BMPs 6-7
6.3.6. S5 Protect Slopes and Channels 6-7
6.3.7. S6 (SD-31) Loading Dock Areas 6-7
6.3.8. S7 (SD-31) Maintenance Bays 6-8
6.3.9. S8 (SD-33) Vehicle Wash Areas 6-8
6.3.10. S9 (SD-36) Outdoor Processing Areas 6-9
6.3.11. S10 Equipment Wash Areas 6-9
6.3.12. S11 (SD-30) Fueling Areas 6-10
6.3.13. S12 (SD-10) Site Design and Landscape Planning (Hillside Landscaping) 6-10
6.3.14. S13 Wash Water Controls for Food Preparation Areas 6-10
6.3.15. S14 Community Car Wash Racks 6-10
6.4. Municipal Non-Structural Source Control Measures 6-11

APPENDICES

Appendix A. Examples of Integrating LID and Hydromodification Requirements in North Orange County (Placeholder)

Appendix B. Examples of Integrating LID and Hydromodification Requirements in South Orange County

Appendix C. Groundwater-Related Infiltration Feasibility Criteria

Appendix D. Infiltration Rate Evaluation Protocol and Factor of Safety Recommendations

Appendix E. Hydrologic Calculations and Sizing Methods for LID and Treatment Control BMPs

Appendix F. Harvest and Use Demand Calculations and Design Considerations

Appendix G. BMP Fact Sheets

Appendix H. Technical Basis for Green Roof Design Criteria

Appendix I. Guidelines for Use of Dry Wells in Stormwater Management Applications

Appendix J. Proprietary BMP Acceptance Process

Appendix K. Approved Methods for Quantifying Hydrologic Conditions of Concern (North Orange County) (Placeholder)

Appendix L. Placeholder for South Orange County Hydromodification Content if Needed

Appendix M. Worksheets

Appendix N. Map Exhibits

TABLES

Table 1-1: Division of Permit Areas 1-3

Table 1-2. Intended Purpose and Integration of Planning Documents 1-7

Table 1-3. Categories of BMP Requirements and Project Type Applicability 1-15

Table 2-1. WQMP Preparation Steps, Key Efforts, and Expected Outcomes 2-2

Table 2-2. Expected Activities and WQMP Content for Investigation of the Existing Site 2-11

Table 2-3: Anticipated and Potential Pollutants Generated by Land Use Type 2-25

Table 2-4: Summary of the Approved 2010 303(d) Listed Water Bodies and Associated Pollutants of Concern for North Orange County 2-27

Table 2-5: Summary of the Approved 2010 303(d) Listed Water Bodies and Associated Pollutants of Concern for South Orange County 2-27

Table 2-6: Summary of the Status of TMDLs for Waterbodies in Regions 8 (NOC) and 9 (SOC). 2-28

Table 2-7. Expected Activities and WQMP Content for Development of Site Design and Drainage Plan 2-35

Table 2-8. Approximate (Rule of Thumb) Space Requirements for Structural BMPs for the Purposes of Preliminary Site Layout 2-39

Table 2-9. Menu of LID BMPs Appropriate for Each Infiltration Feasibility Category 2-48

Table 2-10. Expected WQMP Content for LID BMP Selection and Sizing 2-49

Table 2-11. Expected WQMP Content for Hydromodification Design. (Content for NOC included only as placeholder for future update of this TGD upon adoption of the 5th Term NOC MS4 Permit) 2-54

Table 2-12. Expected O&M Manual Content 2-58

Table 2-13: Potential BMPs for Applicable Green Streets Projects 2-65

Table 4-1. Definition of Infiltration Feasibility Categories 4-4

Table 4-2: Definition of Project Size Categories 4-19

Table 4-3: Default Space Allocations for LID BMPs by Project Type in Absence of Project-Specific Findings 4-22

Table 4-4. Potential Contingency Design Elements for Infiltration BMPs in Marginal or Uncertain Conditions 4-28

Table 4-5: Relative Treatment Performance Rates for Biotreatment BMPs....4-32

Table 4-6: Pollutants Addressed by Unit Operations and Processes....4-34

Table 4-7: Relative Treatment Performance Ratings of Treatment Control BMPs 4-37

Table 4-8. Pretreatment Options and Descriptions 4-41

Table 4-9: BMP Reference Manuals for BMP Design Guidance 4-48

Table 5-1. Guidelines for Selecting Hydromodification Design Approach in NOC 5-6

Table 5-2. Guidelines for Selecting Hydromodification Design Approach in SOC....5-6

FIGURES

Figure 1-1: General Hierarchy of LID BMPs 1-17

Figure 2-1. DMA Delineation 2-38

Figure 2-2. Overview of LID BMP Selection Process 2-47

Figure 4-1: LID BMP Selection and Sizing Flow Chart....4-3

ACRONYMS

BMP – Best Management Practice
CEQA - California Environmental Quality Act
CMF – Cartridge Media Filtration
CWA – Federal Clean Water Act
DAMP – Drainage Area Management Plan
DCIA – Directly Connected Impervious Area
DCV – Design Capture Volume
DCF – Design Capture Flow
DWF – Dry Weather Flow
DEDB – Dry Extended Detention Basin
ESA – Environmentally Sensitive Area
ET – Evapotranspiration
HCOC – Hydrologic Condition of Concern
HMP – Hydromodification Management Plan
HSC – Hydrologic Source Control
EIATA – Effective Irrigated Area to Tributary Area
IRWMP – Integrated Regional Water Management Plan
LID – Low Impact Development
LIP – Local Implementation Plan
MEP – Maximum Extent Practicable
MS4 – Municipal Separate Storm Sewer System
NOC – North Orange County (Region 8- SARWQCB Jurisdictional Area)
NPDES – National Pollutant Discharge Elimination System
NPP – Non-Priority Project
NTS – Natural Treatment Systems
OCWD – Orange County Water District
POC – Pollutant of Concern
RWQCB – Regional Water Quality Control Board
SARWQCB – Santa Ana Regional Water Quality Control Board
SDRWQCB – San Diego Regional Water Quality Control Board
SJBA – San Juan Basin Authority
SOC – South Orange County (Region 9 -SDRWQCB Jurisdictional Area)
SSMP – Standard Stormwater Mitigation Plan
TGD – Technical Guidance Document
TMDL – Total Maximum Daily Load
TUTIA – Toilet Users to Impervious Area
WMA – Watershed Management Area
WMAA – Watershed Management Area Analysis
WQ – Water Quality
WQIP – Water Quality Improvement Plan
WQMP – Water Quality Management Plan

GLOSSARY OF KEY TERMS

Agronomic Demand – the amount of irrigation required to meet plant water needs, accounting for inefficiencies in irrigation.

Alternative Compliance Program – In general, refers to a program through which qualifying project applicants may participate in alternative compliance options in lieu of implementing some or all on-site structural BMP requirements. Specific criteria and attributes of alternative compliance programs vary by region.

Assessment of Susceptibility (to Hydrologic Conditions of Concern) – an assessment of the receiving water(s) of a project to determine whether downstream water courses, water bodies, and/or stormwater conveyance infrastructure would potentially be impacted by changes in hydrologic regime.

Average Annual Capture Efficiency (a.k.a. capture efficiency) – the estimated percent of long term average annual runoff volume that is managed/controlled by a BMP. Target capture efficiency serves as one element of the performance criteria for LID and treatment control BMPs.

Biofiltration BMP – A class of BMPs that use dense vegetation and biologically-active amended soils to detain and treat runoff from impervious areas. Treatment is through filtration, infiltration, adsorption, ion exchange, and biological uptake of pollutants.

Biotreatment BMP[1] – A sub-category of structural treatment control BMPs that employ biological uptake, transformation, or degradation of pollutants as their principal mechanism(s) of pollutant removal. Although a portion of the design capture volume or flow may incidentally infiltrate, evaporate, or evapotranspire, the principal of operation involves the discharge of the treated storm water after detention in a densely-vegetated basin and/or passing through porous, biologically-active medium, dense vegetation or both. Biofiltration BMPs are a kind of biotreatment BMP.

Biofiltration volume (see also "pre-filter and pore storage volume") – the volume of storage in biofiltration BMPs, measured from the lowest treated discharge elevation of the BMP up to BMP overflow elevation; this volume includes surface storage and pore storage but does not include the volume that would be retained in the BMP and discharged to infiltration, ET, or uses.

Biotreatment Volume – see biofiltration volume.

Bypass – runoff that is routed around a BMP or passes through the BMP with minimal treatment. Bypass generally occurs when the inflow volume or flowrate has exceeded the BMP capacity and the BMP is completely full.

Capture Efficiency – see *average annual capture efficiency***.**

[1] Biotreatment BMPs that do not also meet the definition of a "biofiltration BMP" are not considered LID BMPs; they may be considered treatment control or pretreatment BMPs.

Capture Efficiency Method – a BMP sizing method based on capturing a specified percentage of the average annual stormwater runoff volume from a project as determined with continuous flow modeling or via nomograph methods developed from continuous simulation modeling.

Conceptual Project WQMP - a Project WQMP prepared at the planning phase of projects subject to discretionary approval; intended to describe, at the earliest possibly phase in the development process, the BMPs that will be implemented and maintained throughout the project (functionally equivalent to a Preliminary Project WQMP; nomenclature varies by local jurisdiction).

Conforming BMP – A structural BMP that substantially conforms to one of the BMP types in the BMP fact sheets and has been designed using generally-accepted engineering methods.

Design Capture Storm Depth – the 85th percentile, 24-hr storm depth at the project site; varies by location within the County.

Design Capture Volume (DCV)– the volume of storm water runoff resulting from the design capture storm depth.

Design Criteria – requirements that serve as the basis for designing a BMP to meet performance criteria. Design criteria may encompass BMP sizing and other characteristics of BMP design.

Drainage Area Management Plan (DAMP) – The specific water pollutant control elements of the Orange County Stormwater Program are documented in the Drainage Area Management Plan (DAMP), which is the Permittees' primary policy, planning and implementation document for municipal NPDES Stormwater Permit compliance.

Drawdown – the process of discharging water from a BMP. Drawdown results in emptying of the BMP over time following a storm event and results in creation of storage volume for subsequent storm events.

Drawdown Rate – the rate at which water discharges from a BMP, making storage volume available for subsequent storm events.

Drawdown Time – the time it takes to drain a BMP from brim full. Drawdown time may need to be calculated separately for the retention volume of the BMP and the biotreatment volume of the BMP in order to support design calculations if both types of volume exist. These separate measures are referred to as the "retention drawdown time" and "biotreatment drawdown time".

Environmentally Sensitive Area - areas such as those designated in the Ocean Plan as Areas of Special Biological Significance or waterbodies listed on the CWA Section 303(d) list of impaired waters (See full definition in **Section 2.3.4)**.

Evapotranspiration (ET) - the loss of water to the atmosphere by the combined processes of evaporation (from water, soil and plant surfaces) and transpiration (from plant tissues). As used in this TGD, ET refers to one or both of these processes.

Evapotranspiration BMP (aka ET BMP) – a class of retention BMPs that discharges stored volume predominantly to ET; some infiltration may occur. ET includes both evaporation and transpiration, and ET BMPs may incorporate one or more of these processes.

Final Project WQMP – a Project WQMP submitted at the ministerial approval phase prior to final approval of a grading or building permit; expected to reflect the detail available at the time of project ministerial-level approval.

Harvest and Use – The process of capturing rainwater or stormwater runoff, storing it, and making it available for subsequent use. This process is performed by Harvest and Use BMPs.

Harvest and Use BMP (aka Rainwater Harvesting BMP) – a class of retention BMPs that captures rainwater or stormwater runoff and stores it for subsequent use.

Hydrocollapse - a sudden collapse of granular soils caused by a rise in groundwater dissolving or deteriorating the inter-granular contacts between the sand particles

Hydrologic Condition of Concern (HCOC) – a combination of upland hydrologic conditions and stream biological and physical conditions that presents a condition of concern for physical and/or biological degradation of a stream.

Hydrologic Source Control (HSC) - a class of LID BMPs integrated with site design that retain stormwater runoff and reduce the volume (and potentially rate) of stormwater discharge to the downstream system. HSCs are differentiated from retention and biotreatment classes of LID BMPs by their higher level of integration with a site. They are not sized according to engineering design criteria, and they do not typically result in a distinct facility. Consequently, they are usually regarded as site design practices, as opposed to structural treatment control BMPs. An example includes routing roof runoff into adjacent landscaped areas.

Hydromodification – Changes in runoff and sediment yield caused by land use modifications.

Hydromodification Control – Management techniques which reduce the potential for hydromodification impact.

Hydromodification Impact – The physical response of stream channels to changes in runoff and sediment yield caused by land use modifications

Infiltration BMP – a class of retention BMPs that discharges stored volume predominantly to infiltration/deeper percolation; some evapotranspiration may also occur.

In-stream Control – Modification of a receiving channel as a technique for managing hydromodification impacts. The modifications are usually done for the purposes of allowing the channel to accept changes in hydrology while minimizing impacts to beneficial uses.

Irrigation Area Ratio – a ratio describing the agronomic irrigation demand for harvested stormwater as a fraction of the tributary area to the stormwater storage device.

Irrigation Efficiency – the ratio of plant irrigation needs met to the amount of irrigation water applied. A value of 0.75 implies that 1 inch of irrigation water must be applied to satisfy 0.75

inches of plant water needs. The balance is lost directly to evaporation or to deeper percolation below the root zone.

LID BMP – a BMP that provides retention or biotreatment as part of an LID strategy – these may include HSCs, retention, and biotreatment BMPs. Biotreatment BMPs that do not meet the definition of biofiltration are not considered LID BMPs in the SOC MS4 permit.

LID Site Design – The component of an LID approach that relates to the way in which a site is laid out to achieve strategic stormwater management and resource management objectives. Site design practices work synergistically with LID BMPs, treatment control, and hydromodification control strategies. Example practices include minimizing impervious areas and locating pervious areas such that impervious areas can drain to pervious areas.

Liquefaction - a seismically-induced geological hazard that can result in damage to structures as a result in reduction in bulk volume of saturated granular soils.

Local Implementation Plan (LIP) - The Local Implementation Plan (LIP) describes how the DAMP is being implemented by individual permittees under the MS4 Permit. The DAMP provides a foundation for the description and detail of how the Orange County Stormwater Permittees commonly implement model programs designed to prevent pollutants from entering receiving waters to the maximum extent practicable (MEP). The LIP is designed to supplement the DAMP and each city and the County have developed a comprehensive LIP that is specific to their jurisdiction.

Nonconforming BMP – Any structural BMP that does not substantially conform to one of the BMP types in the BMP fact sheets.

Non-Infiltration Biotreatment BMP – A biotreatment BMP that is designed to avoid infiltration or does not provide appreciable infiltration.

Non-Priority Project - a new development or redevelopment project that has a nexus to stormwater quality but does not meet the thresholds to be considered a Priority Project described in Section 1.2 of the TGD.

On-site LID Practices – LID practices that are implemented within the project boundary.

Other Pollutants of Concern – a pollutant which is expected to be generated by the project's land uses for which there is no 303(d) listing or TMDL in place for any receiving water of the project.

Partial Infiltration Biotreatment BMP – a biotreatment BMP that includes incidental infiltration and has been designed to maximize volume reduction via infiltration and ET in those conditions where partial infiltration is feasible.

Performance Criteria – specific measurable or verifiable requirements against which the performance of a system is compared to assess conformance with applicable requirements. There are three separate types of performance criteria: 1) LID, 2) treatment control, and 3) hydromodification control. These performance criteria are evaluated individually although

they can be interrelated. It is possible to meet one and not meet the others. This is synonymous with "performance standard."

Preliminary Project WQMP – a Project WQMP prepared at the planning phase of projects subject to discretionary approval; intended to describe, at the earliest possibly phase in the development process, the BMPs that will be implemented and maintained throughout the project (functionally equivalent to a Conceptual Project WQMP; nomenclature varies by local jurisdiction).

Pre-filter Volume (see also "biofilter volume") – the volume of storage in biofiltration BMPs, measured from the lowest treated discharge elevation of the BMP up to BMP overflow elevation; this volume includes surface storage and pore storage but does not include the volume that would be retained in the BMP and discharged to infiltration, ET, or uses.

Primary Pollutant of Concern - A pollutant which is expected to be generated by the project's land uses for which there is a 303(d) listing or TMDL in place for any receiving water of the project.

Priority Development Project – See Priority Project. The term "priority development project" is used in the South Orange County MS4 Permit, but for the purpose of this document, only the term "Priority Project" is used.

Priority Project – a new development or redevelopment project meeting the thresholds described in Section 1.2 of the TGD.

Project Water Quality Management Plan (Project WQMP) - a project submittal that describes the Best Management Practices (BMPs) that will be implemented and maintained throughout the life of a project. This term is used in this TGD to describe Conceptual/Preliminary and Final Project WQMPs.

Retention BMP – a class of LID BMPs including infiltration BMPs, evapotranspiration BMPs, and harvest and use BMPs whose design does not allow the discharge of stormwater runoff to the storm drainage system or surface water up to the DCV; these BMPs either infiltrate, evapotranspire, or allow for storage and later use of the retention volume.

Retention Volume – the volume of storage in retention and biotreatment BMPs that would be retained and discharged to infiltration, ET, or uses as the BMP drains. All storage volume is retention volume in retention BMPs. In biotreatment or biofiltration BMPs, retention includes water held below the lowest treated discharge elevation and in suction storage in soil pores

Site Design – a stormwater management strategy that emphasizes conservation and use of existing site features to reduce the amount of runoff and pollutant loading that is generated from a project site. Site design practices compliment LID BMPs, treatment control, and hydromodification control strategies. Example practices include clustering development, minimizing impervious areas, and locating pervious areas such that impervious areas can drain to pervious areas.

Sizing Criteria – specific design criteria related to BMP size that serve as a basis for meeting performance criteria.

Source Control – a class of preventative measures intended to prevent the introduction of pollutants into stormwater.

Standard Stormwater Mitigation Plan (SSMP) – see Project WQMP

Structural BMP Requirements – refers to the portion of WQMP requirements that apply only to Priority Projects, including LID BMPs sized for the DCV (or equivalent), treatment control BMPs (if applicable), and hydromodification control (if applicable).

Susceptibility – a channel's lack of ability to resist physical response due to hydromodification

Treated Discharge – water that is discharged from a BMP to the storm drain or receiving water after treatment (see *treatment*).

Treatment – removal of pollutants from stormwater discharges. Treatment is provided by LID and treatment control BMPs. Levels of treatment vary by BMP types. Volume reduction via infiltration or ET is considered to be a type of treatment.

Treatment Control BMP – a structure designed to treat pollutants in stormwater runoff and release the treated runoff to surface waters or a storm drain system, but is not a biotreatment BMP. Examples include sand filters and cartridge media filters. In the SOC Permit, this category of BMPs is referred to as "Flow Thru Treatment Control BMPs."

Water Quality Improvement Plan – a requirement of the Fifth Term MS4 permit in SOC which provides an adaptive management pathway for Copermittees to select and address the highest priority water quality issues through an iterative process.

Water Quality Management Plan – see *Project Water Quality Management Plan*

Watershed Management Area (WMA) - Watershed Management Areas (WMAs) are used in the countywide Water Quality Strategic Plan as the structure for water resource management. The eleven watersheds in Orange County are grouped by similar characteristics into three Watershed Management Areas: North, Central, and South County.

Watershed Management Area Analysis (WMAA) – an element of the Water Quality Improvement Plan in SOC.

2-year, 24-hour Event – a 24-hour storm event expected to be equaled or exceeded, on average, every 2 years. As defined for Orange County by the Orange County Hydrology Manual.

EQUIVALENT TERMINOLOGY USAGES IN THIS TGD

The 5th Term SOC MS4 Permit uses certain terminology that is different than the 4th Term SOC MS4 Permit and is different from previous versions of this Technical Guidance Manual. The purpose of this section is to list the terms used in this TGD and the equivalent terms found in the 5th Term SOC MS4 Permit.

Site Design BMPs – In this document, this term is specifically used to refer to BMPs that relate to how a site is designed. In the SOC MS4 Permit, many of these practices are found under a heading of Low Impact Development, however these are not referred to as LID BMPs in this document.

Structural Treatment BMPs – This refers to a class of BMPs that is designed to a specific sizing standard and operates to remove pollutants from stormwater via combinations of hydrologic losses (e.g. infiltration, ET, harvest and use) and treatment processes (e.g., filtration, biological update, conversion). This is This is synonymous with "Stormwater Pollutant Control BMPs" used in the SOC MS4 Permit.

LID BMPs – This term is used to refer specifically to a subset of structural treatment BMPs including retention BMPs, biofiltration BMPs, and hydrologic source controls. These BMPs have a specific numeric sizing basis and are the first priority class of BMPs for controlling pollutants.

Retention BMPs – The first priority class of LID BMPs. Includes infiltration and harvest and use BMPs, both of which may also be supported by evapotranspiration.

Biotreatment/Biofiltration BMPs – The second priority class of LID BMPs. The SOC Permit uses only the term biofiltration. Biofiltration is a narrower term than biotreatment. Biofiltration is always biotreatment, but biotreatment is only biofiltration if it meets the narrower definition and criteria to be considered biofiltration. Biotreatment BMPs that do not meet the definition of biofiltration BMPs may only be used as a treatment control BMP or a pretreatment BMP, not to fulfill LID requirements.

Treatment Control BMPs – This term refers to a specific subset of structural treatment BMPs that is not a retention or biotreatment BMP. This is synonymous with "flow thru treatment control BMP" used in the SOC MS4 Permit.

Structural BMP Requirements – The set of requirements related to LID BMPs, treatment control BMPs (if applicable), hydromodification control BMPs (if applicable), and alternative compliance associated with these requirements that are required for Priority Projects but are not required for non-Priority Projects.

SECTION 1. INTRODUCTION AND PROJECT APPLICABILITY CRITERIA

1.1. Orientation and How to Use this Document

This Technical Guidance Document (TGD) is intended to assist project applicants and agency staff developing and reviewing designs that address **post-construction** urban runoff and stormwater pollution from **new development and significant redevelopment projects** in the portion of the County of Orange within the San Diego Permit Region (See Section 1.1.4).

This document includes technical guidance to:

- Determine which requirements are applicable to a project
- Develop Project Water Quality Management Plan (WQMPs) that incorporate and comply with applicable requirements
- Conduct supporting investigations and calculations
- Design Best Management Practices (BMPs) that are identified to be applicable to the project

The following sections provide brief guidance related to what this document covers and how it can be used.

1.1.1. What is a WQMP?

A Water Quality Management Plan is a land development project submittal that describes the post-construction BMPs that will be implemented and maintained throughout the life of a project. This term is used in this TGD to describe Conceptual/ Preliminary and Final Project WQMPs. A WQMP does not describe construction-phase stormwater management approaches.

1.1.2. What types of projects require WQMPs?

Development projects meeting triggers to be considered "Priority Projects" are required to develop a WQMP. Not all development projects require WQMPs. Some may require Non Priority Project (NPP) checklists (or alternative local mechanisms for demonstrating conformance). Projects that do not have a nexus to stormwater pollution or meet other specific definitions do not require any stormwater-related plans. All users should consult **Section 1.2** to determine what type of plan is required for their project.

1.1.3. Why is a WQMP required?

Preparation and implementation of WQMPs for Priority Projects is required by municipal National Pollutant Discharge Elimination System (NPDES) permits held jointly by the

Permittees as part of implementation of the Clean Water Act. These permits are issued to the Permittees by the State of California through the Regional Water Quality Control Boards. In the County of Orange, these permits include an MS4 Permit covering North Orange County (Santa Ana Region - Order No. R8-2009-0030) and an MS4 Permit covering South Orange County (San Diego Region; R9-2013-00021 as amended by R9-2015-0001 and R9-2015-0100). These are referred to as the North Orange County (NOC) Permit and the South Orange County (SOC) Permit in this document. This version of the TGD is applicable only for projects in the SOC permit region at this time.adoption of the 5th Term NOC MS4 Permit

1.1.4. Which MS4 Permit Applies to a Project Site?

The division between regions generally follows El Toro Road. This follows the watershed divide between the San Diego Creek, Santiago Creek, and Newport Coast watersheds to the north (each in NOC) and the Aliso Creek and Laguna Coast watersheds to the South (both in SOC).

Certain cities that are split between these regions include:

- The Cities of **Laguna Hills** and **Laguna Woods** are both solely covered by the **SOC MS4 Permit** for the purpose of land development stormwater management requirements.
- At the time that the 5th Term North OC MS4 Permit goes into effect, the **City of Lake Forest** will be covered solely within the **NOC MS4 Permit**. Until that time, the City of Lake Forest is within both regions depending on the location of the development project within the City.

Table 1-1 identifies the division of permit areas.

Table 1-1: Division of Permit Areas

Jurisdictions within Santa Ana Region (NOC)	Jurisdictions within San Diego Region (SOC)	Jurisdictions within both the NOC and SOC Regions
City of Anaheim	City of Aliso Viejo	County of Orange
City of Brea	City of Dana Point	Orange County Flood
City of Buena Park	City of Laguna Beach	Control District
City of Costa Mesa	City of Laguna Hills	City of Lake Forest*
City of Cypress	City of Laguna Woods	
City of Fountain Valley	City of Laguna Niguel	
City of Fullerton	City of Mission Viejo	
City of Garden Grove	City of Rancho Santa Margarita	
City of Huntington Beach	City of San Clemente	
City of Irvine	City of San Juan Capistrano	
City of La Habra		
City of La Palma		
City of Lake Forest*		
City of Los Alamitos		
City of Newport Beach		
City of Orange		
City of Placentia		
City of Santa Ana		
City of Seal Beach		
City of Stanton		
City of Tustin		
City of Villa Park		
City of Westminster		
City of Yorba Linda		

* At the time that 5th Term NOC MS4 Permit goes into effect, the City of Lake Forest will be covered solely within the NOC MS4 Permit. Until that time, the City of Lake Forest is within both regions depending on the location within the City.

1.1.5. Who reviews WQMPs?

A Project WQMP is reviewed by the local MS4 Copermittee that has development project review jurisdiction over the location of the project. This may include one of the 34 cities in Orange County or the County of Orange. Specific review steps and procedure are described in the Model WQMP and/or the reviewing jurisdiction's Local Implementation Plan.

1.1.6. How should a WQMP be developed?

The minimum standards and content for WQMP development are presented in the Model WQMP. **Section 2** of this TGD presents a stepwise process for WQMP development and includes references to the other TGD sections and appendices to assist with each step. This stepwise process is not mandatory, but it is intended to support the collection of appropriate information at each project phase and provide standard approaches for developing designs making decisions. Additionally, the reviewing agency can provide a WQMP Template to assist in organizing information in a consistent format. Where deviations from recommended processes and criteria are determined to be necessary for a project, the SOC Model WQMP should be consulted to determine the underlying standards that must be met in Project WQMP development.

1.1.7. When should a WQMP first be prepared?

An approved Conceptual or Preliminary WQMP[2] should be completed as part of the first phase of project approval. For significant and discretionary projects (most projects), the Conceptual or Preliminary WQMP should be approved prior to the discretionary approval of the overall project (e.g., a city council or Board of Supervisors approval). **It is strongly encouraged to begin stormwater quality planning and Conceptual or Preliminary WQMP preparation at the earliest stages of project site layout and preliminary design.** Preparation of a compliant WQMP requires that applicant be able to describe how the site layout was developed to maximize the feasibility of low impact development (LID) BMPs. Developing the Conceptual or Preliminary WQMP early in the site layout process helps prevent having to revise the site layout in later phases of the project to accommodate LID BMPs. A Final Project WQMP builds upon the Conceptual or Preliminary WQMP and is required as part of the grading and building permit application process (see next section).

[2] A Preliminary WQMP and Conceptual WQMP refer to the same document, but different nomenclature is used in different jurisdictions.

1.1.8. What is the difference between a Conceptual/Preliminary and Final Project WQMP?

There are two primary differences: (2) the phase of approval they accompany, and (2) the level of detail they contain.

A **Conceptual/Preliminary WQMP** accompanies discretionary approval of the project, or the first phase of approval, if the project is not subject to discretionary approval. The level of detail that is appropriate varies by project. In general, the Conceptual/Preliminary WQMP should provide enough detail to demonstrate that the project will conform to applicable standards and demonstrate that the approach for conforming is reasonable and feasible. It may not be appropriate or necessary to describe detailed BMP designs at this phase. Certain aspects of the conceptual design may be contingent on obtaining additional, more detailed information, such as infiltration tests at specific locations.

A **Final Project WQMP** accompanies the grading and building permit application process. At this phase, the level of detail in the WQMP must be consistent with the level of detail found in the detailed design and construction plans. The plans must be construction ready, and the WQMP must definitively describe how the proposed construction plans conform to applicable standards. It is typical for additional site investigation information, focused at specific BMP locations, to be available to support the Final Project WQMP that may not have been available for the Conceptual/Preliminary WQMP.

1.1.9. What requirements are associated with a Project WQMP?

New development and significant redevelopment projects that qualify as Priority Projects are required to prepare a Project Water Quality Management Plan (Project WQMP) which describes the practicable and enforceable controls the Priority Project will use to demonstrate and maintain conformance with four major sets of requirements:

- **Site Design –** approaches and practices for configuring a site that reduce stormwater runoff volume, reduce pollutant loads to receiving waters, protect sensitive areas, and allow more feasible placement of LID BMPs.
- **Source Control –** approaches for reducing the introduction of pollutants into stormwater and eliminating dry weather urban runoff.
- **Pollutant Treatment –** requirements intended to remove pollutants from stormwater, including use of LID BMPs (first priority) and treatment control BMPs (second priority). These BMPs must be designed to specific numeric sizing standards and selected according to a hierarchy as described in this TGD and the in Model WQMP.
- **Hydromodification Control–** requirements intended to reduce the potential for site hydrologic modifications to cause downstream channel erosion, potentially including

additional or larger BMPs than required for pollutant treatment. These requirements only apply where channels are susceptible to erosive impacts and are based on specific numeric sizing criteria as described in this TGD and in the Model WQMP.

These requirements apply to all Priority Projects except where a specific requirement is demonstrated to be not applicable. Additionally, a WQMP must provide an O&M plan and assign O&M responsibility for ongoing operation of BMPs into perpetuity.

1.1.10. What requirements are associated with a Non Priority Project?

Non Priority Projects must incorporate applicable site design and source control BMPs but are not required to implement pollutant treatment or hydromodification BMPs. A NPP checklist can be used to guide and document the incorporation of these BMPs. Local jurisdictions may provide alternative templates or checklists to document the site design BMPs and source control BMPs that were incorporated.

1.1.11. How should a project applicant use this TGD?

This TGD is not intended to be read from "cover to cover." Additionally, there is no "right or wrong" way to use this TGD. However, a suggested approach for usage includes:

- Start consulting this TGD early in the project development process at a time when stormwater management objectives can be considered in overall site layout and design.
- Use Section 1.2 to determine project categorization and determine if a WQMP is required
- Review Section 1.3 and 1.4 as an introduction to the types of stormwater BMPs and the underlying principles for selecting and designing these BMPs
- Use the stepwise process described in Section 2 to begin to develop a WQMP. This section includes cross references to the other sections of the TGD that are applicable to the project.
- Based on the references from Section 2 that apply to the project, consult other sections and appendices, as needed.
- Use the worksheets from the TGD (consolidated in Appendix M) to document decisions.
- Use a WQMP template acceptable to the reviewing jurisdiction as the structure upon which to organize the WQMP

For guidance on specific topics, the Table of Contents may be used to hyperlink to relevant sections of the document or relevant appendices.

1.1.12. How do the various planning documents relate to each other?

There are five documents that describe requirements and provide guidance for developing Project WQMPs or NPPs. These documents are listed in Table 1-2. Additionally, the respective

MS4 Permits are expected to serve as a reference in cases not specifically addressed by these documents.

Table 1-2. Intended Purpose and Integration of Planning Documents

Document	Intended Purposes
South Orange County Model WQMP (DAMP Section 7.II)	Describes core performance criteria underlying the development of Project WQMPs Describes requirements that are specific to the South Orange County Permit Region Describes requirements and procedures for WQMP development, review, approval, verification, and ongoing implementation
Technical Guidance Document (DAMP Section 7.III) (serves North and South Orange County)	Provides technical guidance for: • Determining applicability of requirements • Developing Project WQMPs that incorporate applicable requirements • Conducting and documenting associated investigations and calculations • Designing BMPs that meet applicable requirements Provides examples and worksheets
Hydromodification Management Plan for South Orange County (DAMP Section 7.IV)	Provide technical guidance for developing hydromodification management designs for projects in South Orange County
WQMP Template	Provides a standardized format, organizational structure, and embedded guidance for developing a project WQMP for a Priority Project.
Non-Priority Project Checklist	The local jurisdictions may use a checklist or alternative template for NPPs to support identification and documentation of applicable BMPs.

1.2. Project Categorization to Determine Applicable Requirements

1.2.1. Overall Project Categories

Development and redevelopment activities that are permitted with City and County planning and building departments can include a wide range of activities. Not all activities require post-construction stormwater management planning, even when approval from City and County planning and building departments are required. Development and redevelopment activities fall under three categories for the purposes of determining their post-construction stormwater requirements:

Priority Projects: A project that meets the Priority Project criteria described in Section 1.2.4. These projects require a Project WQMP unless the project is, in its entirety, necessary to mitigate an emergency.

Non-priority Projects: This category includes activities that do not meet the requirements to be considered a Priority Project but have a potential for stormwater pollution that is non-negligible. Additional guidelines for defining non-Priority Projects is found in Section 1.2.4.

Other projects: This category includes development or redevelopment activities that are not exposed to stormwater, do not include new potential sources of pollutants to stormwater, or do not meet the minimum requirements to be considered a Non-Priority Project or Priority Project. No documentation of post-construction stormwater planning is required for these types of activities.

Projects as a whole may be either Priority Projects, Non-priority Projects, or Other Projects. It is prohibited for projects to be subdivided into elements and with these elements individually categorized. The project categorization must be based on the "whole of the action" that is reasonably foreseen and/or proposed.

Under certain conditions and limitations, some site activities may be exempted from stormwater management requirements. Specific exemptions are discussed in Section 1.2.4.

1.2.2. General Criteria for Defining Priority Projects

In the MS4 Permit, Priority Projects categories are defined based on the total area affected by the project, quantity of new or replaced impervious area, project type, and/or design features. To determine classification, the project applicant shall review each Priority Project category, defined in Section 1.2.4[3]. If any of the categories match the project, the entire project is a Priority Project. For example, if a project feature such as a parking lot falls into a Priority Project category, then the entire development footprint including project components that otherwise would not have been designated a Priority Project on their own (such as other impervious components that did not meet Priority Project size thresholds, and/or landscaped areas), shall be subject to Priority Project requirements. Note that size thresholds for impervious surface created or replaced vary based on land use, land characteristics, and whether the project is a new development or redevelopment project. Therefore, all definitions must be reviewed carefully.

[3] Section 1.2.4 includes requirements specific to the SOC permit region. Section 1.2.3 is included as a placeholder for requirements from the NOC permit region upon approval of the 5th term NOC MS4 Permit.

The following terms are relevant to interpret these categories:

Existing impervious surface area: The amount of impervious surface that exists on the site prior to the proposed development action.

Created impervious surface: New impervious surface that will be created as part of new development or redevelopment where there was previously pervious surface.

Added impervious surface: Synonymous with "created impervious surface."

Replaced impervious surface: New impervious surface that will be placed where there is existing impervious surface that is being removed as part of a redevelopment action.

Removed impervious surface: Impervious surface that exists before the project that will be removed and left pervious after the project.

Maintained impervious surface: Impervious surface that will be subject to routine maintenance, either as a standalone action or as an action that occurs as part of the project.

Note that Priority Project categories are primarily based on created, added, or replaced impervious surface; not removed impervious surface or maintained impervious surface.

1.2.3. Specific Criteria for Priority Project Categories in North Orange County

[Placeholder for NOC-specific content upon adoption of the 5th Term NOC MS4 Permit]

1.2.4. Specific Criteria for Priority Project Categories in South Orange County

A project meeting one or more of the following criteria is a Priority Project unless the project is, in its entirety, necessary to mitigate an emergency.

(a) New development projects that create 10,000 square feet or more of impervious surfaces (collectively over the entire project site). This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land.

(b) Redevelopment projects that create and/or replace 5,000 square feet or more of impervious surface (collectively over the entire project site on an existing site of 10,000 square feet or more of impervious surfaces). This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land.

(c) New and redevelopment projects that create and/or replace 5,000 square feet or more of impervious surface (collectively over the entire project site), and consist primarily of one or more of the following uses:

(i) Restaurants. This category is defined as a facility that sells prepared foods and drinks for consumption, including stationary lunch counters and refreshment

stands selling prepared foods and drinks for immediate consumption (Standard Industrial Classification (SIC) code 5812).
Information and an SIC search function are available at
https://www.osha.gov/pls/imis/sicsearch.html.

(ii) Hillside development projects. This category includes development on any natural slope that is twenty-five percent or greater.

(iii) Parking lots. This category is defined as a land area or facility for the temporary parking or storage of motor vehicles used personally, for business, or for commerce.

(i) Streets, roads, highways, freeways, and driveways. This category is defined as any paved impervious surface used for the transportation of automobiles, trucks, motorcycles, and other vehicles.

(ii) Automotive repair shops. This category is defined as a facility that is categorized in any one of the following SIC codes: 5013, 5014, 5541, 7532-7534, or 7536-7539.
Information and an SIC search function are available at
https://www.osha.gov/pls/imis/sicsearch.html.

(iii) Retail gasoline outlets. This category includes Retail gasoline outlets that meet the following criteria: (a) 5,000 square feet or more or (b) a projected Average Daily Traffic of 100 or more vehicles per day.

(d) New or redevelopment projects that create and/or replace 2,500 square feet or more of impervious surface (collectively over the entire project site), and discharge directly to an Environmentally Sensitive Area (ESA). "Discharging directly to" includes flow that is conveyed overland a distance of 200 feet or less from the project to the ESA, or conveyed in a pipe or open channel any distance as an isolated flow from the project to the ESA (i.e. not commingled with flows from adjacent lands).

Note: ESAs are defined in Section 2.3. For projects adjacent to an ESA, but not discharging to an ESA, the 2,500 sq-ft threshold does not apply as long as the project does not physically disturb the ESA and the ESA is upstream of the project.

(e) New or redevelopment projects that result in the disturbance of one or more acres of **total** land (impervious and pervious) and are expected to generate pollutants post-construction.

Note: This category is intended to apply to sites where there is a permanent change in site use that does not include addition of impervious cover but is expected to generate runoff volume greater than existing condition and/or pollutant loads greater than existing condition. Projects creating less than 5,000 sf of impervious surface and where any added landscaping does not require regular use of pesticides and fertilizers, such as a slope stabilization project using native plants, are excluded from this category. Calculation of the square footage of disturbance need not include linear pathways that are for infrequent vehicle use, such as for emergency or maintenance access or for

bicycle or pedestrian use, if they are built with pervious surfaces or if they sheet flow to surrounding pervious surfaces.

Specific Exclusions and Clarifications in South Orange County

1) Area that may be excluded from impervious area calculations for determining if the project is a Priority Project include:
    a) Impervious surface associated with routine maintenance activities, such as trenching and resurfacing associated with utility work; pavement grinding; resurfacing existing roadways, sidewalks, pedestrian ramps, or bike lanes on existing roads; and routine replacement of damaged pavement, such as pothole repair.
    b) Swimming pools and decorative ponds with adequate freeboard or an overflow structure that does not release overflow to the MS4 shall not be included in any project acreage tabulations.
    c) Area that is modified for the sole purpose of installing a structural BMP retrofit project where a separate planning process describes the planning, design, ownership, and O&M of the retrofit facility.
    d) Impervious cover that is added within a channel rehabilitation project that is determined to be necessary to ensure geomorphic stability, protect infrastructure and property, and/or provide access for operations and maintenance.

2) The following categories of projects may be exempted from being defined as Priority Projects at the discretion of the permittee with jurisdiction over project review:
    a) New or retrofit paved sidewalks, bicycle lanes, or trails that meet the following criteria:
        i. Designed and constructed to direct storm water runoff to adjacent vegetated areas, or other non-erodible permeable areas; OR
        ii. Designed and constructed to be hydraulically disconnected from paved streets or roads; OR
        iii. Designed and constructed with permeable pavements or surfaces in accordance with USEPA Green Streets guidance.
    b) Retrofit or redevelopment of existing paved alleys, streets or roads that are designed and constructed in accordance with the USEPA Green Streets guidance.

Guidance for incorporating required features to potentially qualify for these exemptions is found in Section 2.9 of this TGD.

Criteria for Redevelopment of a Portion of a Site in <u>South Orange County</u> (50% Rule)

The following provisions apply to cases where a portion of a site is redeveloped:

a) Where redevelopment results in the creation or replacement of impervious surface in an amount of less than fifty percent of the surface area of the previously existing development, then the structural BMP performance requirements described in this TGD (pollutant treatment and hydromodification) apply only to the creation or replacement of impervious surface, and not the entire development; or
b) Where redevelopment results in the creation or replacement of impervious surface in an amount of more than fifty percent of the surface area of the previously existing development, then the structural BMP performance requirements of this TGD apply to the entire development.

This TGD interprets the term "surface area" in this subsection to mean impervious surface area.

It must be noted that if a portion of the site does not require treatment per bullet (a) above but cannot be hydrologically separated from the areas being treated (i.e. comingles), then the comingled runoff from this area also needs to be treated.

Example:

- An existing site is 1.2 acres and contains 0.8 acres of impervious surface.
- A redevelopment project would add 0.2 acres of impervious surface, replace 0.3 acres of impervious surface, and remove 0.1 acres of impervious surface, and bringing the total impervious surface to 0.9 acre.
- The added or replaced impervious surface is 0.5 acres.
- Comparing 0.5 acres to the existing impervious surface area of 0.8 acres yields a value of 62%. This is greater than 50%. Structural BMP requirements apply to the entire impervious surface area of the site and any other area that comingles with this area prior to treatment.

1.2.5. Special Considerations and Common Issues with Project Categorization

The following subsections provide clarification on common issues encountered in project categorization.

1.2.5.1. Tabulating Total Quantity of Imperviousness versus Net Change

Categories are defined by the total quantity of "added or replaced" impervious surface, not the **net change** in impervious surface.

For example, consider a redevelopment project that adds 7,500 square feet of new impervious surface and removes 4,000 square feet of existing impervious surface. The project has a net increase of 3,500 square feet of impervious surface. However, the project is still classified as a Priority Project because the total added or replaced impervious surface is 7,500 square feet, which is greater than 5,000 square feet.

1.2.5.2. Defining a Project and a Site

The definition of what is meant by the project must be clearly defined in the Project WQMP and must be consistent with the project description used in other aspects of discretionary approval or subsequent administrative approvals.

With respect to the location of treatment (i.e., on-site or off-site), the limits of the project boundary, as defined in the project description, define the site.

The definition of an existing developed site extends beyond the limits of the project boundary of the currently proposed project. This may be important evaluate the "50 percent rule" to determine what portion of the existing site require treatment. In this case, the site-specific information is necessary. As a general rule, the existing developed site is reasonably defined as:

- The tax lot(s) where the project will occur (appropriate in cases where the project will occur within a small number of tax lots and there was not a common plan of development that involved more than one tax lot at the time of original development)
- The finest scale of development approval for the original development (appropriate where there was a common plan of development at the time of the original development and the proposed project will cross multiple tax lots)

1.2.5.3. Accounting for the Use of Pervious Pavement Surfaces

Where development projects incorporate permeable pavement surfaces, these surfaces may be tabulated as pervious in the tabulation of impervious area in determining Priority Project categorization. Such projects may not trigger being Priority Projects. Such projects must be required to maintain these permeable surfaces into perpetuity, so a Non Priority Project Water Quality Plan must be developed and maintained for the site.

1.2.5.4. Small Projects with Driveways and/or Parking Lots

The MS4 permit defines lower impervious areas thresholds for projects that support driveways, parking lots, and roads (5,000 sq-ft) than exist for new development projects (10,000 sq-ft). Many projects include some portion of these uses, but this does not necessarily reduce the impervious area threshold to 5,000 sq-ft for these projects. These values should be tested independently:

- Is the total parking lot area greater than 5,000 sq-ft of impervious surface?
- Is the total road or driveway area greater than 5,000 sq-ft impervious surface?
- Is the total impervious area greater than 10,000 sq-ft of impervious surface?

If any of these tests is positive, the project is a Priority Project. If all are negative, then the project is a non-Priority Project.

For example:

- If a project has a new 4,000 sq-ft driveway, 2,000 sq-ft parking lot, and 3,000 sq-ft of other imperviousness, then the project is not a Priority Projects.
- If a project has a 6,000 sq-ft driveway and 3,000 sq-ft of other imperviousness, then the project is a Priority Project because the driveway exceeds 5,000 sq-ft.

1.2.5.5. Priority Projects that Involve Improvements in Existing Right of Ways

The MS4 permit establishes specific approaches for roadway and utility projects within existing right of ways that are different from what would apply to an ordinary development or redevelopment project. However, it is possible that a development or redevelopment project would involve off-site improvements in existing right of ways within its project description (e.g., turn lane addition). These improvements would encounter similar constraints to projects that are purely right of way projects. In such a case, it is acceptable to subdivide the project and apply different standards and approaches for the area within the existing right-of-way and outside of the existing right-of-way.

1.3. Types and Applicability of Stormwater Best Management Practices

This TGD describes BMP strategies for meeting the four major sets of requirements in the WQMP (See Section 1.1.9). BMP requirements are divided into four primary categories to reflect the four major sets of requirements as described in Table 1-3.

Table 1-3. Categories of BMP Requirements and Project Type Applicability

BMP Requirement	Description	Examples (partial list)	Applicability by Project Type
Site Design	Approaches and practices for configuring a site that reduce pollutants and volumes of stormwater runoff, protect natural resources, and allow more feasible placement of LID BMPs. Certain types of site design BMPs, known as HSCs, can have quantifiable benefits for sizing associated with Priority Projects.	Buffers on riparian areas and slopes Revegetation and decompaction of pervious area Disconnection of impervious area	Non Priority Projects and Priority Projects
Source Control	Approaches for reducing the introduction of pollutants into stormwater and eliminating dry weather urban runoff.	Covered garbage areas Storm drain stenciling Community car wash area	Non Priority Projects and Priority Projects
Pollutant Treatment	Requirements intended to remove pollutants from stormwater, including use of **LID BMPs** (first priority) and **treatment control BMPs** (second priority). These BMPs must be designed to specific numeric sizing standards and selected according to a hierarchy. Pollutant treatment BMPs may be located within a project site or in off-site locations subject to certain criteria.	Bioretention Biofiltration Sand Filters	Priority Projects
Hydromodification Control	Requirements intended to reduce the potential for site hydrologic modification to cause downstream channel erosion, potentially including additional or larger BMPs than required for pollutant treatment. These requirements only apply where channels are susceptible to erosive impacts and are based on specific numeric sizing criteria.	Detention ponds Flow duration control ponds	Priority Projects only where the project drains to susceptible stream channel

1.4. BMP Selection and Integration Principles

The development of WQMPs should be based on three underlying principles:

1. Integration of BMP types into a holistic system of stormwater management is expected to yield the highest performance and most efficient design
2. The use of BMP types that are effective, applicable, and feasible for a project, based on a realistic assessment of reliable site data is expected to improve overall performance and reduce the rate of failure and needed rehabilitation.
3. BMPs should be selected and designed for resiliency, adaptability, and ability to be operated and maintained into perpetuity.

These principles are explained further below and have been considered throughout this TGD.

1.4.1. Integration of BMP Types

While this TGD established four separate sets of BMP requirements, the types of BMPs are intended to be synergistic and function as an integrated system. Examples of synergy include:

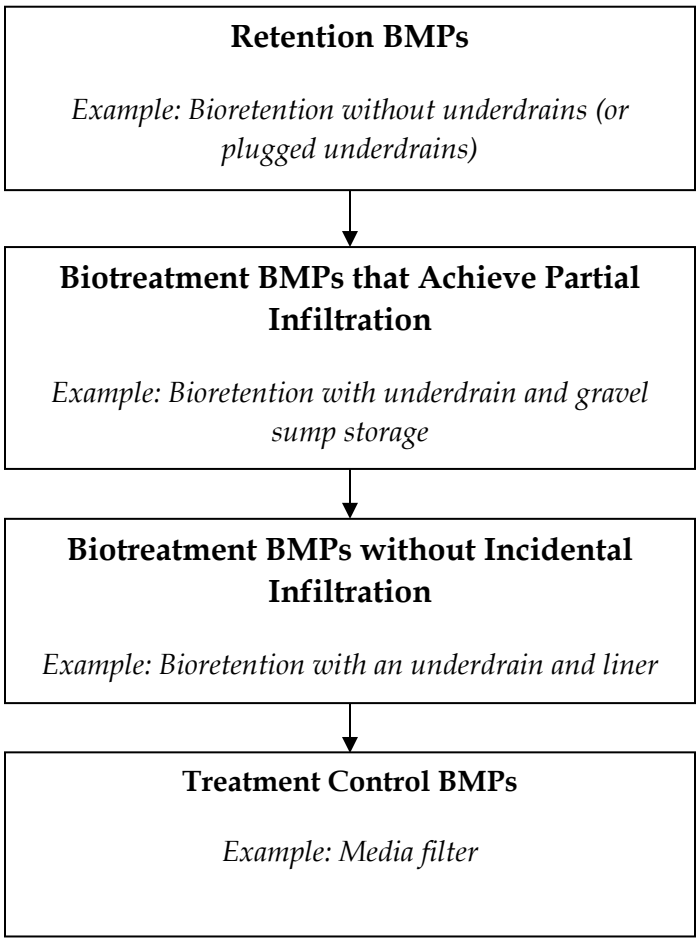
- Site design BMPs can have quantifiable benefits on reducing runoff volume that can result in smaller structural LID, treatment control, and hydromodification BMPs.
- Source control BMPs help reduce high intensity pollutant sources, thereby reducing maintenance burden on pollutant treatment BMPs, reducing the list of pollutants of concern that pollutant treatment BMPs must address, and improving the overall quality of stormwater leaving the site.
- Site design and source control BMPs can both help reduce the quantity of dry weather flows (e.g., irrigation excess, air conditioner condensate, car wash water) and lessen nuisance issues from persistent flows into pollutant treatment BMPs and/or lessen the need for structural measures (e.g., a lift station) to eliminate these flows.
- LID BMPs that are adequately sized fully address pollutant treatment standards, thereby eliminating the need for any treatment control BMPs.
- LID BMPs and hydromodification BMPs can be integrated into the same facility or treatment train, where the hydrologic benefits provided by the LID BMP portion of the system serves as part of complying with hydromodification requirements.

The design approaches in Section 2, 4, and 5 and Appendix B provide more details and examples of how multiple BMP types can be integrated.

1.4.2. Use of Effective, Applicable and Feasible BMPs

The MS4 Permits require BMPs to be selected from a hierarchy that favors retention BMPs, then biotreatment BMPs that achieve some volume reduction, then biotreatment BMPs without volume reduction, and then non-LID treatment control BMPs. The LID hierarchy is discussed in more detail in Section 2.5 and Section 4, but the general hierarchy is described in Figure 1-1.

Figure 1-1: General Hierarchy of LID BMPs[4]



This hierarchy must be observed in a manner consistent with the Maximum Extent Practicable (MEP) standard that underlies the MS4 Permit. However, this hierarchy must not be interpreted by applicants or reviewers as a mandate to use BMPs types that cannot be reliably supported by

[4] Biotreatment BMPs that do not also meet the definition of a "biofiltration BMP" are not considered LID BMPs in South Orange County; they may be considered treatment control or pretreatment BMPs.

site information and/or are not appropriate for the project type. A BMP that is selected from a higher level of the hierarchy based on unreliable information and does not perform to acceptable standards or leads to property or environmental damage is unacceptable. The WQMP development process must equally seek the use higher priority BMPs and also ensure that the BMPs that are used are reliably supported, safe, and do not pose risks that cannot be reasonably mitigated.

A principal role of this TGD is to describe the processes and criteria to ensure that the LID hierarchy is incorporated into project WQMPs to the maximum extent practicable (MEP) **and** whichever BMP type is selected is adequately confirmed to be effective and safe in its proposed use, or an option is available to adapt the BMP design to ensure that this is met.

1.4.3. Focus on Resiliency, Adaptability and Long Term O&M

WQMPs are planning and design documents that describe a system of BMPs that must work in the post construction phase and be maintainable into perpetuity. Foremost, the designer and reviewer must acknowledge that information about the site that is available at the design phase is inherently imperfect and also may change during construction or via evolution of site condition and uses over time. This is particularly important for designs that rely solely on infiltration, which is dependent on an infiltration rate that must be estimated during the planning and design phases of the project. Infiltration rates may vary by orders of magnitude within a small area of a site or with depth, and can be very sensitive to variations in compaction that can result during construction.

In contrast to previous versions of this document, this TGD includes greater emphasis on ensuring that systems are selected and designed to be more resilient and adaptable to actual conditions, encouraging the use of confirmation testing during the construction phase, and including design features to facilitate long term O&M that is needed to sustain performance. This includes:

- Providing BMP selection and design options for cases where infiltration conditions are marginal and/or inherently uncertain prior to completion of construction activities
- Describing how data that are obtained between the planning phase (Conceptual WQMP) and design phase (Final WQMP) can be incorporated into design refinements and/or adaptations.
- Providing design recommendations for BMPs that enable adaptation during or after the construction process.
- Providing design criteria and checks to identify and address cases that pose elevated risk of clogging for infiltration, biofiltration, and filtration types of BMPs
- Providing design recommendations for BMPs that enable them to be inspected and maintained.

The selection process and criteria for LID BMPs is detailed in Section 2.5 and Section 4. BMP fact sheets are included in **Appendix G**.

1.5. Limits in Scope of the Technical Guidance Document

To help make this document relevant for the majority of users, the guidance is tailored primarily to projects that will comply with applicable requirements via on-site LID and hydromodification BMPs (as applicable). Options for on-site LID BMPs include highly space efficient options such as proprietary biotreatment BMPs, such that the frequency that a project will demonstrate infeasibility of on-site approaches and be required to seek alternative approaches is quite limited. The following primary limitations apply:

Alternative Compliance Options. Pathways for alterative compliance are contingent on the development of jurisdictional frameworks. At this time, alternative compliance options are not discussed in this TGD, but are discussed in the Model WQMP.

Regional BMPs. Regional BMPs can be acceptable options, with a set of associated criteria. These criteria are provided in the Model WQMP. This TGD provides general guidance for adapting LID BMPs to larger scales, but does not focus on Regional BMPs at this time. The design and permitting process for regional BMPs is anticipated to be project-specific and would typically be conducted to meet the underlying criteria described in the Model WQMPs but would not necessarily follow the standardized process described in this TGD.

In-stream hydromodification BMPs. This option may be available for hydromodification control under specific conditions. This option is anticipated to be very rarely implemented by an individual Priority Project without significant permittee involvement. Each design and permitting process is anticipated to be project-specific. Therefore, this TGD does not attempt to provide guidance for this option.

Groundwater, Soil, and Geotechnical Analysis Methods. This TGD identifies the need for qualified professionals to investigate groundwater, soil, and/or geotechnical factors and the key metrics or types of recommendation that are needed to support project development. However, it does not seek to prescribe specific methods that must be used. It is expected that the qualified professional shall apply discretion to determine appropriate methods, subject to reviewer approval.

BMP Design Standards. This TGD attempts to clearly describe what is meant by each BMP type, provide a reasonably comprehensive set of criteria, and the rationales for these criteria. However, this TGD also provides flexibility for designer preference and project-specific adaptations. Variations on these designs are permissible, and additional design references may need to be consulted. BMP design criteria should be interpreted as standard guidelines, not strict limits.

Non-Priority Project BMPs. This TGD can be used as a reference for site design and source control approaches applicable for NPPs. However, this TGD presents a process that is focused specifically on Priority Projects and does not attempt to present the much abbreviated process that an NPP would follow. NPPs can typically refer to an NPP checklist available from a local jurisdiction for guidance. The local jurisdiction may use a checklist or alternative method to identify and document applicable requirements.

1.6. Organization of the Technical Guidance Document

TGD Body

- **Section 1** provides an introduction to the purpose of the document, methods for project priority categorization, and the underlying principles of this TGD.
- **Section 2** contains stepwise guidance on how to develop BMP plans and prepare each section of the WQMP
- **Section 3** provides guidance for site design principles and practices.
- **Section 4** provides guidance on pollutant treatment BMPs, including BMP selection, sizing, and design guidance for LID and treatment control BMPs.
- **Section 5** provides guidance for design approaches for hydromodification control BMPs.
- **Section 6** provides guidance for the type, functionality, and selection of Source Control Measures, both structural and non-structural.

TGD Appendices

- **Appendix A** provides examples of integration of LID and hydromodification requirements into BMPs in the NOC permit area [PLACEHOLDER ONLY].
- **Appendix B A** provides examples of integration of LID and hydromodification requirements into BMPs in the SOC permit area.
- **Appendix C** describes methods for investigating groundwater-related issues and provides groundwater-related infiltration feasibility criteria.
- **Appendix D** provides guidance for evaluating infiltration rates and determining safety factors for infiltration feasibility screening and design.
- **Appendix E** contains guidance on standardized hydrologic calculations and sizing methods for LID and treatment control BMPs including worksheets, examples, and stepwise sizing methodologies. It also contains guidance methodologies for checking clogging risk, minimum BMP footprint areas, and approaches for space-constrained sites.
- **Appendix F** summarizes harvest and use demand calculations and design considerations.
- **Appendix G** provides concise fact sheets for 20 LID and treatment control BMPs and 7 hydrologic source control BMPs in addition to 3 fact sheets on soil amendments and other media. References to more extensive design guidance is also provided.

- **Appendix H** provides the technical basis for green roof design criteria.
- **Appendix I** contains guidelines for the use of dry wells for stormwater management applications.
- **Appendix J** describes the criterion for acceptance of proprietary BMPs.
- **Appendix K** provides approved methods for quantifying hydrologic conditions of concern in the North Orange County permit area [PLACEHOLDER ONLY].
- **Appendix L** provides guidelines for applying the South OC HMP for development of hydromodification designs. [PLACEHOLDER ONLY, CURRENTLY]
- **Appendix M** provides links to worksheets that are referenced throughout the TGD.
- **Appendix N** contains exhibits to support preparing a Project WQMP.

SECTION 2. TECHNICAL GUIDANCE FOR PREPARING PROJECT WQMPS

2.0 Section Orientation and Stepwise Process

This section provides a recommended stepwise process for developing Conceptual/Preliminary and Final Project WQMPs. This section is intended to be the core reference for users developing WQMPs. This section explains when the other guidance in this TGD is applicable and should be consulted.

Why use a stepwise process?

- **Stormwater management is site- and watershed-specific.** Of primary importance in WQMP development is for planning and design decisions to be based on adequate and reliable data. A stepwise process helps to organize data collection efforts and make clear the intended outcomes of these efforts.
- **WQMP development can involve multiple disciplines and multiple phases**. A structured process helps develop a common understanding across design and review staff about what decisions are necessary at each phase and what are the intended outcomes of investigations and calculations.
- **It is critical that decisions be documented to provide the basis for decisions about site design, BMP selection, and BMP design.** A structured process help organize this information in a more standardized format and makes it easier to review.
- **Knowledge of a site and the resulting proposed BMP plans inherently improve over time.** Following a process helps provide a point of reference for how to incorporate and adapt decisions and designs to new information as it becomes available.

Table 2-1 provides an orientation to this stepwise approach.

Sections 2.1 through 2.8 are organized to mirror the respective Sections 1 through 8 of the Project WQMP Template and Section 2.1-2.8 of the Model WQMP. The Model WQMP is intended to describe the expected content and underlying performance criteria associated with each aspect of WQMP development. The WQMP Template is intended to provide standardized structure and format for WQMP preparation.

This TGD provides methods and guidance to aid project applicants through development of each of these sections of the Project WQMP. These steps can be followed for both the Conceptual/Preliminary WQMP (planning phase) and the Final Project WQMP (design phase), with certain steps being geared towards one or the other or requiring more detail for the Final Project WQMP as additional information is acquired. These steps are designated in the table below as (*Planning Phase*) and (*Design Phase*).

Table 2-1. WQMP Preparation Steps, Key Efforts, and Expected Outcomes

Step	WQMP Preparation Step	Section Reference (click to jump)	Key Efforts	Key Expected Outcomes

1	Determine discretionary permits and water quality conditions	2.1	• Review of previous approval:
			  ○ Prior WQMPs
			  ○ Environmental clearance (e.g., CEQA)
			  ○ Other
				Fully characterize requirements that apply to stormwater management, potentially beyond those prescribed by the MS4 Permit, Model WQMP and TGD

2	Describe the project	2.2	• Provide the legal description of the project • Inventory certain site features and land uses	• Fully characterize what is meant by the "project" • Provide information to support subsequent steps

3	Assess the site and the watershed	2.3	• Summarize key aspects of existing site information and proposed plans
			• Compile and interpret available mapped and tabular data
			• Investigate the site relative to infiltration and harvesting feasibility to:
			  ○ Determine areas with greatest potential feasibility
			  ○ Determine tentative feasibility at BMP locations (*Planning Phase*)
			  ○ Identify needed future investigation (*Planning Phase*)
			  ○ Confirm or adapt BMP-specific design parameters and feasibility findings (*Design Phase*)
				• Describe the existing and proposed conditions of the site
				• Describe how the site connects to the off-site drainage system
				• Identify and characterize the water bodies to which the site discharges
				• Determine Pollutants of Concern
				• Determine whether Hydrologic Conditions of Concern apply
				• Document a comprehensive evaluation of conditions related to the feasibility of stormwater infiltration and harvesting (*Planning Phase)*
				• Document BMP-specific design investigations at BMP locations (if needed) to establish design parameters (*Design Phase*)

Step	WQMP Preparation Step	Section Reference (click to jump)	Key Efforts	Key Expected Outcomes
4	Develop the site design and drainage plan	2.4	• Develop the layout of the site and the conceptual drainage plan • Incorporate site design approaches and BMPs into overall project site design • Identify and reserve locations for site design BMPs and structural BMPs in the drainage plan • Identify structural BMP locations • Delineate "Drainage Management Areas" (DMAs) • Iteratively refine site design, drainage plan, and BMP locations as new information is available and as designs become more detailed	• Identify and incorporate applicable site design BMPs • Identify and incorporate applicable source control BMPs • Document the site configuration approaches that were used to maximize the feasibility of BMPs that include infiltration and harvesting • Establish the BMP locations and "Drainage Management Area" delineations as the foundation for BMP selection and sizing
5	Select, size, and design LID BMPs for each DMA (if applicable)	2.5	Apply site investigation data and drainage plan data to: • Determine the LID BMP category that is applicable to each DMA • Select a BMP from the applicable category • Determine the required size of the BMP • Compare sizing to available space to determine the need for design adaptation or alternate BMP selection • Determine the conceptual (*Planning Phase)* and detailed (*Design Phase*) BMP designs	Planning Phase: • Tentative BMP selection for each DMA • BMP sizing requirements for each DMA • Tentative confirmation that required sizes will be provided • Documentation and calculations for each DMA • Conceptual BMP design Design Phase: • Confirmed BMP types and design parameters • Final required size based on final DMA characteristics • Documentation and calculations for each DMA • Final BMP design

Step	WQMP Preparation Step	Section Reference (click to jump)	Key Efforts	Key Expected Outcomes
6	Select, size, and design hydromodification BMPs for each Point of Compliance (if applicable)	2.6	• Define points of compliance for hydromodification criteria • Conduct hydrologic analyses and iterative BMP design adaptation to develop a design that meets applicable hydromodification criteria • Determine the conceptual (*Planning Phase)* and detailed (*Design Phase*) BMP designs	Planning Phase: • Integrated structural BMP design and sizing that meets both LID and hydromodification control requirements • Documentation of hydromodification sizing calculations for each point of compliance • Conceptual BMP design Design Phase: • Integrated structural BMP design and sizing that meets both LID and hydromodification control requirements • Documentation of hydromodification sizing calculations for each point of compliance • Final BMP design
7	Prepare the Project WQMP and BMP plan	2.7	Assemble the results of step 1 through 6 into a compliant Project WQMP	Planning Phase: • Document the conceptual BMP plan • Document that appropriate BMPs are selected • Provide tentative confirmation that required sizes will be provided Design Phase: • Document the final BMP plan • Document confirmation that BMPs are selected per hierarchy, are protective of property and environment, and are maintainable. • Provide a definitive comparison of required size versus as-designed size

Step	WQMP Preparation Step	Section Reference (click to jump)	Key Efforts	Key Expected Outcomes
8	Prepare the Operation and Maintenance (O&M) Plan	2.8	Identify the following for each BMP: • Maintenance responsibility and funding source • Inspection requirements • Routine, periodic, and corrective maintenance requirements and triggers • Documentation requirements	Funded, implementable, enforceable, and transferrable plan for perpetual O&M of all BMPs included in the WQMP. Only required as part of the Final Project WQMP.

Frequent Questions

Does this approach need to be followed precisely?

No, it is expected that most projects will adapt the details of this approach based on project-specific considerations. As with every aspect of this TGD, the intent is to provide recommended guidelines for how to meet the minimum criteria described in the Model WQMP. The applicant and reviewer have discretion to deviate from these guidelines with appropriate rationale provided that minimum criteria are met.

Is this a linear process?

In reality, most design processes are iterative. It is expected that there will be feedback loops in this process, and the acquisition of additional data or design adjustments as part of design refinement may prompt revisiting earlier steps.

Why is the feasibility of infiltration important in WQMP development?

Determining where and to what degree infiltration is feasible is among the most important questions that guides WQMP development. Retention (i.e., control of the DCV without surface discharge) is the highest priority type of LID BMP and must be used unless demonstrated to be infeasible. Infiltration is the most significant retention process that may be feasible in typical cases. Additionally, biotreatment must be designed to maximum volume retention, including incidental infiltration and evapotranspiration. However, there are a number of factors that limit infiltration to being only partially feasible or not feasible in any amount. This influences BMP selection and sizing. It also can have an effect on integrating hydromodification management into BMP designs.

Do all of the potential infiltration feasibility criteria associated with Step 5 (LID BMP Selection and Design) need to be evaluated?

Not necessarily. Because the LID BMP hierarchy prioritizes infiltration, infiltration feasibility needs to be evaluated. However, infiltration feasibility criteria are numerous, including infiltration rates, groundwater depths, groundwater quality protection, geotechnical hazards, and other factors. Any individual feasibility criterion can control a decision not to infiltrate. So, if a single criterion shows that infiltration is infeasible, there is no need to evaluate any other criteria. However, if infiltration will be used, then the acceptability of this decision must be adequately supported through evaluation of each criterion.

Can regional maps be used to support infiltration feasibility decisions?

At the planning phase, regional maps (Appendix N) can serve as tools for understanding what constraints may exist. However, these maps are considered to be adequately reliable to support

final decisions for only a subset of project and conditions. Additional information on the use of regional maps for infiltration feasibility investigations is provided in Section 4.2.

What is meant by "planning phase" and "design phase" in these steps?

This is loosely associated with the Conceptual/Preliminary WQMP and Final Project WQMP phases. However, it does not need to be associated on a 1-to-1 basis. For a small project where more precise site design is being included in the Conceptual/Preliminary WQMP application, both planning and design phases may be conducted prior to the Conceptual/Preliminary WQMP

In general, at the planning phase, the purpose of site design, investigation, and BMP sizing is to demonstrate that:

- The site has been configured in a way that considers stormwater management objectives
- Differences in infiltration feasibility across the site have been estimated and incorporated into this layout and proposed BMP locations, to the extent feasible
- Appropriate site-specific data has been used to tentatively classify the site in terms of infiltration and harvesting feasibility and hydromodification requirements and appropriate LID BMPs and hydromodification BMPs have been selected
- The space allocated or committed for BMPs is adequate for the BMP sizes estimated to be needed.

In general, at the design phase, the purpose of site design, investigation, and BMP sizing is to demonstrate that:

- The BMP types and designs at each specific location are supported by design phase investigations
- The BMP sizes that are designed are equal to or greater to what is provided

It can be seen that the methods and burden of proof associated with site investigation and associated BMP design is different at the planning phase. This is especially true for projects of a larger scale where there is more flexibility to establish the layout of the project site and where planning phase investigations must inherently be done at a different scale and degree of confidence than design phase investigations.

Are two phases of investigation always necessary?

No. The applicant is responsible for the meeting the following burdens of proof:

- Reliable information has been obtained and adequately considered in site layout and BMP selection consistent with the LID hierarchy
- The selected BMPs are designed to be effective, and protective of property and the environment based on information that applies to the exact location of the BMP.

There are two common cases where a second phase may not be needed:

- If the initial investigation conducted to support conceptual design obtains defensible design-level tests at the specific location of the proposed BMPs that carry through detailed design, then it is not necessary to do additional testing.
- If planning phase investigations definitively conclude that full infiltration is not feasible, then it is not necessary to conduct design phase investigations to demonstrate this again. This finding supports the selection of BMPs that do not rely solely on infiltration, therefore BMP design is resilient to whatever actual infiltration rates are eventually present at BMP locations.

Regardless of the need for additional investigation, the project development process still requires a Conceptual/Preliminary WQMP followed by a Final Project WQMP in most cases.

Does this process allow BMP types to be changed between the planning and design phase?

Yes. BMP types or design configuration must be changed if design phase investigations or analyses at the BMP locations do not support the initial BMP selection and conceptual design. In cases where planning level investigations form the basis for discretionary approvals, the Conceptual/Preliminary WQMP needs to recognize the commitment for further BMP-site-specific testing and identify the range of design contingencies or adaptations that could result. The consideration of these potential contingencies in the discretionary approval provides the envelope of approval for these adjustment to be made, with adequate supporting information, in the design phase.

2.1. Step 1: Document Discretionary Permits and Water Quality Conditions

Section 1 of the WQMP should list the discretionary permit(s) applicable to the project and provide the site address or lot and tract/parcel map number describing the property.

Information from Prior Approvals. List, verbatim, any Water Quality Conditions arising from prior approvals, including the condition requiring preparation of a WQMP, if applicable. Water Quality Conditions may be included as mitigation measures in California Environmental Quality Act (CEQA) documents for the project. For example, a Mitigation Monitoring and Report Program (MMRP) adopted in a certified Environmental Impact Statement (EIR) may include Project Design Features (PDFs), Standard Conditions (SCs), and Mitigation Measures (MMs) related to water quality protection.

A Conceptual/Preliminary WQMP should be prepared for the project in the preliminary planning stages, for example, as a technical appendix in an EIR. At this phase, there may be relatively few prior approvals and prior conditions of note. Through the EIR process or equivalent, and through the review and approval of the Conceptual/Preliminary WQMP, it is common for conditions of approval to be added.

The Conceptual/Preliminary WQMP must be used as a source of information for the Final Project WQMP. The project description and stormwater control approaches must be substantially consistent with the Conceptual/Preliminary WQMP, otherwise an additional discretionary approval process may be necessary. In order to demonstrate consistency, Section 1 of the Final Project WQMP should discuss whether there are any substantial differences compared to the Conceptual/Preliminary WQMP and the significance of these differences.

If the project is part of a common plan of development where regional BMPs have been installed as part of an earlier phase, then these regional facilities should be described here, including the planning and design documents related to their construction.

Watershed-based plans. Watershed planning efforts may also result in special conditions that must be considered in WQMP development for Priority Projects. The following watershed-based plans should be reviewed for requirements that may affect the selection of best management practices (BMPs) for the project:

> ***Water Quality Improvement Plans (South Orange County).*** A Water Quality Improvement Plan has been developed as required by the SOC MS4 permit. WQIPs provide an adaptive management pathway for Copermittees to select and address the highest priority water quality issues in receiving waters through an iterative process. Within this process, the pollutants of highest priority are identified for each region. Additionally, strategies have been identified and will be implemented, which may be related to land development projects. These may exceed the provisions described in the Model WQMP and TGD.

Watershed Management Plans (North Orange County). [Placeholder for section to be developed].

2.2. Step 2: Document the Project Description

This section provides guidance for documenting the project descriptions as part of completing Section 2 of the WQMP template. This section of the Conceptual/Preliminary or Project WQMP should provide the information listed below. The purpose of this information is to:

- Legally define what is meant by the "project" for the purpose of discretionary and subsequent approval
- Provide a general introduction to proposed development patterns, land uses, site activities as they relate to determining applicable stormwater management provision.

This section should not provide a detailed description of the existing or proposed site. That information should be catalogued in more detail as part Step 3: Site and Watershed Characterization.

The project description section of the WQMP should include:

- Project location, parcel numbers, and legal address, as applicable
- Legal boundaries of the proposed project
- Project acreage
- Proposed land uses and site activities, including associated quantification (e.g., acreages, units)
- Off-site improvements as part of the overall project action
- General description of site grading and drainage modifications as part of proposed development

Describe the ownership of all portions of the project and site. State whether any infrastructure will transfer to public agencies (City, County, Caltrans, etc.). State if a homeowners or property owners' association will be formed that will be responsible for the long term maintenance of the project's stormwater facilities.

The information in this section must match the legal project description that is being considered as part of discretionary approval.

2.3. Step 3: Characterize the Site and Watershed

This section provides guidance for conducing site and watershed characterization as part of completing Section 3 of the WQMP template and supporting subsequent decisions about the BMP plan. The purpose of this section of the WQMP is to provide data to support site design, drainage design and BMP selection. This step consists of the following steps:

- Characterize site conditions
- Characterize proposed site development activities
- Identify receiving waters
- Determine Pollutants of Concern (POCs)
- Determine if HCOCs apply

2.3.1. Characterize Site Conditions

The WQMP must describe the existing condition of the site. At a minimum, the following information summarized in Table 2-2 must be catalogued.

Table 2-2. Expected Activities and WQMP Content for Investigation of the Existing Site

Expected Activities/Content	Rationale
Identify sensitive environmental features and hydrologic features that currently exist at the site.	The WQMP must document that the site was designed in a way to minimize impacts to these features.
Identify drainage patterns, including points of run-on and run-off from the project site	These are important constraints in developing post-development drainage plans. For infill and redevelopment site, the existing developed grade and points of connection to the storm sewer system may not be able to be changed significantly during development.
Quantify existing impervious cover	This is important to evaluate the "50% rule" in determining the priority status of a project.
Characterize existing topography	The change in topography proposed as part of development (e.g., cut/fill) can be relevant for BMP selection.
[Planning level; all sites] Describe soil, groundwater, geotechnical, and/or utility issues (as applicable) at a level of detail and site specificity adequate to support the tentative determination of infiltration feasibility for all portions of the site where it may be reasonably practical to site LID BMPs.	BMP selection based on the LID hierarchy must be adequately documented based on "substantial evidence." The level of effort and the range of factors needed to satisfy this burden of proof is expected to vary from project to project depending on the size and complexity of the project and the features of the site.

Expected Activities/Content	Rationale
[Design level; only if full infiltration BMPs are used] Provide additional or modified description of soil, groundwater, geotechnical, and/or utility issues (as applicable) at specific BMP locations adequate to support the design and construction of BMPs.	If full infiltration BMPs are used, the design of BMPs must be fully supported by site-specific information at the precise location of the BMP site.

The following sections provide guidance for satisfying this minimum content in the characterization of the existing site condition. The specific recommendations contained in this section are not intended to prevent the consideration of site-specific factors or substitute for the need to exercise sound engineering judgment. In addition, the recommendations made in this section are intended to be applied to the extent that they are necessary to meet minimum site-assessment requirements. These recommendations are not intended to imply that each of these analyses must be conducted for every project if an equally reliable source of information is available in place of any of these analyses or if the analysis outcome is obvious and can be documented based on simpler analysis methods. For example, if groundwater is known to be very deep based on regional surveys or other available information, it is not necessary to conduct an evaluation of the exact elevation of the water table or the potential for groundwater mounding.

2.3.1.1. Topography, Drainage Patterns, and Infrastructure

The planning and design phase of most projects should begin with a topographic and environmental survey of the project site. Based on this information, the WQMP should describe, as applicable:

- Overview of site topography
- Site elevations ranges and slopes
- Presence, locations, and extents of slopes over 15 percent
- General surface drainage patterns
- Specific points of concentrated runoff onto and off of the site
- Acreage and imperviousness of land upstream of each point of concentrated or sheet flow run-on
- Existing storm drain infrastructure and points of connection from the site
- Existing impervious surfaces
- Adjacent infrastructure to remain in service after project development (e.g., roads, foundations)
- On-site or adjacent utilities (within 100 feet)

2.3.1.2. Groundwater Considerations

Site groundwater conditions at the site must be investigated in a manner adequate to support the selection of LID BMPs consistent with the LID BMP selection hierarchy described in Section 2.5. This investigation must be conducted for all locations of the site where it is reasonably possible to site LID BMPs. Guidance on specific methods and criteria for evaluating the feasibility of infiltration related to groundwater consideration is provided in **Appendix C.**

Groundwater Levels

The depth to seasonal high groundwater table (normal high depth during the wet season) beneath the project may preclude infiltration if the groundwater table is too close to the surface. Depth to seasonal high groundwater level should be estimated as the average of the annual minima (i.e., the shallowest recorded measurements in each water year, defined as October 1 through September 30) for all years on record. If groundwater level data are not available or not considered to be representative, seasonal high groundwater depth can be determined using field data, regional surveys, or geologic reports of the site. If regional groundwater is known to be very deep, then these methods may suffice for investigation of groundwater levels depending on the needs and circumstances of the project. If regional groundwater levels are relatively shallow, then the groundwater depth at the site can be determined by redoximorphic analytical methods combined with temporary groundwater monitoring for November 1 through April 1 at the proposed project site. **Appendix C** provides guidance for determining the depth to seasonally high groundwater table and the potential magnitude of groundwater mounding that could occur below infiltration BMPs.

Groundwater and Soil Contamination

In areas with known groundwater and soil pollution, infiltration may need to be avoided if it could contribute to the movement or dispersion of soil or groundwater contamination or adversely affect ongoing clean-up efforts. Mobilization of groundwater contaminants may also be of concern where contamination from natural sources is prevalent (e.g., marine sediments, selenium-rich groundwater), to the extent that data is available. If infiltration is under consideration in areas where soil or groundwater pollutant mobilization is a concern, a site-specific analysis must be conducted to determine where infiltration-based BMPs can be used without adverse impacts. It is possible that a certain amount of stormwater infiltration would not be detrimental, or could be beneficial. See **Appendix C** for specific guidance on assessing groundwater and soil contamination to ensure that project drainage plans do not contribute to movement or dispersion of groundwater contamination or interfere with groundwater cleanup activities

Protection of Groundwater Quality

Research conducted on the effects on groundwater from stormwater infiltration by Pitt et al. (1994) indicate that the potential for contamination due to infiltration is dependent on a number of factors including the local hydrogeology and the chemical characteristics of the pollutants of concern. Chemical characteristics that influence the potential for groundwater impacts include

mobility, soluble fractions, and concentration. Pollutants that have high mobility (low adsorption potential to soil), a high soluble fraction (most of the pollutant is dissolved rather than particulate), and/or have a high concentration in urban runoff have an elevated risk for groundwater contamination. As a class of constituents, trace metals tend to adsorb onto soil particles and are filtered out by the soils. This has been confirmed by extensive data collected beneath stormwater detention/retention ponds in Fresno (conducted as part of the Nationwide Urban Runoff Program (Brown & Caldwell, 1984)) that showed that trace metals tended to be adsorbed in the upper few feet in the bottom sediments. Bacteria are also filtered out by soils. More mobile and soluble pollutants, such as chloride and nitrate, have a greater potential for impacting groundwater.

Appendix C provides criteria for infiltration related to protection of groundwater quality, including:

- Minimum separation from groundwater, including guidance for calculating mounding potential,
- Categorization of infiltration BMPs by relative risk of groundwater contamination,
- Pollutant sources in the tributary watershed and pretreatment requirements,
- Setbacks from known plumes and contaminated sites,
- Guidelines and triggers for review by applicable groundwater management agencies and/or well permitting agencies.

Appendix I provides specific guidelines for the use of stormwater dry wells as part of Project WQMPs.

Groundwater Aquifer Recharge

Infiltration of stormwater can provide the benefit of recharging groundwater aquifers if hydrogeological conditions are conducive and the site is located over an aquifer. As feasible, infiltration BMPs should be located in areas where infiltration would be most beneficial for groundwater recharge. The site characterization should attempt to identify areas where infiltration would have the greatest benefit for groundwater aquifer recharge. Generally, a greater fraction of infiltrated water reaches groundwater aquifers in cases where there is a relatively direct hydrogeological connection between the surface and an aquifer.

Groundwater/Surface Water Interactions

Groundwater discharge to surface water is generally a primary source of dry weather base flows in perennial stream systems. Intermittent and ephemeral systems are often characterized by groundwater discharge during portions of the year and streams losing flow to groundwater during other portions of the year. In Southern California, due to the Mediterranean climate, intermittent and ephemeral systems are very common. These systems may be sensitive to minor changes in groundwater levels which could result from increased infiltration compared to the existing condition. In such systems, increases in groundwater levels could potentially

increase the duration of dry weather base flows in intermittent and ephemeral drainages. These changes may have significant impacts on riparian habitat and geomorphology. If intermittent or ephemeral drainages are located adjacent to and down-gradient of the project, the application of infiltration BMPs could potentially impact these drainages, which could result in a finding of infeasibility for infiltration. The Conceptual/Preliminary or Project WQMP should provide analyses to support this finding. Consultation with the local groundwater agency may also help inform this analysis.

Coordination with Groundwater and Well Permitting Agencies

Certain infiltration activities should be coordinated with the applicable groundwater management agency, such as the Orange County Water District, to ensure groundwater quality is protected. It is recommended that coordination be initiated as early as possible during the Preliminary/Conceptual WQMP development process, as part of the CEQA process (preferred) or otherwise. See **Appendix C** for specific guidance as well as a template letter to facilitate groundwater agency consultation.

Certain infiltration BMPs, including dry wells and infiltration galleries trigger USEPA Class V Underground Injection Control (UIC) definitions and require registration via USEPA Region 9. The infiltration BMP Fact Sheets (**Appendix G**) identify BMPs that are potentially categorized as Class V Injection Wells and provide guidelines for registering these BMPs.

Dry wells are classified as Class V wells and fall under the California Well Standards (Bulletin 74-81) and the Orange County Well Ordinance (No. 2607). This requires design per specific standards and a specific separate permitting process beyond what is required for WQMPs. **Appendix I** provides guidance for use of dry wells.

2.3.1.3. Soil and Geologic Infiltration Characteristics

Soil and geologic conditions at the site must be investigated in a manner adequate to support the selection of LID BMPs consistent with the LID BMP selection hierarchy described in Section 2.5. This investigation must be conducted for all locations of the site where it is reasonably possible to site LID BMPs. Guidance on specific methods for measuring or estimating infiltration rates at the planning and design phases of project are described in **Appendix D.**

At the planning phase of a project, this investigation should result in, as applicable:

- Narrative description of soil conditions at the site, including information such as texture class, NRCS hydrologic soil group
- Narrative description of geologic conditions underlying the site, including information such as texture class, degree of consolidation.
- Locations of infiltration testing conducted at the project site
- Raw results and professional interpretation of infiltration tests conducted at the project site

- Locations and logs of borings at the project site that are relevant for interpretation of infiltration feasibility
- Identification of areas of the site that fall within estimated observed infiltration rate thresholds indicative of likelihood of full or partial stormwater infiltration (See Section 4.2.2 and Appendix D for definitions of "observed infiltration rate", "feasibility screening infiltration rate", and "design infiltration rate"):
    - Areas with an observed infiltration rate > 4 inch per hour – these areas have the highest potential for full infiltration BMPs.
    - Areas with an observed infiltration rate 0.6 to 4 inches per hour – these areas may support full infiltration BMPs, but conditions may be marginal and require more thorough analysis or contingency planning as part of BMP selection.
    - Areas with an observed infiltration rate 0.1 to 0.6 inches per hour – these areas may support incidental infiltration, but not likely full infiltration.
    - Areas with an observed infiltration rate less than 0.1 inches per hour – these areas likely do not support appreciable levels of incidental infiltration.
- A geotechnical investigation report containing investigation methods and interpretation of findings
- Characterization of surface soils to determine presence, locations, and extents of critical course sediment, as further defined in the **South Orange County HMP.** (Note: this provision applies only to projects which have an HCOC, see Section 2.3.5)

In addition, available geologic or geotechnical reports on local geology should be reviewed to identify relevant features such as depth to bedrock, rock type, lithology, faults, and hydrostratigraphic or confining units. These geologic investigations may also identify shallow water tables and past groundwater or soil contamination issues that are important for BMP design (see below). Geologic investigations may provide an assessment of whether soil infiltration properties are likely to be uniform or variable across the project site.

At the design phase of the project, if infiltration BMPs will be used, the investigation of soils and geology should also include:

- Infiltration testing at the location and elevation of the proposed infiltrating surface consistent with an acceptable design-phase testing method described in Appendix D.
- Interpretation of infiltration testing result consistent with the guidance provided in Appendix D.
- Stamped geotechnical report documenting and certifying findings.

Note that if the presence of another infiltration feasibility factor (e.g., groundwater limitation) controls the categorization of infiltration feasibility, no testing or site characterization may be needed to meet the minimum requirements.

2.3.1.4. Geotechnical Considerations

Infiltration of stormwater can cause geotechnical issues in certain conditions, including: (1) settlement through collapsible soil, (2) expansive soil movement, (3) slope instability, and (4) an increased liquefaction hazard. Stormwater infiltration temporarily raises the soil moisture and groundwater level near the infiltration facility, such that the potential geotechnical conditions are likely to be of greatest significance near the area of infiltration and diminish with distance. If infiltration BMPs are considered, a geotechnical investigation should be performed for the infiltration facility to identify potential geotechnical issues and geological hazards that may result from infiltration and identify potential mitigation measures.

Increased water pressure in soil pores reduces soil strength. Decreased soil strength can make foundations more susceptible to settlement and slopes more susceptible to failure. In general, infiltration-based BMPs must be set back from building foundations or steep slopes. Recommendations for each site should be determined by a licensed geotechnical engineer based on soil boring data, drainage patterns, and the current requirements for stormwater treatment. Implementing the geotechnical engineer's requirements is essential to prevent damage from increased subsurface water pressure to surrounding properties, public infrastructure, sloped banks, and even mudslides.

It must be noted that reliance on geotechnical engineering recommendations does not relieve the project applicant of attempting to identify locations for BMPs that satisfy the recommended setbacks and still allow the opportunity for infiltration.

Geotechnical recommendations should consider the following factors.

Collapsible Soil

Typically, collapsible soil is observed in sediments that are loosely deposited, separated by coatings or particles of clay or carbonate, and subject to saturation. Infiltration of stormwater may result in a temporary rise in the groundwater elevation. This rise in groundwater could change the soil structure by dissolving or deteriorating the intergranular contacts between the sand particles, resulting in a sudden collapse, referred to as hydrocollapse. This collapse phenomenon generally occurs during the first saturation episode after deposition of the soil, and repeated cycles of saturation are not likely to result in additional collapse. If infiltration is considered, it is important to evaluate the potential for hydrocollapse during the geotechnical investigation. The magnitude of hydrocollapse is proportional to the thickness of the soil column where infiltration is occurring; in most instances, the magnitude of hydrocollapse will be small. Regardless, if infiltration BMPs are considered, the geotechnical engineer should evaluate the potential effects of hydrocollapse and, if necessary, specify mitigation and monitoring measures.

Expansive Soil

Expansive soil is generally defined as soil or rock material that has a potential for shrinking or swelling under changing moisture conditions. Expansive soils contain clay minerals that expand in volume when water is introduced and shrink when the water is removed or the material is dried. When expansive soil is present near the ground surface, a rise in groundwater from infiltration activities can introduce moisture and cause these soils to swell. Conversely, as the groundwater surface falls after infiltration, these soils will shrink in response to the loss of moisture in the soil structure. The effects of expansive soil movement (swelling and shrinking) will be greatest on near surface structures such as shallow foundations, roadways, and concrete walks. Basements or below-grade parking structures can also be affected as additional loads are applied to the basement walls from the large swelling pressures generated by soil expansion. If infiltration BMPs are considered, the geotechnical investigation should identify if expandable materials are present near the proposed infiltration facility, and if they are, evaluate if the infiltration will result in wetting of these materials and any potential mitigation measures.

Slopes

Slopes near infiltration facilities can be affected by the temporary rise in groundwater. The presence of a water surface near a slope can substantially reduce the stability of the slope from a dry condition. If infiltration BMPs are considered near a slope, groundwater mounding analysis should be performed to evaluate the rise in groundwater around the facility. If the computed rise in groundwater approaches nearby slopes, then a separate slope stability evaluation should be performed to evaluate the implications of the temporary groundwater surface. The geotechnical and groundwater mounding evaluations should identify the duration of the elevated groundwater and assign factors of safety consistent with the duration (e.g., temporary or long-term conditions).

Liquefaction

Soil liquefaction is a phenomenon in which saturated granular materials experience a reduction in bulk volume and a loss of bearing capacity induced by seismic motion. Soil liquefaction can also result in instabilities and lateral spreading in embankments and areas of sloping ground.

Saturation of the subsurface soils above the existing groundwater table may occur as a result of stormwater infiltration. If infiltration BMPs are considered, the potential for liquefaction should be assessed. If this assessment shows that potential for liquefaction exists, appropriate geotechnical analyses should be conducted to determine the level of stormwater infiltration that can be safely tolerated.

2.3.1.5. Reporting of Groundwater, Soil and Geotechnical Investigations

For simple cases that have a clear basis for rejecting infiltration, separate reporting of groundwater, soil and geotechnical investigations may not be necessary. For example, for

projects that can document and confirm the presence of a limiting constraint within the WQMP, a supplemental report is not necessary. However, in cases where findings regarding infiltration feasibility and/or design involve data analysis and/or measurements that are beyond a standard civil engineering discipline, a separate report or set of reports prepared under the supervision of a qualified professional may be required. In any case, the documentation must present findings based on substantial evidence that are adequate to support defensible responses to the feasibility criteria described in Section 2.5, as applicable.

2.3.2. Characterize the Proposed Site Development Activities

The WQMP must describe the proposed condition of the site. At a minimum, the following information summarized in Table 2-3 must be catalogued. To the extent that this data is shown in drainage plan exhibits developed in subsequent sections, it is not necessary to have a separate exhibit in this section of the WQMP.

Table 2-3. Expected Activities and Content for Description of the Proposed Site

Expected Activities/Content	Rationale
Identify sensitive environmental features and hydrologic features that will be preserved at the site.	The WQMP must document that the site was designed in a way to minimize impacts to these features; certain site design BMPs are applicable to protection of these features
Identify proposed drainage patterns, including points of run-on and run-off from the project site.	These factors may represent constraints in siting BMPs. Run-on must be considered in sizing and crediting of BMPs as described in Section 2.5.
Characterize and quantify proposed land uses, land use activities, and applicable industrial codes	Land uses, land use activities, and industrial codes are relevant to defining pollutants of concern and determining applicable source control measures.
Characterize specific pollutant source areas	Specific pollutant source areas are relevant to identifying applicable source control measures.
Characterize the spatial extent, magnitude, and locations of significant proposed cut and fill	A description of proposed fill is relevant to the evaluation of infiltration feasibility. If BMPs will be located in fill, the infiltration rate of the BMPs cannot be known prior to construction, and a full infiltration approach is not acceptable.
Characterize potential harvested water demands in the proposed condition	Harvested water demand can be screened based on the overall project land uses to evaluate whether an LID approach based on harvesting may be feasible.

The following guidelines apply for information that should be collected and summarized.

2.3.2.1. Project Land Uses

Provide the following information:

- For the entire project, list and describe the proposed land uses, the area of each land use, and the estimated imperviousness for each land use.
- List and show on a figure where facilities will be located and what activities will be conducted:
    - List what kinds of materials and products will be used (if known), how and where materials will be received and stored (if applicable), and what kinds of wastes will be generated (if any).
    - Describe all paved areas, including the type of parking areas.
    - Describe all landscaped areas and open space areas (if any).
- For commercial and industrial projects:
    - Provide the Standard Industrial Classification (SIC) Code which best describes the facilities operations.
    - Describe the type of use (or uses) for each building or tenant space (if known).
    - If the project includes food preparation, cooking, and eating areas, specify the location and type of area.
    - Describe delivery areas and loading docks (specify location, design, if below grade, and types of materials expected to be transferred).
    - Describe outdoor materials storage areas (describe and depict location(s), specify type(s) of materials expected to be stored).
    - Describe activities that will be routinely conducted outdoors.
    - Describe any activities associated with equipment or vehicle maintenance and repair, including washing or cleaning.
    - Indicate the number of service bays or number of fueling islands/fuel pumps, if applicable.
- For residential projects:
    - For a single dwelling unit, describe the unit and project site.
    - For a tract, list the range of lot and home sizes.
    - Describe all community facilities such as laundry, car wash, swimming pools, parks, open spaces, tot lots, etc.

2.3.2.2. Post Development Drainage Characteristics

The Project WQMP should generally describe the proposed drainage for the site, including the following:

- Will the site connect to a storm drain system or discharge directly into a receiving water body?
- If the site will connect to a storm drain system, name the locations for the connection(s).

2.3.2.3. Property Ownership/Management

Describe the ownership of all portions of the project and site. State whether any infrastructure will transfer to public agencies (City, County, Caltrans, etc.). State if a homeowners or property owner's association will be formed that will be responsible for the long term maintenance of the project's stormwater facilities.

2.3.2.4. Potential Harvested Water Demands

The project proponent may choose to implement harvest and use BMPs to capture stormwater from the site and use it for demands such as irrigation and toilet flushing. Harvest and use BMPs for stormwater management require that there is sufficient demand for the harvested water so that the water can be used in a reasonable time. To support subsequent assessment of harvest and use feasibility, this section of the WQMP should describe the types and magnitudes of potential harvested water demands. **Appendix F** contains methods and guidance for calculating the potential harvested water demand for a range of scenarios.

2.3.3. Identify Receiving Waters

Name every receiving water to which the project will discharge. Name the direct receiving water body for the project site and list each subsequent water body until reaching the ocean. If the project will connect to the storm drain, determine where the storm drain system discharges into a receiving water body and each subsequent downstream receiving water. For assistance in mapping the receiving water bodies, see the maps provided in **Appendix N**.

2.3.4. Determine Pollutants of Concern

Urban runoff from a developed site has the potential to contribute pollutants to the municipal storm drain system and ultimately to the tributary receiving waters during both dry and wet weather. Pollutants that are commonly associated with urban development include suspended solids/sediment, nutrients, metals, pathogens, oil and grease, toxic organic compounds, and trash and debris. Additionally, non-permitted non-stormwater discharges that are allowed to leave the project site can also convey pollutants and are a water quality condition of concern. Pollutants of concern are separated into two types:

Primary pollutants of concern: Defined as pollutants that are expected to be generated by the project at levels of concern and are identified as an impairment of any downstream water body. Additionally, pollutants or conditions identified as contributing to a Highest Priority Water Quality Condition per the Water Quality Improvement Plan are a primary pollutant of concern regardless of the potential for them to be generated from the project.

Other Pollutants of Concern: Defined as pollutants identified as expected to be generated from the project at levels of concern, but for which downstream waterbodies are not listed as impaired.

The WQMP shall identify the pollutants and other water quality conditions of concern for the project based on the definition described in Section 2.3.4.5. Specifically, the WQMP shall:

- Determine pollutants expected to be generated or have the potential to be generated from the project based on land uses and specific features (See Section 2.3.4.2)
- Identify water quality impairments and/or priority receiving water quality conditions in the water bodies that receive runoff from the site, directly or indirectly, and all downstream water bodies (See Section 2.4.3.3)
- Identify environmentally sensitive areas that relate to the project (See Section 2.4.3.4)
- Identify primary pollutants or conditions of concern and identify other pollutants or conditions of concern (See Section 2.4.3.5).

The following sections provide guidance and resources for determining pollutants of concern.

2.3.4.1. Pollutant Categories

Pollutants and water quality conditions of concern can be grouped into the following seven general categories:

- ***Suspended Solids / Sediment***: consist of soils or other surficial materials that are eroded and then transported or deposited by wind, water, or gravity. Excessive sedimentation can increase turbidity, clog fish gills, reduce spawning habitat, lower young aquatic organisms survival rates, smother bottom dwelling organisms, and suppress aquatic vegetation growth. Sediments in runoff also transport other pollutants that adhere to them, including trace metals, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and phosphorus. Sediment also reduces storage and clogs media and soils in BMPs which impacts BMP performance. The largest source of suspended solids / sediment is typically erosion from disturbed soils.
- ***Nutrients/Eutrophication:*** includes the macro-nutrients nitrogen and phosphorus. They commonly exist in stormwater in the form of mineral salts or organic matter dissolved or suspended in stormwater. Excessive discharge of nutrients to water bodies and streams can cause eutrophication, including excessive aquatic algae and plant growth, loss of dissolved oxygen, release of toxins in sediment, and significant swings in

hydrogen ion concentration (pH). Primary sources of nutrients in urban runoff are fertilizers, illicit connections to sanitary sewers, trash and debris, pet waste, and eroded soils. Urban areas with improperly managed landscapes can be substantial sources.

- ***Metals:*** includes certain metals that can be toxic to aquatic life if concentrations become high enough to stress natural processes. Metals of concern include cadmium, chromium, copper, lead, mercury, and zinc among others. Lead and chromium have been used as corrosion inhibitors in primer coatings and are also raw material components in non-metal products such as fuels, adhesives, paints, and other coatings. Copper and zinc are typically associated with building materials, including galvanized metal and ornamental copper, and automotive products, including tires and brake pads. Humans can be impacted from contaminated groundwater resources, and bioaccumulation of metals in fish and shellfish. Environmental concerns regarding the potential for release of metals to the environment have already led to restricted metal usage in certain applications, for example lead additives in gasoline. The primary source of metals in urban stormwater is typically commercially available metal products and automobiles.
- ***Pathogens (Bacteria and Viruses)/Human Health Risk***: include harmful bacteria and viruses, which are ubiquitous microorganisms that thrive under a range of environmental conditions. Water containing excessive pathogenic bacteria and viruses, particularly form human sources, can create a harmful environment for humans and aquatic life. This has been identified as a Highest Priority Water Quality Condition in coastal waters in South Orange County. Typically, in Southern California, indicator bacteria are used as a surrogate of pathogens because there are many different pathogens, and the methods required to detect and monitor them are much more complex than those used for indicator bacteria. Indicator bacteria are fecal bacteria that originate from human or animal wastes, so their presence may indicate the present of pathogens.
- ***Oil and Grease***: are characterized as high-molecular weight organic compounds. Elevated oil and grease content can decrease the aesthetic value of the water body, as well as the water quality. Introduction of these pollutants to water bodies may occur due to the wide uses and applications of some of these products in municipal, residential, commercial, industrial, and construction areas. Primary sources of oil and grease are petroleum hydrocarbon products, motor products from leaking vehicles, esters, oils, fats, waxes, and high molecular-weight fatty acids.
- ***Toxic Organic Compounds***: include organic compounds (pesticides, solvents, hydrocarbons) which at certain concentrations constitute a hazard to humans and/or aquatic organisms. Stormwater coming into contact with organic compounds can transport excessive levels organics to receiving waters. Dirt, grease, and grime retained in cleaning fluid or rinse water may also adsorb levels of organic compounds that are harmful or hazardous to aquatic life. Sources of organic compounds include landscape maintenance areas, vehicle maintenance areas, waste handling areas, and potentially most other urban areas.

- ***Trash and Debris –*** includes trash, such as paper, plastic, and various waste materials, that can typically be found throughout the urban landscape, and debris which includes waste products of natural origin which are not naturally discharged to water bodies such as landscaping waste, woody debris, etc. The presence of trash and debris may have a significant impact on the recreational value of a water body and upon the health of aquatic habitat. Trash and debris also tend to clog stormwater infrastructure and can be source of other pollutants as they break down.
- ***Dry Weather Flows –*** Dry weather flows (e.g., irrigation overspray, air conditioner condensate, car wash water) have the potential to impact riparian beneficial uses by contributing to an unnatural flow regime in inland streams. This condition has been identified as a Highest Priority Water Quality Condition in inland receiving waters in South Orange County.

2.3.4.2. Expected Pollutants Based on Project Land Use Activities

This section describes how to determine expected pollutants based on project land use activities. Pollutants in stormwater runoff are typically related to land use activities, which means that the project's site uses provide some indication of the pollutants that may be present in runoff from the project site. Pollutants that are expected to be generated or have a potential to be generated from a project based on the project's land use activities must be identified using **Table 2-3**, as applicable**.** The identification of expected pollutants must always be based on the land use activities proposed. In addition, site-specific conditions must also be considered for potential pollutant sources, such as pollutants generated from specific process on-site, legacy pesticides or nutrients in site soils as a result of past agricultural practices or hazardous materials in site soils from industrial uses. Hazardous materials that have been remediated and do not pose a current or future threat to stormwater quality are not considered a pollutant of concern.

Municipal projects should determine expected pollutants based on the pollutant generating activities associated with the project using Table 5.5 in **Section 5 of the Orange County DAMP** (**www.ocwatersheds.com/Documents/2003_DAMP_Section_5_Municipal_Activities.pdf**).

Table 2-3: Anticipated and Potential Pollutants Generated by Land Use Type

Priority Project Categories and/or Project Features	General Pollutant Categories							
	Suspended Solid/ Sediments	Nutrients	Heavy Metals	Pathogens (Bacteria/ Virus)	Pesticides	Oil & Grease	Toxic Organic Compounds	Trash & Debris
Detached Residential Development	E	E(1)	N	E	E(1)	E	N	E
Attached Residential Development	E	E(1)	N	E	E(1)	E(2)	N	E
Commercial/ Industrial Development	E(1)	E(1)	E(2)	E(3)	E(1)	E	E	E
Automotive Repair Shops	N	N	E	N	N	E	E	E
Restaurants	E(1)(2)	E(1)	E(2)	E	E(1)	E	N	E
Hillside Development >5,000 ft²	E	E(1)	N	E	E(1)	E	N	E
Parking Lots	E	E(1)	E	E(4)	E(1)	E	E	E
Streets, Highways, & Freeways	E	E (1)	E	E(4)	E(1)	E	E	E
Retail Gasoline Outlets	N	N	E	N	N	E	E	E

E = expected to be of concern
N = not expected to be of concern

(1) Expected pollutant if non-drought tolerant landscaping exists on-site. Where landscaping is drought tolerant and is depressed within planting areas, nutrients and pesticides are not expected at levels of concern.
(2) Expected pollutant if the project includes uncovered parking areas, otherwise not expected.
(3) Expected pollutant if land use involves food or animal waste products, otherwise not expected.
(4) Bacterial indicators are routinely detected in pavement runoff.
(5) Expected if outdoor storage or metal roofs, otherwise not expected.

2.3.4.3. *Identifying Water Quality Impairments, TMDLs, and Highest Priority Water Quality Conditions*

The presence of impairments and TMDLs has an important role in the identification of pollutants of concern and therefore selection of BMPs for the project. Therefore, it is important to identify impairments and TMDLs as part of Section 3 of the Project WQMP.

Table 2-5 lists the impaired waterbodies within the South Orange County permit area that are included on the 2010 303(d) list. The 303(d) listings for the San Diego Region (South Orange County permit area) were scheduled to be updated in the 2016 Integrated Report. As of the writing of this document, only the 2010 Integrated Report with the 2010 303(d) listings has been approved by USEPA for the San Diego Region. **Project proponents should consult the most recent EPA-approved 303(d) list to identify whether the project's proximate and downstream receiving water bodies are listed as impaired.** The WQMP should document the 303(d) list that was consulted. The most recent EPA-approved 303(d) list is located on the State Water Resources Control Board website[5] **Table 2-6** lists TMDLs that have been adopted and are being implemented in the Orange County Watersheds as of March 2016.

In South Orange County Water Quality Improvement Plan identifies the highest priority water quality conditions for receiving waters. A highest priority water quality condition is considered to be a priority pollutant or condition, even if that pollutant or condition is not typically generated from that land use type. Highest priority water quality conditions include:

> **Pathogen Health Risk:** Applies to coastal waters, including any inland water that discharges to coastal waters. Pathogens and indicator bacteria should always be categorized as a primary pollutant of concern.
>
> **Unnatural Water Balance/Flow Regime:** Applies to all inland receiving waters. Dry weather discharges from projects should always be classified as a primary water quality condition of concern for areas that drain to inland receiving waters. Additionally, if a subsequent update of the Water Quality Improvement Plan determines that stormwater infiltration is responsible for unnatural water balance in a specified area, then this may be a basis for determining infeasibility of infiltration in that the specified area.
>
> **Geomorphic Impacts/Stream Erosion:** This is relevant to any channel that is susceptible to hydromodification impacts as described in Section 2.3.5. Priority Projects discharging to susceptible reaches are required to meet hydromodification control criteria.

Highest priority water quality conditions may change over time with revisions of the Water Quality Improvement Plan.

[5] http://www.swrcb.ca.gov/water_issues/programs/#wqassessment

Table 2-4: Summary of the Approved 2010 303(d) Listed Water Bodies and Associated Pollutants of Concern for North Orange County

[Placeholder for future addition after adoption of the 5th Term NOC MS4 Permit]

Table 2-5: Summary of the Approved 2010 303(d) Listed Water Bodies and Associated Pollutants of Concern for South Orange County

Region	Water Body	Bacteria Indicators/ Pathogens	Metals	Nutrients	Pesticides	Toxicity	Trash	Sediment	Other Organics	Other Inorganics
Region 9 San Diego	Aliso Creek (Mouth)	X								
	Aliso Creek (20 Miles)	X	X	X		X				
	Arroyo Trabuco Creek			X	X	X				
	Dana Point Harbor		X			X				
	English Canyon		X		X	X			X	
	Laguna Canyon Channel					X				
	Oso Creek (at Mission Viejo Golf Course)									X
	Oso Creek (lower)		X			X				
	Pacific Ocean Shoreline, Aliso HSA at Aliso Beach (Middle and Mouth)	X								
	Pacific Ocean Shoreline, Dana Point HSA	X								
	Pacific Ocean Shoreline, Laguna Beach has at Main Beach	X								
	Pacific Ocean Shoreline, Lower San Juan HSAs	X								
	Pacific Ocean Shoreline, San Clemente HA	X								
	Pacific Ocean Shoreline, Tijuana HU	X								
	Prima Deshecha Creek		X	X				X		
	San Juan Creek	X	X	X	X	X				
	San Juan Creek (mouth)	X								
	Segunda Deshecha Creek			X		X		X		

On October 11, 2011, the 2010 303(d) list was approved by USEPA Region 9. Project proponents should consult the most recent 303(d) list located on the State Water Resources Control Board website[6].

[6] http://www.swrcb.ca.gov/water_issues/programs/#wqassessment

Table 2-6: Summary of the Status of TMDLs for Waterbodies in Regions 8 (NOC) and 9 (SOC).

Region	Water Body	Pollutant				
		Bacteria Indicators/ Pathogens	Metals	Nutrients	Pesticides	Turbidity/ Siltation
Region 8 Santa Ana (NOC) (Included as a placeholder only until adoption of the 5th Term NOC MS4 Permit)	Newport Bay, Lower	Implementation Phase	Technical TMDLs	Implementation Phase	Technical TMDLs	Implementation Phase
	Newport Bay, Upper (Ecological Reserve)	Implementation Phase	Technical TMDLs	Implementation Phase	Technical TMDLs and Implementation Phase	Implementation Phase
	San Diego Creek, Reach 1		Technical TMDLs	Implementation Phase	Technical TMDLs and Implementation Phase	Implementation Phase
	San Diego Creek, Reach 2		Technical TMDLs	Implementation Phase		Implementation Phase
	Coyote Creek/San Gabriel River		Technical TMDLs[1]			
Region 9 San Diego (SOC)	Pacific Ocean Shoreline: Laguna Beach HSA, Aliso HSA, Dan Point HSA, Lower San Juan HSA, San Clemente HSA	Implementation Phase				
	Pacific Ocean Shoreline: Dana Point Harbor at Baby Beach	Implementation Phase				
	Aliso Creek	Implementation Phase				
	San Juan Creek	Implementation Phase				
	Pacific Ocean Shoreline: Doheny State Beach	In Progress				

[1]This TMDL was adopted by the Los Angeles Regional Water Quality Control Board (Region 4), however it applies to the areas of Orange County that drain to Coyote Creek and San Gabriel River.

2.3.4.4. Determining Environmentally Sensitive Areas and Areas of Special Biological Concern

To assist developers in determining the presence of ESAs such as areas designated in the Ocean Plan as Areas of Special Biological Significance (ASBS) or waterbodies listed on the CWA Section 303(d) list of impaired waters, The County of Orange has prepared watershed maps that identify each ESA (http://ocwatersheds.com/documents/wqmp).

A Priority Project may potentially impact a water body considered to be an ESA if this project is:

- Within or adjacent to, or
- Discharge pollutants directly to an ESA

For the purposes of these procedures, the following terms are defined:

- *Adjacent* -located within 200 feet of the listed water body
- *Discharging directly to* -discharge from a drainage system that is composed entirely of flows from the subject facility or activity, i.e., discharge from an urban area that comingles with downstream flows prior to discharging to an ESA is not subject to this requirement.

An ESA exists if any of the following designations have been applied to the water body of concern:

- Clean Water Act 303(d) listed impaired water body based on **most recent approved 303(d) list.**
- Areas designated as Areas of Special Biological Significance by the SWRCB in the Water Quality Control Plan for Ocean Waters of California (California Ocean Plan)
- Water bodies designated with the RARE beneficial use by the SWRCB in the Water Quality Control Plans for the Santa Ana River and San Diego Basins (Region 8 and Region 9 Basin Plans)
- Water bodies located within areas designated under the California Department of Fish and Game's Natural Community Conservation Planning (NCCP) Program as preserves or equivalent in subregional plans (http://www.dfg.ca.gov/nccp/status.htm)
- Areas designated as Critical Aquatic Resources in the Orange County Drainage Area Management Plan (DAMP)
- Any other equivalent ESAs that contain water bodies that have been identified by the local jurisdiction to be of local concern.

The maps available at the OC Watersheds website may be used to assist in the identification and classification Priority Projects in order to determine if they potentially impact an ESA. (http://ocwatersheds.com/documents/wqmp)

2.3.4.5. Selecting the Pollutants of Concern for the Project

Compare the list of pollutants for which the receiving waters are impaired or for which TMDLs have been adopted with the pollutants anticipated to be generated by the land uses included in the project (as identified in **Table 2-3**). In SOC, in addition to the pollutants generated by the land uses included in the project, identify the highest pollutant of concern from the WQIP applicable for the location of the project.

Primary Pollutants of Concern are any pollutants anticipated to be generated by the project using **Table 2-3** that have also been identified as causing impairment of project receiving waters (**Table 2-4** or **Table 2-5)** or for which a TMDLs is in place (**Table 2-6)**. Note that this applies to all receiving waters between the point of discharge from the project and the ocean. In addition, a highest priority water quality condition from the Water Quality Improvement Plan is also a primary pollutant of concern, even if it is not expected to be generated at levels of concern by land uses included in the project.

Other pollutants of concern are those pollutants anticipated to be generated by the project using **Table 2-3** that have not been identified as causing impairment in the project's receiving waters. In addition, pollutants that may affect the performance of BMPs (e.g. sediment) should be considered when selecting pretreatment and designing BMPs.

In addition to the process described in this section, primary pollutants of concern may also be identified through the environmental impact assessment for the project (e.g., project-specific pollutant evaluations in CEQA EIRs). Watershed planning documents should also be reviewed for identification of specific implementation requirements that address pollutants of concern as discussed in **Section 2.1.**

Guidance on selecting LID and treatment control BMPs to address pollutants of concern is provided in **Section 4.2**.

2.3.5. Determine Potential Hydrologic Conditions of Concern

The physical response of stream channels to changes in catchment runoff and sediment yield caused by land use modifications is referred to as hydromodification. Unless managed, hydromodification can cause channel erosion, migration, or sedimentation, as well as biologic impacts to streams.

2.3.5.1. Primary Basis for Determining Potential HCOCs

This section of the WQMP (Section 3.5) shall identify whether there are potential HCOCs. This section does not need to determine whether hydromodification controls are needed to address the HCOC; it simply determines whether HCOCs need to be considered as part of Step 6 (Section 2.6) or whether this design requirement can be disregarded.

The determination of potential HCOCs is made primarily based on whether there are channels downstream that are susceptible to hydromodification.

For phased projects, the determination of potential HCOCs and subsequent analysis to address HCOCs should be done for the overall project and for each phase as it is approved, cumulative of the current phase and previously completed phases. More guidance on phased projects is provided in Section 4.8 of the Model WQMP.

North Orange County

[Placeholder for future addition after adoption of the 5th Term NOC MS4 Permit]

South Orange County

Projects are categorically exempted from hydromodification requirements where the project discharges to:

1. Existing underground storm drains discharging directly to water storage reservoirs, lakes, enclosed embayments, the Pacific Ocean, or one of the channel types described below;
2. Conveyance channels whose bed and bank are concrete lined all the way from the point of discharge to water storage reservoirs, lakes, enclosed embayments, or the Pacific Ocean; or
3. An area identified by the Copermittees as appropriate for an exemption by the optional Watershed Management Area Analysis incorporated into the Water Quality Improvement Plan.

The most recent approved version of the Watershed Management Area Analysis shall be consulted to determine the list of reaches that are exempted per bullet #3 above. If waterbodies are not potentially susceptible to hydromodification impacts, an HCOC does not exist and hydromodification does not need to be considered further.

2.3.5.2. Potential Project-Specific Exemptions in North Orange County

[Placeholder for future addition after adoption of the 5th Term NOC MS4 Permit]

2.3.5.3. Potential Project-Specific Exemptions in South Orange County

Project-specific determination of the susceptibility of downstream channels may be pursued by the permittee and/or project applicant via an amendment to the Watershed Management Area Analysis.

The project applicant and/or permittee may provide the technical basis for an amendment to the list of exempted reaches approved as part of the Watershed Management Area Analysis. At the permittee's discretion, this amendment to the Watershed Management Area Analysis may be submitted to the San Diego RWQCB at an acceptable time for consideration and approval. If approval is granted, this additional exemption can be granted for the Priority Project.

2.3.5.4. Guidance for Optional Project-Specific Evaluation of Stream Susceptibility

Should the project applicant and/or permittee pursue an amendment to the hydromodification susceptibility maps and/or list of exempted reaches via one of the pathways described above (Section 2.3.5.2 or 2.3.5.3), a technically defensible analysis of stream susceptibility is necessary. This analysis should be conducted by a qualified professional. This analysis must be based on "substantial evidence" and consider cumulative effects of proposed or potential land development within the watershed in conformance to CEQA requirements.

The following guidelines apply to conducing a project or reach-specific analysis of stream susceptibility.

- The inherent potential for a stream channel to undergo excessive downcutting or widening in response to hydromodification caused by land use changes is related to a number of factors, including the nature of the bed and bank materials, channel geometry and slope, sediment supply, and flow regime. Potential impacts on channel stability must include considerations of the following, as applicable:

    - **Bed and bank materials**. Sand-bedded streams have lower critical shear stresses and are more readily transported by increased flows, whereas channel materials that are larger, such as gravels and cobbles, and more cohesive, such as clays, are more resistant.
    - **Channel geometry and slope**. The magnitude of applied shear stress on the channel boundary for a given flow is dependent on both cross section geometry and longitudinal slope. The width to depth ratio of the channel will influence how shear stresses increase with increasing flows (e.g. with other factors such as slope and bottom and side slope materials the same, deep, narrow channels will experience higher shear stresses for a given flow than a shallower, wider channel of similar cross-sectional area). Incised channels may also have banks which are close to or above the critical height for stability (a function of bank angle and degree of cohesion, in addition to height).
    - **Sediment supply**. Sediment-starved or "hungry" water can lead to channel degradation and instability. Land development can cause a reduction in the amount of sediment delivered to a stream system by trapping sediment in detention facilities and/or removing sediment supply by mass grading, compaction, landscaping, and paving. In the tectonically active region of Southern California, many streams are naturally transport-limited, meaning the rate that sediment is supplied to the stream network is greater than the in-stream sediment transport capacity. If the sediment supply is reduced to a level less than the transport capacity, then the stream becomes supply-limited and susceptible to excess in-stream erosion due to sediment supply reductions.
    - **Flow regime.** Reduced infiltration and interception storage capacity associated with impervious surfaces and soil compaction result in increased magnitude and

frequency of surface runoff. Furthermore, ephemeral/intermittent streams in Southern California appear to be highly sensitive to changes in total basin impervious cover, more-so than perennial streams (SCCWRP, 2005[7]). Ephemeral/intermittent streams are also considered more susceptible to vegetation type changes (and resulting habitat impacts) due to dry weather flows even if these flows are not great enough to cause excess erosion.

- Physical structures may be severely impacted by channel morphological changes and instability, resulting in potential loss of infrastructure, property damage, creation of unsafe conditions for residents and motorists, and water quality impacts through leaks or spills of toxic or oxygen demanding materials. Infrastructure can in turn cause changes in sediment transport processes within stream channels, and therefore these data will also inform the assessment of susceptibility to excess erosion. Existing infrastructure may also provide some opportunities to control hydromodification impacts. For example, by retrofitting the existing outlet structure of a detention basin to mimic the pre-development flow regime or through routing runoff into a reclaimed water supply system (assuming water supply standards have been adequately addressed) such as Rattlesnake or Sand Canyon Reservoirs. Potential impacts to physical structures must consider the following, as applicable:

    - Utility networks (e.g., sewer lines, gas lines, etc.)
    - Road crossings (culverts and bridges)
    - Storm Drains
    - Constructed channel network
    - In-stream drop structures / grade control
    - Dams and other basins

- Currently, most quantitative design standards for hydromodification management focus primarily on controlling excess erosion. While prevention of excess erosion is considered a necessary prerequisite for a healthy stream ecosystem, it may not be a sufficient condition, as riparian habitats and aquatic biota can be impacted by other aspects of hydromodification including changes in flow regime and water quality. Therefore, a channel considered to be fairly resistant to excess erosion may still be highly susceptible to habitat and biota impacts. Potential impacts to riparian and aquatic habitat should consider:

    - Longitudinal connectivity of the stream system (i.e., to allow for migration of fauna)
    - Lateral connectivity of the stream channel to its floodplain

[7] Southern California Coastal Water Research Project (SCCWRP). 2005. Effect of Increases in Peak Flows and Imperviousness on the Morphology of southern California Streams. Technical Report 450.

- Existing riparian corridors
- Perennial and ephemeral channels
- Channels where groundwater discharges either seasonally or year-round
- Impaired waterbodies
- Existing and proposed treatment BMPs
- Channel reaches planned for enhancement or restoration
- Water quality monitoring and bioassessment sampling locations and data
- Existing vegetation types, special habitat, locations of threatened or endangered species, and barriers restricting movement

2.4. Step 4: Develop Site Design and Drainage Plan

The purpose of this section of the Conceptual/Preliminary or Project WQMP is to develop the site design and drainage plan incorporating all applicable site design BMPs and source control BMPs and to determine the locations for structural BMPs by dividing the site into separate drainage management areas (DMAs).

2.4.1. Regulatory Criteria Applicable to Site Design and Drainage Planning

The MS4 Permits do not establish specific criteria for site design and drainage planning. However, in order to support subsequent phases of BMP planning, every project must engage in a site design and drainage planning phase related specifically to stormwater quality management and hydromodification management (if applicable). Specifically, the documentation of the site design and drainage plan must demonstrate that the following underlying criteria are met:

- BMPs are provided to remove pollutants from runoff prior to its discharge to any receiving waters, and are located as close to the source as possible
- Structural BMPs must not be constructed within any Water of the United States.
- All site design BMPs and source control BMPs that are applicable and feasible for the project must be identified and implemented.
- Water quality and hydromodification management (if applicable) must be considered at the earliest practical phase of project development. As part of this requirement, the plan must explain how the locations determined for LID BMPs were identified to support the use of higher priority LID BMP types that maximize retention of stormwater.
- Space constraints and overriding considerations in site layout and BMP locations must be presented based on technical justifications

2.4.2. Expected WQMP Content

The expected activities and WQMP content associated with this effort are described in **Table 2-7**. In practice, the process of site design and drainage planning (Step 4, this section), LID BMP selection and sizing (Step 5, Section 2.5), and hydromodification BMP selection and sizing (Step

6, Section 2.6) are iterative and interdependent. Approaching them in isolation is unlikely to result in efficient designs. Additionally, there are many potential approaches for conducting these three steps depending on the nature of the site, characteristics of the project, and designer preferences. This section is intended to identify expected content and provide suggested approaches. It is not intended to be interpreted as the only acceptable approach.

Table 2-7. Expected Activities and WQMP Content for Development of Site Design and Drainage Plan

Expected Activities/Content	Rationale
Subdivide the site into discrete DMAs (single DMA may be acceptable for simpler sites)	DMAs are generally defined at the BMP scale and must be used as the spatial basis for structuring the drainage plan
Describe the properties of each DMA, including: • Impervious cover • Land uses • Areas of potential elevated pollutant generation within DMA • Topographic features of significance • Sensitive environmental features or natural drainage features of significance • Infiltration feasibility of the DMA consistent with the phase of WQMP being prepared	Defining these parameters at a DMA level allows BMP approaches to be determined appropriate to each part of the site. This base description helps provide the rationales for how DMAs were subdivided. An overall site-level description of these parameters does not provide adequate spatial discretization, except for simple sites.
Describe the type, location, and spatial extent of site design BMPs associated with each DMA. Provide an explanation for why a certain site design BMP was not applicable if it was not used (See Section 3).	Approaches and features must be assigned to specific locations based on DMA characteristics.
Describe the type, location, and spatial extent of source control BMPs associated with each DMA. Provide an explanation for why a certain source control BMP was not applicable if it was not used (See Section 6).	Approaches and features must be assigned to specific locations based on DMA characteristics.
Identify structural BMP locations and tributary area	This provides the underlying structure for structural BMPs as part of Step 5 and 6.

Expected Activities/Content	Rationale
Include a site-level narrative description of the rationale for the site plan and drainage plan, including: • Rationale for why any site design approaches were not employed • Rationales used for subdividing the site into DMAs • How the placement of structural BMPs sought to improve the feasibility of retention BMPs and allow adequate space to avoid subsequent findings of spatial constraints • Overriding factors requiring compromise in site design or structural BMP locations	While there are no specific numeric criteria for site design, all applicable and feasible site design BMPs must be implemented. This section must clearly explain how stormwater management was incorporated into the project at the earliest possible time in a manner consistent with the intents of the MS4 Permit and Model WQMP. Where a site is constrained by overriding factors, this should be explained holistically here rather than only identifying space constraints in subsequent steps in the context of individual BMP locations. It is often not possible to evaluate the validity of infeasibility and space constraint claims at the scale of individual BMPs without a clear introduction to site scale planning and constraints.

2.4.3. Guidelines and Techniques for Site Design and Drainage Planning

As discussed above, the actual approach used by designers to develop site designs and drainage plans is dependent on designer preference, the characteristics of the site, and the characteristics of the project. The following sections do not define a specific approach for meeting the minimum criteria described in the Model WQMP; rather they are intended to provide helpful guidelines and suggestions.

2.4.3.1. Types of Site Design BMPs

Site design approaches and BMPs are described in Section 3. Site design BMPs that should be implemented wherever applicable include, but are not limited to:

- Maximize Natural Infiltration Capacity and Groundwater Recharge (where appropriate),
- Preserve Existing Drainage Patterns and Time of Concentration,
- Protect Existing Vegetation and Sensitive Areas,
- Minimize Impervious Area,
- Disconnect Impervious Areas,
- Minimize Construction Footprint, and
- Re-vegetate Disturbed Areas

Refer to the Bay Area Stormwater Management Agencies Association (BASMAA) **Start at the Source** manual for more guidance on LID site design practices beyond those in Section 3.

2.4.3.2. Types of Source Control BMPs

Source control BMPs and approaches are described in Section 6. Source control BMPs are specific to pollutant generating source areas and activities. As part of site design, the designer should review the list and description of source control BMPs and describe which source control BMPs are applicable and how they will be incorporated into the site design.

2.4.3.3. Defining and Delineating DMAs

Drainage management areas (DMAs) provide an important framework for feasibility screening, BMP prioritization, and storm water management system configuration. BMP selection, sizing, and feasibility determinations must be made at the DMA level; therefore, delineation of DMAs is highly recommended at the conceptual site planning phase and is mandatory for completing the project design and meeting submittal requirements.

There is not a precise process for defining DMAs. However, in order to be useful for developing the water quality management approach and documenting conformance, there are several guidelines for DMAs:

- DMAs are defined based on the proposed drainage patterns of the site and the BMPs to which they drain.
- During the early phases of the project, DMAs shall be delineated based on site drainage patterns and possible BMP locations identified in the site planning process.
- DMAs are primarily used as a tool for identifying the BMPs proposed at the site and performing calculations to show that they are adequately sized. The designer should anticipate the scales and locations at which BMPs will be applied and tailor DMA delineations to these BMPs.
- DMAs should not overlap and should be similar with respect to BMP opportunities and feasibility constraints.
- More than one DMA can drain to the same BMP. However, because the BMP sizes are determined by the runoff from the DMA, a single DMA may not drain to more than one BMP. See Figure 2-1.
- Some DMAs may be self-retaining (i.e. produce no runoff for the 85th percentile 24-hour storm event) through the use of hydrologic source controls (HSCs) discussed in Section 4.3.1 and will not require an LID BMP.
- Where it is possible to isolate potential sediment sources associated with natural or non-pollution generating areas of the site, this is strongly recommended to help avoid sediment loading to BMPs and preserve the natural flow of sediment from these areas of the project site.

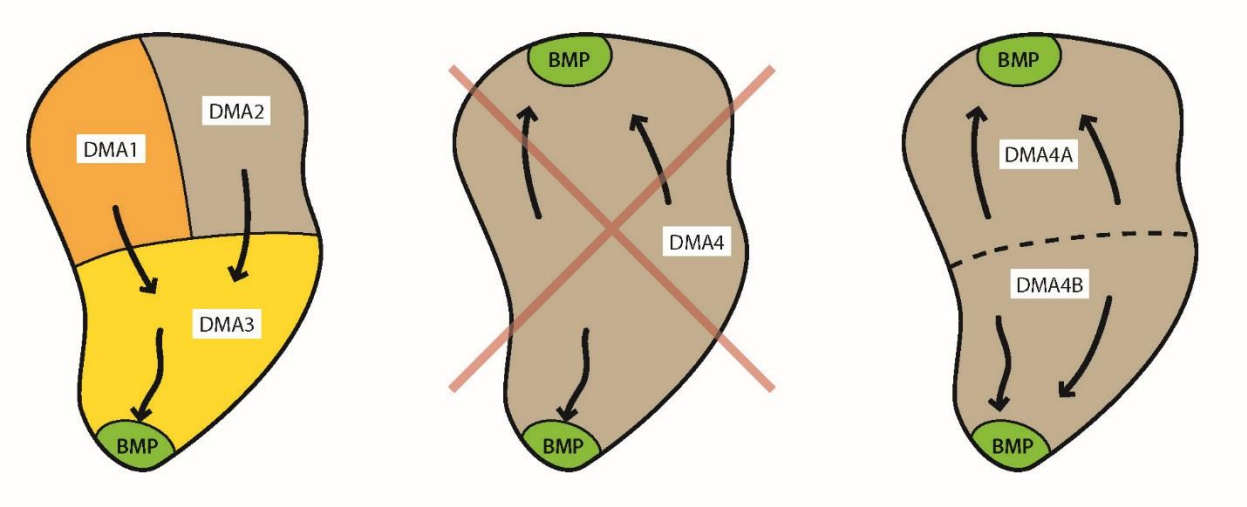


Figure 2-1. DMA Delineation

2.4.3.4. Differences in Delineations between Conceptual/Preliminary and Final Project WQMPs

The primary difference between Conceptual/Preliminary and Final Project WQMPs is the detail and resolution of drainage delineations and the specificity with which individual BMPs are located. At the conceptual/preliminary approval level, it may be acceptable to define an overall BMP strategy for a homogeneous DMA and use a "sizing factor" type of approach. For, example, a 2-acre parking lot could be identified as being treated by bioretention with a sizing factor equivalent to 4% of the tributary drainage area. The adequacy of the sizing factor could be established and the overall space allocation could be established without subdividing individual drainage areas to each BMP at the discretion of the reviewer. However, at the Final Project WQMP phase, each BMP must be specifically delineated and sized based on BMP-specific calculations. Similarly, the specific locations of site design and source control BMPs must be shown in Final Project WQMPs but may be more generally described in Preliminary/Conceptual BMPs at the discretion of the reviewer.

2.4.3.5. Space Requirements and Recommended Allowances for Structural BMPs

Perhaps the most important aspect of site planning is allowing sufficient space for LID BMPs and hydromodification BMPs (if applicable) in areas that can physically accept runoff and have good potential for allowing retention or partial retention of stormwater. Simple rules of thumb are presented in **Table 2-8** to help allow sufficient space in preliminary site layout. **Table 2-8 cannot be used to determine the required footprint for the purpose of BMP sizing, and is to be used only for estimating the amount of space required for structural BMPs during preliminary site layout.**

Each of these values is dependent on site-specific factors. More detailed methodologies for sizing LID and hydromodification BMPs and determining required footprints are described in subsequent steps. In general, the size allocations for LID BMPs is a function of:

- Reliable infiltration rate - higher reliable rates will tend to allow somewhat deeper BMPs with smaller footprints and vice versa; a higher factor of safety is recommended for systems where investigation is less thorough, there is less redundancy, or where systems are underground and less maintainable. These conditions will tend to require larger surface areas.
- Adaptability – where systems, such as underground systems, cannot be adapted with a supplemental treated discharge to accommodate infiltration rates less than planned, a higher factor of safety is required and this results in a larger footprint.
- Sediment loads and pretreatment – lower sediment loads, better pretreatment, and/or the presence of vegetation helps reduce potential for clogging and allows somewhat deeper systems and smaller footprints.
- Vertical constraints of a site – where the profile of BMPs must be relatively shallow due to vertical constraints, this can increase footprint.
- The size allocation for hydromodification BMPs in SOC is primarily a function of soil type and the depth of the detention system that is allowable based on site constraints.

Some of these factors can and should be addressed as part of site investigation and BMP design to help result in footprint requirements that are toward the lower end of the ranges presented in Table 2-8. Additional guidance is provided in Section 4 and Appendix E.

Table 2-8. Approximate (Rule of Thumb) Space Requirements for Structural BMPs for the Purposes of Preliminary Site Layout

BMP Type	Percent of Tributary Impervious Area Recommended in Site Design Allowance as "Rule of Thumb"	
	Well Drained Soils (> 2.0 in/hr)	Moderately Drained Soils (0.6 to 2.0 in/hr)
LID Surface Infiltration OR LID Subsurface Infiltration with Filtration Pretreatment or Rooftop Only Drainage	2.5 to 5	4 to 8
LID Subsurface Infiltration with Hydrodynamic or Settling Pretreatment	4 to 8	Not recommended
LID Biotreatment/biofiltration	2.5 to 5 percent of tributary impervious area	
LID Harvest and Reuse	1-2 percent of tributary area (based on cistern 4 to 8 feet tall, indoor or outdoor)	

NOC – Hydromodification – Redevelopment Projects	Typically satisfied as part of BMPs for LID
NOC – Hydromodification – New Development Projects	May require approximately 2x size to increase volume reduction (first priority), or greater depth (second priority), if increased volume reduction is not feasible, or combination of increased footprint and depth to maximize volume reduction and match peak flowrates
SOC – hydromodification	Typically 2x to 5x LID size, however detention compartments may be subsurface

2.4.3.6. Influence of Infiltration Feasibility Findings and Recommended Setbacks on Drainage Planning

As introduced above, one of the primary goals of LID site design is to identify and set aside areas that are more likely to be feasible for retention BMPs. In this regard, a clear understanding of feasibility constraints and recommended setbacks from the site investigation conducted in Step 3 (Section 2.3) is critical and should be clearly cross-referenced in the narrative about how DMAs and BMP locations were established. Where feasible, the site plan should demonstrate a clear priority for siting BMPs in areas that are outside of recommended setbacks and allow for infiltration or partial (incidental) infiltration, respectively, as the first and second priority, respectively.

2.4.3.7. Influence of Hydromodification Requirements on Drainage Planning

Hydromodification requirements can mandate a larger BMP volume as reflected in the site area allowances recommended in Section 2.4.2.5 and detailed in Section 2.6 and Section 5.

Given that hydromodification requirements can be met via detention rather than retention or biotreatment, this provides the designer with the option of meeting this larger control volume designing separate detention systems or creating additional components/larger sizes within LID BMPs.

There is no preference for volume reduction versus flow duration control for hydromodification compliance, so a detention-based centralized system or larger LID BMPs are equally permissible.

Hydromodification requirements include provisions to avoid critical course sediment areas and allow critical course sediment to continue to be transported from the site. This mandates that DMAs be configured to avoid treating the runoff from critical course sediment areas and may require that certain natural drainage courses be preserved. This is also a good approach to help avoid premature clogging of BMPs.

2.4.3.8. Self-Mitigating and Self-Retaining Areas

Self-mitigating or self-retaining areas are an important outcome of effective site design. By hydrologically isolating areas that do not have impervious cover and do not generate pollutants at levels of concern, these areas do not need to be treated and do not require structural BMPs. This is especially beneficial if these areas are also potential sediment sources. By keeping these sediment sources out of infiltration or filtration BMPs, required factors of safety can be reduced. Similarly, self-retaining areas can eliminate or lessen the need for downstream structural BMPs. These areas are defined as follows:

Self-mitigation areas: DMAs that have no impervious cover and are not managed with the use of fertilizers or pesticides and are hydrologically disconnected from other DMAs (i.e., do not flow to BMPs).

Self-retaining areas: DMAs that produce no runoff during the 85th percentile, 24-hour storm event through application of HSCs.

2.4.3.9. Alternatives to the Use of DMAs

The MS4 Permit does not specifically require a unit known as a "DMA." While use of this common term/concept is strongly recommended, alternative units of drainage planning could be used at the discretion of the reviewer provided that they meet the same objectives.

2.5. Step 5: Select, Size, and Design LID BMPs for Each Drainage Management Area

At the core of WQMP development are three requirements for LID BMPs that apply to all Priority Projects:

- **BMP Selection**: LID BMPs must be selected to maximize volume retention and pollutant reduction according to a specific hierarchy; and
- **BMP Sizing:** LID BMPs must be sized to capture and retain the Design Capture Volume (DCV); where biotreatment is used for a portion of the DCV that is not retained, specific additional sizing criteria apply for biotreatment components. Note that biotreatment BMPs must meet the requirements to be called biofiltration BMPs in order to be used to fulfill LID requirements
- **BMP Design:** LID BMPs must be designed per accepted engineering standards to provide safe and reliable operation, avoid premature failure or nuisance conditions, and allow for inspection and maintenance activities without entrainment of captured pollutants or disruption of functionality.

For each DMA that is not self-retaining or self-mitigating, structural LID BMPs are required. Selecting the appropriate LID BMP type and determining the required size to meet LID requirements are functions of the site conditions, the information gathered as discussed in Step

3 (Section 2.3), and the site design and drainage planning conducted as part of Step 4 (Section 2.4).

This section describes the underlying criteria that need to be met by LID BMP plans and the content that is expected to be included in Project WQMPs as part of providing adequate demonstrations that LID BMP criteria have been met. More detailed technical guidance and criteria related to LID BMPs are consolidated in Section 4 of this TGD and multiple supporting appendices.

Where hydromodification criteria also apply, the design of systems to comply with LID and hydromodification requirements can be integrated. Therefore, it is strongly recommended that both Step 5 and 6 be consulted prior to beginning efforts on BMP selection and sizing. Appendix B can also be consulted to help understand how LID and hydromodification requirements can be integrated.

2.5.1. LID Selection and Sizing Criteria

The criteria for LID selection and sizing are provided below.

First Priority – Full Retention

LID BMPs must be implemented that are designed to retain stormwater onsite (i.e. intercept, store, infiltrate, evaporate, and/or evapotranspire) and meet one of the following equivalent criteria:

> Capture and retain the volume of stormwater runoff produced from a 24-hour 85th percentile storm event (DCV) and demonstrate that this DCV is drawn down within 48 hours or less following the end of precipitation.
>
> OR
>
> Demonstrate via use of nomographs or continuous simulation that BMPs will retain 80 percent of average annual runoff volume via either volume-based, flow-based, or combined approaches.

[Guidance: Where HSCs are applicable, they can be accounted to reduce the DCV of the retention BMP.]

Second Priority – Biotreatment with Maximized Retention:

Where it is demonstrated based on substantial evidence that it is not feasible to fully infiltrate the DCV or equivalent per the first priority criteria above, but incidental (i.e., partial) infiltration is determined to be feasible, LID BMPs must be implemented that are designed to meet the following criteria:

1) Maximize volume and pollutant retention through the incorporation of all of the following design elements that apply:

a) Use of all applicable HSCs, and
b) Use of retention compartments within BMPs, including gravel storage below the lowest point of treated discharge, amended soils and other features designed to achieve similar processes.

[Guidance: As a target, BMPs should be designed to provide static retention storage equivalent to one-third of the DCV or achieve retention of 40 percent of average annual runoff volume.]

AND

2) Size biotreatment[8] components of the BMP to meet one of the following criteria:

a) Treat 1.5 times the portion of the DCV that is not reliably retained through the use the volume reduction measures described above.
   OR
b) Retain or treat 80 percent of average annual runoff volume, and apply a multiplier of 1.5 to the resultant required volume and footprint.
   OR
c) Design a biofiltration BMP that has a static biofiltration volume (bowl volume plus media pore spaces) of at least 0.75 times the portion of the DCV not retained through the use of the volume reduction measures described above.

[Guidance: Option (a) and (b) do not have a specific static storage volume requirements and allow routing to be considered; Option (c) specifies a minimum static storage volume and does not require or allow routing to be considered.]

[Guidance: Where HSCs are applicable, they can be accounted to reduce the DCV that is the basis for biotreatment sizing.]

Third Priority – Biotreatment with Negligible Retention

Where it is demonstrated based on substantial evidence that it is not feasible to infiltrate any appreciable volume, LID BMPs must be implemented that are designed to meet the following criteria:

1) Maximize volume retention through the incorporation of all applicable HSCs.

[8] In order to meet LID requirements, biotreatment BMPs must meet the requirements to be called biofiltration BMPs.

[Guidance: Due to their more distributed nature, some HSCs may allow incidental volume reduction in marginal conditions where no volume reduction is permissible within LID BMPs.]

AND

2) Size biotreatment[9] BMPs to meet one of the following criteria:

d) Treat 1.5 times the DCV.
OR
e) Treat 80 percent of average annual runoff volume, and apply a multiplier of 1.5 to the resultant required volume and footprint.
OR
f) Design a biofiltration BMP that has a static biofiltration volume (bowl volume plus media pore spaces) of at least 0.75 times the DCV.

[Guidance: Option (a) and (b) do not have a specific static storage volume requirements and allow routing to be considered; Option (c) specifies a minimum static storage volume and does not require or allow routing to be considered.]

[Guidance: Where HSCs are applicable, they can be accounted to reduce the DCV that is the basis for biotreatment sizing.]

Application of LID Criteria at a Regional Scale

While the majority of projects will comply with these criteria on-site, the MS4 Permit provides pathways for use of regional BMPs located outside of the project site that may serve areas larger than the project and/or removed from the project site. The criteria and guidance provided in this section are written to be most useful for projects that comply with LID requirements within the project site. Specific criteria for regional BMPs are provided in Section 3 of the Model WQMP. General guidance for design of LID BMPs at a larger scale is provided in Section 4.4.7.

Lower Priorities and Alternative Pathways

If LID BMPs are demonstrated to be not feasible or not feasible for the full sizing criteria based on substantial evidence, Section 2.5 of the Model WQMP describes additional and alternative pathways that may apply. This may include:

- Use of treatment control BMPs or biotreatment BMPs, and/or
- Retrofits of offsite locations, and/or

[9] In order to meet LID requirements, biotreatment BMPs must meet the requirements to be called biofiltration BMPs.

- Participation in an alternative compliance program

Specific criteria for use of these approaches are not discussed in this TGD.

2.5.2. LID Selection and Sizing Process

The LID selection and sizing process is based on determining the infiltration feasibility condition for the BMP location and selecting an individual type of BMP that is compatible with that feasibility condition. This process specifically does not require the applicant to assemble a system of multiple LID BMPs from different levels of the LID hierarchy in order to meet the sizing criteria.

The overall simplified process for LID BMP selection and sizing is depicted in Figure 2-2. A more detailed version of this process is depicted in Figure 4-1.

This process involves the following steps:

1. Determine the feasibility conditions for infiltration and harvest and use associated with each BMP location and its tributary DMA based on feasibility criteria described in Section 4.2. The applicable infiltration feasibility categories include:

    - *Full infiltration*: It is feasible to infiltrate the full DCV without foreseen issues.
    - *Partial infiltration*: It is not feasible to infiltrate the full DCV due to limited infiltration rates or limited space, however incidental nfiltration of a portion of the DCV would be possible without significant risk.
    - *No infiltration*: It is not feasible to infiltrate in any appreciable quantity due to demonstrated physical limitation or risk.

    These categories are defined based on applicable criteria in Section 4.2.2. Stormwater harvesting is categorized as either required or optional based on the criteria in Section 4.2.3. In almost all cases, harvest and use will be optional.

2. Determine and document any demonstrated space constraints at each BMP location based on considerations identified in Section 4.2.4.

3. Select BMPs from a menu associated with each feasibility category as identified in Table 2-9 and detailed in Section 4.3, with modification for demonstrated space constraints, as appropriate.

4. Size the selected BMP based on methods specific to the BMP type identified in Section 4.3 and detailed in Appendix E. Target footprint sizing factors related to volume reduction and/or clogging lifespan goals may apply as described in Section 4.4, Appendix E, and the BMP fact sheets to which they apply.

5. Design BMPs based on the BMP-specific criteria contained in the BMP Fact Sheets in Appendix G. Optionally, BMP designs may be adapted while still conforming to the general design criteria contained in Section 4.4.

6. Where necessary, conduct design- phase and/or construction-phase investigations to confirm or adapt BMP selection and design. Return to earlier steps, as needed, to incorporate new information.

A more detailed description of this process and supporting criteria are provided in Section 4.

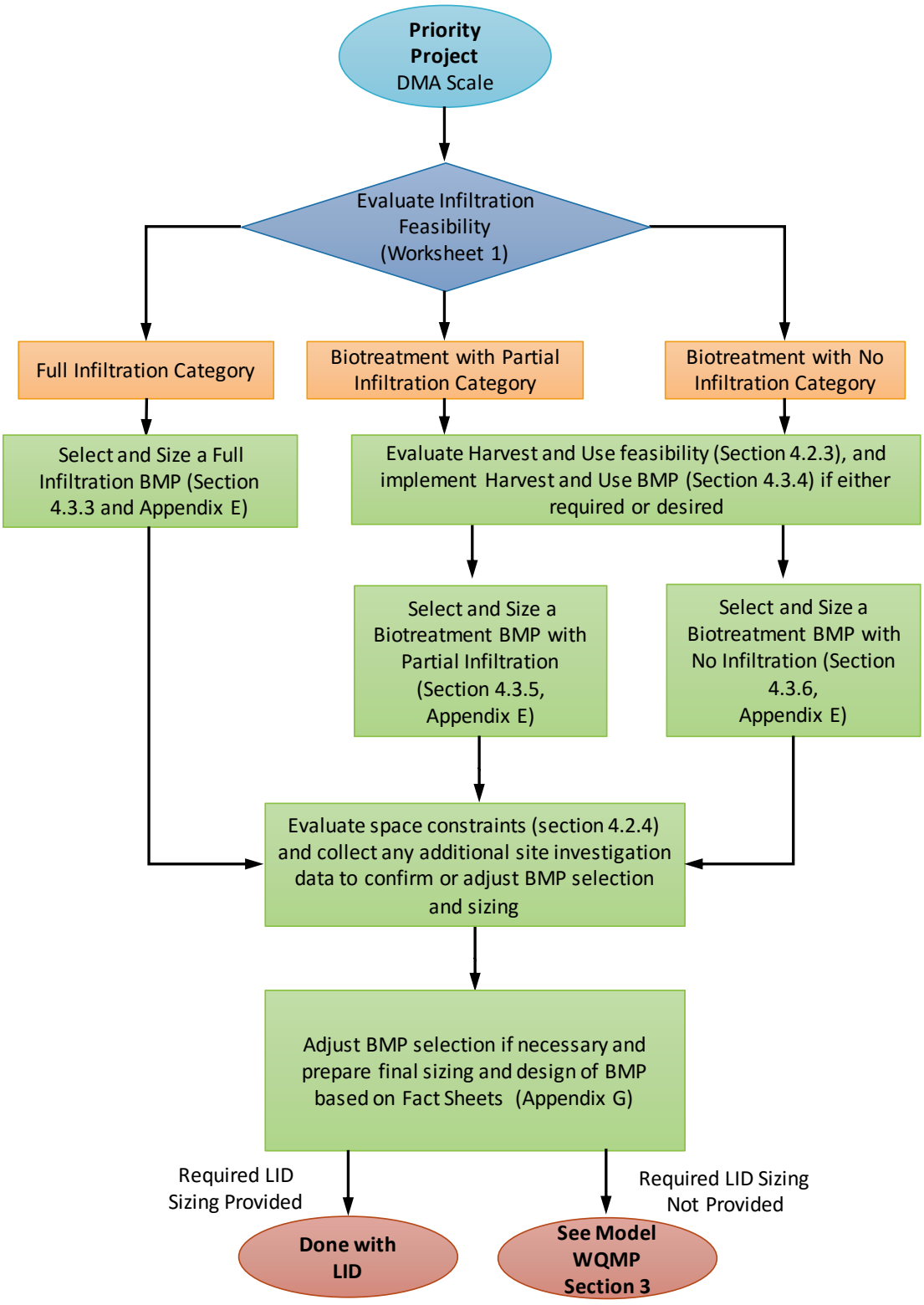


Figure 2-2. Overview of LID BMP Selection Process

Table 2-9. Menu of LID BMPs Appropriate for Each Infiltration Feasibility Category

Infiltration/Harvesting Category	BMP Types Compatible with Infiltration Category
Full Infiltration	INF-1: Infiltration Basin INF-2: Infiltration Trench INF-3: Bioretention with no Underdrain INF-4: Drywell INF-5: Permeable Pavement (concrete, asphalt, and pavers) INF-6: Underground Infiltration
Biotreatment with Partial Infiltration *BMP selection must also be based on pollutants of concern* *Only BIO-1 and BIO-5 can meet the definition of biofiltration in South Orange County. BIO-2, BIO-3, and BIO-4 may only be used as treatment control BMPs in SOC.*	*First check for full harvest and use feasibility. If not required, then choose from:* BIO-1: Bioretention with raised underdrain discharge elevation (internal water storage) BIO-2: Swales with amended soils and shallow infiltration sump (adjustable sump preferred) BIO-3: Filter strip with amended soils BIO-4: Dry extended detention basin with amended soils, vegetation, and shallow infiltration sump (adjustable sump preferred) BIO-5: Proprietary biotreatment with supplemental retention *Upstream retention options:* Hydrologic source controls, cisterns, permeable pavement, *Downstream options:* Shallow infiltration chambers, trenches, or dry well for a portion of the DCV *Where demonstrated space constraints exist:* BIO-1: Bioretention with raised underdrain with compact sizing factor BIO-5: Proprietary biotreatment
Biotreatment without Infiltration *BMP selection must also be based on pollutants of concern* *Only BIO-6 and BIO-7 can meet the definition of biofiltration in South Orange County. BIO-8, BIO-9, and BIO-10 may only be used as treatment control BMPs in SOC.*	*First check for harvest and use feasibility. If not required, then choose from:* BIO-6: Bioretention with Underdrain and Impervious Liner/Minimal Volume Reduction BIO-7: Proprietary Biotreatment BIO-8: Wet Detention Basin BIO-9: Constructed Wetland BIO-10: Other Biotreatment BMPs with an Impervious Liner

2.5.3. Expected WQMP Contents

WQMPs must demonstrate conformance to the specific narrative and numeric criteria related to LID BMP selection and sizing as described above. Additionally, in order to facilitate consistent review, certain minimum content is necessary in the WQMP. Table 2-10 identifies the minimum criteria and content that must be included in the WQMP.

Table 2-10. Expected WQMP Content for LID BMP Selection and Sizing

Expected WQMP Content	Rationale
Describe and support the preliminary feasibility category for infiltration and harvest and use for each identified BMP location, including the technical basis for this categorization for each location based on substantial evidence. BMPs must be categorized into one of the following categories in each set: Infiltration • Full infiltration • Incidental infiltration • No infiltration Where full infiltration is not feasible, the feasibility of harvest and use needs to be evaluated.	The WQMP must translate the findings of site investigation and BMP locations to a categorization of infiltration and harvesting feasibility based on "substantial evidence" as the principle basis for selection of BMPs. Section 2.5.2 explains these categories. This TGD takes the approach that retention is maximized when BMPs are selected from a menu of BMPs that has been determined to be appropriate for each feasibility category.
Describe and provide supporting information for any overriding space constraints, approved site uses, of other technical factors that substantiate the need to use more compact BMPs than applicable BMP defaults; describe and support at the DMA scale	Default footprints apply to certain BMP types to ensure that volume reduction is appropriately maximized and the chance of premature clogging is reduced. Deviation from these defaults requires that the project applicant to explain and provide specific details regarding the space constraints that are claimed. Acceptance of these explanations is at the discretion of the reviewer.
Identify the selected LID BMP for each DMA, including any HSCs, used as part of numeric sizing	The WQMP must clearly identify the suite of BMPs that is used to achieve numeric conformance with LID sizing criteria.
Calculate and document the required size versus the provided size to demonstrate conformance with LID performance criteria	The WQMP must clearly describe how the proposed suite of BMPs achieves numeric conformance with LID sizing criteria.

Expected WQMP Content	Rationale
Describe the design of the BMP for each DMA, consistent with the inputs used as part of sizing (e.g., depths of compartments, elevations of outlets)	The WQMP must describe the BMP design in adequate detail to confirm that appropriate inputs and assumptions are used in sizing calculations.
Describe any additional investigation that is required following approval of the subject WQMP and the design contingencies that could result from potential findings from these investigations	At the Conceptual/Preliminary WQMP phase, it may be necessary to identify the need for additional information to fully confirm final designs. If there are design contingencies associated with this information, these contingencies must be defined and disclosed in the Conceptual/Preliminary WQMP as part of discretionary approval so that these adaptations can be made within the design or construction phase, as necessary.
If LID and Hydromodification requirements are addressed within a single BMP system, the WQMP must describe how the operation of the system to meet these two standards does not interfere with the ability of the BMP to conform to applicable LID criteria.	While it is possible to integrate the design of BMPs, it still is necessary to demonstrate conformance to each sizing and design standard separately.
For Final WQMP Only, utilizing any additional information obtained following discretionary approval:	
Confirm or revise the feasibility category of the BMP and adapt design within the "envelope" of the allowable contingencies that were established as part of discretionary approval	The BMPs that are proposed must be proven to be effective and safe; if additional data changes the determination, then the contingencies identified in the Conceptual/Preliminary WQMP must be activated or the project must revisit discretionary approval.
Calculate and document the required size versus the size and design that is provided as part of detailed design and construction plans.	The Final WQMP must verify required size versus the actual designed size.
Identify whether in situ, as constructed infiltration testing is needed to confirm as-constructed design and/or determine the need for design adaptations.	Some projects may require as-constructed infiltration testing, particularly if testing prior to construction could not be done with adequate rigor or if there was significant earthwork.

2.5.4. Detailed Guidance on LID BMP Selection, Sizing and Design

Section 4 of this TGD provides more detailed guidance on selection, sizing and design of LID BMPs to support the development of LID BMP plans that conform to the minimum criteria and expected content identified above.

2.5.5. Frequent Questions

2.5.5.1. What is meant by "substantial evidence" in determining feasibility conditions?

Substantial evidence is defined as "Facts, reasonable assumptions predicated on facts, or expert opinion supported by facts. Substantial Evidence does not include argument, speculation, unsubstantiated opinion or narrative, or evidence which is clearly erroneous or inaccurate" (Public Resources Code Section 21080(e)). Specific criteria and acceptable methods recommended to provide substantial evidence are provided in Section 4.2 and referenced appendices.

2.5.5.2. When would a feasibility condition change between discretionary approval and final design approval?

This could happen if additional information became available about infiltration rates or other aspects of the site that was not known as part of discretionary approval. However, if there are significant unknown factors as part of discretionary approval, these need to be disclosed and the Conceptual/Preliminary WQMP should describe the approaches that would be used to adapt to new information as it becomes available. This would allow adaptation of designs while still being within the "envelope" of approval established in discretionary approval. However, if new information significantly changes the water quality management approach outside of what was anticipated as part of discretionary approval, then the project may need to go through discretionary approval again.

2.5.5.3. Why is infiltration feasibility the primary factor in BMP selection?

Where soils have any significant permeability, the amount of volume loss to infiltration is expected to well exceed evapotranspiration and harvesting in most cases. This makes the investigation of infiltration feasibility the most important factor in selecting BMPs that maximize volume reduction.

2.5.5.4. If the full DCV is retained, is it still necessary to use all applicable HSCs?

No, it is not necessary. However, other applicable site design measures still need to be incorporated. In conditions where biotreatment with partial infiltration or biotreatment with no infiltration is used, all applicable HSCs must be used as part of maximizing volume reduction.

2.5.5.5. Under what conditions is a project required to use harvest and use BMPs?

Criteria for harvest and use feasibility are provided in Section 4.2.3. In general, except in cases with unusually high harvested water demand, it is not required (but is allowable) to consider harvest and use.

2.5.5.6. Can harvest and use BMPs be used even if they are not required?

Yes, even if harvest and use is determined to be not required, it can still be used as part of a water quality management approach. The LID sizing methods described in Appendix E allow for accounting of partial capture provided by harvest and use systems upstream of other LID BMPs.

2.5.5.7. Are there different processes and criteria for small and large projects?

The overall LID selection process is the same for all projects. However, small projects, as defined in Section 4.2.2.6 are permitted to apply alternative investigation methods in some cases to avoid excessive cost impacts. Small projects may also be more likely to prepare a more precise design as part of the Conceptual/Preliminary WQMP phase.

2.6. Step 6: Select, Size and Design Hydromodification BMPs

This steps only applies if the project has potential HCOCs, as determined as part of Step 3 (Section 2.3.5).

Where HCOCs exist, applicable hydromodification criteria must be met by either:

- Demonstrating that the BMPs provided to conform with LID BMP requirements also provide hydrologic performance necessary to meet HCOC criteria
- Adapting or augmenting the design of LID BMPs so that the combined stormwater management systems conform to both LID and hydromodification criteria, or
- Providing separate systems that conform to hydromodification criteria and do not modify the LID BMPs selected and sized as part of Step 5.

This section describes the underlying criteria that need to be met by combined LID plus hydromodification BMP plans and the content that is required to be included in WQMPs as part of providing adequate demonstrations. More detailed technical guidance and criteria related to hydromodification BMPs is consolidated in Section 5 of this TGD and multiple appendices.

2.6.1. Hydromodification Management Criteria

Hydromodification management criteria are described below. It is notable that hydromodification requirements must be met at each "point of compliance" for the project rather than the scale of individual DMAs which is the scale at which LID BMPs are evaluated. This may establish different scales of analysis and control than LID BMPs. Defining points of compliance is explained in Section 5.2.1.1. In all cases, adaptations to LID BMPs to serve hydromodification purposes must not interfere with the operations of these BMPs for pollutant control. The performance criteria to eliminate or mitigate HCOCs are explained separately in the following sections.

For phased projects that involved tiered approvals, HCOCs should be evaluated for the overall project and also for each phase at the time it is approved. Each phase should consider the cumulative effect of the current phase and any previously constructed phases. At the completion of each phase, the overall project must be in compliance with all applicable requirements.

2.6.1.1. North Orange County Performance Criteria

[Placeholder for future addition after adoption of the 5th Term NOC MS4 Permit]

2.6.1.2. South Orange County Performance Criteria

In SOC, hydromodification management criteria, methods, and tools are defined in the Hydromodification Management Plan (Exhibit 7.IV). The underlying criteria described in the HMP include:

Hydrologic management requirement: All Priority Projects must ensure, at each point of compliance, that the post-project runoff flow rates and durations do not exceed pre-development[10], naturally occurring, runoff flow rates and durations by more than 10%, for flow rates from 10% of the 2-year flowrate up to the 10-year flowrate. (See HMP Section 3). This must be evaluated using the South Orange County Hydrology Model (SOHM) which is a continuous simulation model.

Source sediment management requirement: Priority projects must avoid critical sediment yield areas known by the Copermittee or identified in the Watershed Management Area Analysis, or implement measures that allow critical coarse sediment to be discharged to receiving waters, such that there is no impact to the receiving water.

Project applicants are required to consult the HMP to determine the specific criteria and methods that apply. Additionally, project applicants are required to use the SOHM available from the County WQMP website to conduct hydrologic analyses.
http://media.ocgov.com/gov/pw/watersheds/documents/wqmp/

2.6.2. Design Resources and Examples

Section 5 provides additional guidance and example approaches for developing hydromodification designs and integrating designs with LID BMP designs. Appendix B includes conceptual design examples where LID and hydromodification are integrated.

2.6.3. Expected WQMP Content

Table 2-11 describes expected WQMP content to describe the hydromodification design approach and demonstrate conformance to applicable criteria.

Table 2-11. Expected WQMP Content for Hydromodification Design. (Content for NOC included only as placeholder for future update of this TGD upon adoption of the 5th Term NOC MS4 Permit)

Permit Region	Expected WQMP Content	Rationale
Both	Identify points of compliance	Points of compliance are the primary basis for analyzing hydromodification compliance

[10] In South Orange County, predevelopment is defined as the naturally occurring condition prior to development. Where a site has been graded, the as-graded topography of the site can be considered as the pre-development condition, but without any impervious surfaces and with typical natural vegetation.

Permit Region	Expected WQMP Content	Rationale
Both	Identify and describe BMPs or BMP systems used as part of complying with hydromodification requirements	BMP systems must be fully described in WQMPs
SOC	Describe the pre-development (natural) and post-development drainage characteristics to each point of compliance, including: slope, soils, drainage patterns, imperviousness, BMPs	In SOC, the pre-development (natural) condition is the baseline condition for compliance
SOC	Document findings from SOHM modeling of pre-development and post-development conditions and attach modeling report including model output	In SOC, the use of SOHM is required to evaluate conformance with applicable hydrologic management criteria.
SOC	Identify critical course sediment areas and approaches for avoiding or mitigating these areas	Conformance with this criterion is required for development projects in SOC
NOC	Describe the pre-project (existing) and post-development drainage characteristics to each point of compliance, including: slope, soils, drainage patterns, imperviousness, BMPs	In NOC, the pre-project (existing) condition is the baseline condition for compliance
NOC	Describe the infiltration and harvesting feasibility findings related to hydromodification design based on substantial evidence	The WQMP must document that opportunities to eliminate HCOCs by reducing 2-year, 24-hour runoff volume and increasing the post-development time of concentration must be considered before reducing peak 2-year, 24-hour flowrates.
NOC	Document findings from design hydrology calculations; attach a drainage report that evaluates applicable compliance metrics.	The NOC MS4 Permit specifically requires that the WQMP include a drainage plan documenting design hydrologic calculations for HCOC conformance.
Both	Describe the hydromodification BMP design, how it integrates with LID design, and why it does not interfere with LID operation.	The WQMP must describe the design in adequate detail to confirm that modeling accurately represents the BMP and area draining to the point of compliance

Permit Region	Expected WQMP Content	Rationale
Both	Document how any contingencies in infiltration or harvesting feasibility or design parameters will be addressed in hydromodification designs	If there is a possibility that the feasibility categorizations or related design parameters (e.g., design infiltration rate) may change in subsequent investigation, describe how this affects hydromodification design and the related contingencies that are applicable.

2.7. Step 7: Prepare WQMP and Associated Exhibits

This step provides guidance for assembling the results of Step 1 through 7 into a Project WQMP and preparing associated exhibits.

2.7.1. Expected WQMP Content

The expected content associated each WQMP section is described in Sections 2.1 through 2.6 above (corresponding to Section 1 through 6 of the WQMP template). The WQMP template provides embedded instructions for organizing and documenting this information. Deviations from the expected content may be acceptable at the discretion of the reviewer provided that the underlying criteria are met and the approach for documenting this in the WQMP is clear and technically defensible

2.7.2. Site Plan and Drainage Plan Sheet Set

In addition to the written and tabular sections of the WQMP, exhibits are required to illustrate site conditions, the drainage plan, proposed BMPs, and other information. At the Conceptual/Preliminary WQMP level, the following content is expected to be shown in exhibits. At the reviewer's discretion, the expected content for a Final Project WQMP may also be required at the time of Conceptual/Preliminary WQMP submittal.

2.7.2.1. Expected Content for Conceptual/Preliminary WQMP Exhibits

1) Project location map that shows and identifies each of the downstream receiving water(s) of the project, any 303(d) listed or TMDL water bodies, and any hydromodification susceptible water bodies.
2) Existing conditions site map that identifies drainage patterns, key topographic features, environmentally sensitive features, natural drainage courses, and other relevant information identified in Section 2.3.1.
3) Project site plan that identifies proposed site conditions including the characteristics such as land uses / activities and other relevant information identified in Section 2.3.2.
4) Project site plan that identifies all conditions relevant to infiltration feasibility findings (if applicable), such as, but not limited to, surficial soil properties, depth to groundwater,

and geotechnical hazards, locations of infiltration testing, factors influencing demonstrated space constraints or vertical constraints.

5) Drainage plan that delineates each drainage management area, shows stormwater management infrastructure and storm drains, identifies the locations and extents of source control and site design BMPs, and identifies the location and type(s) of structural LID and hydromodification control BMPs, as applicable.
6) Conceptual design schematics or designs for structural BMPs in adequate detail to document design parameters relevant to sizing calculations.
7) Description and conceptual location of features that will facilitate inspection and O&M (e.g., access roads, monitoring ports).

2.7.2.2. Additional Expected Content for Final Project WQMP Exhibits

1) Detailed locations and extents of each site design and source control BMP, as applicable.
2) Detailed delineations to each proposed structural BMP.
3) Drainage and BMP plans must be overlain with final proposed condition precise grade plans at the same scale.
4) Detailed grading contours of all structural BMPs that have surface storage, clearly indicating surface elevations, overflow elevations, and freeboard elevations.
5) BMP details for all structural BMPs, including inlets, outlets, structures, bioretention media, planting, underdrains, aggregate layers, and other relevant information, as applicable.
6) Specific models and dimensions of proprietary products, where acceptable and used.
7) Identification of specific design features that will facilitate inspection and O&M.

2.8. Step 8: Prepare O&M Plan (Final Project WQMPs Only)

The sustained performance of BMPs over time depends on ongoing and proper maintenance. In order for this to occur, detailed operation and maintenance plans are needed that include specific maintenance activities and frequencies for each type of BMP. In addition, these should include indicators for assessing when "as needed" maintenance activities are required.

Structural BMPs require on-going inspection and maintenance into perpetuity to preserve the intended retention, pollution control, and/or flow control performance. BMPs capture pollutants, sediment, and debris transported by stormwater. These must be periodically removed in order for the BMP to maintain the capacity of the structural BMP to process storm water and capture pollutants from storm events. Structural BMPs that incorporate infiltration or filtration are prone to clogging over time which can result in flooding, standing water, and reduced BMP performance.

A detailed O&M Plan must be developed prior to issuance of construction, grading, building, site development, or other applicable permits. After construction, a final O&M plan should

reflect actual constructed structural BMPs to be maintained including photographs and as-built plans. The O&M Plan must be available on-site with the BMPs for inspection by Copermittees.

2.8.1. Expected O&M Manual Contents

As part of the Final Project WQMP, an O&M Plan must be developed that details O&M responsibilities and activities. Expected contents of the O&M Plan are identified in Table 2-12.

Table 2-12. Expected O&M Manual Content

Expected O&M Manual Content	Rationale/Guidance
Description of the final structural BMP plan that matches the Final Project WQMP (subsequently updated to match as-built condition)	In preparing the O&M Plan, it should be assumed that portions of the WQMP will be recorded with the property, but will not necessarily be consulted by staff responsible for implementing the O&M Plan; the O&M Plan should serve a stand-alone purpose.
Identification and contact information of the responsible party(ies) for maintenance	A responsible party must be identified and contact information must be included
Identification of the required qualifications and any training required for personnel who will perform maintenance	Where certain activities require specific training or qualifications, the required qualifications must be clearly identified.
Identification of the funding mechanism and associated supporting information to demonstrate adequacy of funding to cover anticipated and potential expenses.	The O&M Plan must demonstrate adequate funding and the source of funding.
Description of any unusual, excessively-costly, or hazardous O&M activities required for the proposed BMPs	Such activities need to be fully disclosed so that the acceptability of these activities can be evaluated by the Copermittee and understood by the responsible party.
Regular inspection activities, frequency, and documentation requirements	These are core elements of an effective and complete O&M Plan
Description of routine and planned maintenance activities, frequency (if scheduled) or triggers (if initiated based on inspection findings), and documentation requirements	

Expected O&M Manual Content	Rationale/Guidance
Description of foreseen rehabilitation activities, anticipated frequency, triggers for conducting activities, and the planning/approval/documentation process required to conduct rehabilitation	
Process for identifying, diagnosing, and correcting issues resulting from damage, unusual wear, unforeseen conditions, etc.	
Spill response and notification requirements	

2.8.2. Operation and Maintenance Activities

Operation and maintenance activities typically associated with different BMP types are included in the BMP fact sheets in Appendix G. Site-specific conditions may require additional maintenance activities or adjustments to the activities and frequencies in the fact sheets. The justification for any deviations from the fact sheets should be described in the O&M Plan.

For the purpose of consistent description of activities, the following definitions should be used in the development of O&M Plans:

Routine O&M Activities – Activities conducted at regularly scheduled intervals to sustain long-term performance of each BMP, including inspections and normal upkeep. This category also includes activities conducted on an as-needed basis, prompted by inspections, to correct conditions that are anticipated to occur with normal operations of a BMP.

Rehabilitation Activities – Activities conducted to replace or rehabilitate system components at the end of their usable life. While the need for eventual rehabilitation is an expected event, this is distinct from Routine O&M because it may require more significant redesign and reconstruction efforts. The O&M Manual should seek to estimate the expected design life and the triggers for when a system has reached the end of its usable life.

Corrective Activities. Activities conducted to resolve major issues that are not anticipated. Because these are not anticipated, it is not possible for an O&M Manual to have pre-defined remedies. Rather, the O&M Manual should establish a process for identifying a major issue that requires correction, diagnosing the issue and its underlying causes, determining the appropriate corrections, obtaining permits, if applicable, and appropriately documenting any changes to the design that result.

Emergency Response Activities – Activities related to emergencies, including spills, which may require immediate action and notifications.

Training Activities – Activities to train maintenance staff.

Documentation and Reporting – Protocols for documentation, reporting, and document retention.

2.8.2.1. Phases of Maintenance

Where applicable, the O&M Plan should define the phases of maintenance and any differences in activities or frequency that relate to initial establishment or reestablishment following rehabilitation. For vegetated systems and media-based systems, it may be appropriate to define one or more of the following periods:

Immediate post-construction or major rehabilitation (2 months to 1 year after construction) – During this phase, the system is stabilizing and there may be limitations to placing the system into full service. After initial construction, the contractor may still be under warrantee to maintain the system.

Short-term (2-3 years post-construction or major rehabilitation). This is a period when plants are establishing and initial system conditioning processes (e.g., media settling, soil structure development) are occurring. During this period, more frequent inspections may be needed. Additionally, maintenance activities can be more frequent and intensive, depending on the needs of the BMP. This regime may also need to be reinstated if major replanting occurs at any point in the facility lifespan.

Long-term (after end of short-term phase). This period begins after full establishment of vegetation and upon adequate observations of typical functions. The intention of the long-term maintenance period is to provide sufficient and sustained maintenance to maximize functionality and performance for the life of the BMP while avoiding unnecessary costs. Observations during the short-term period may result in updates to frequencies or activities associated with long-term maintenance.

These phases are not required to be defined in O&M plans, but are encouraged where maintenance needs are expected to evolve over the life of the facility.

2.8.3. Roles and Responsibilities

The responsible parties that should be defined for each O&M Plan are defined as follows:

- **Facility Owner** – The Facility Owner is the party who is ultimately responsible for the functionality of the facility. The maintenance agreement (Appendix B) will identify the facility owner for each facility, including the timing of any ownership transitions.

- **Responsible Party** - The Responsible Party is the party that shall have direct responsibility for the maintenance of the facilities included within this plan. This party shall be the designated contact with inspectors and lead maintenance personnel. The Responsible Party shall sign self-inspection reports and any correspondence regarding the verification of inspections and required maintenance. The Responsible Party will establish a system to delegate general inquiries to the appropriate maintenance personnel concerning the operation and maintenance of the facilities. The Responsible Party reports directly to the Facility Owner and operates and manages the facilities on the Facility Owner's behalf.
- **Designated Emergency Respondent** - The Designated Emergency Respondent is the party responsible for directing activities and communications during emergencies such as clogged drains, broken irrigation pipes, hazardous spill responses etc., that would require immediate response should they occur during off-hours. It is the responsibility of the Designated Emergency Respondent to communicate the emergent situation with the Responsible Party as soon as possible.
- **Key Maintenance Personnel** –Key Maintenance Personnel are the designated lead field manager(s) or supervisor(s) who directly oversee and delegate the maintenance activities, maintains the scheduling, and coordinates activities between all personnel.

2.8.4. Maintenance Mechanisms

Maintenance mechanisms are part of the O&M Plan that assign responsibility for maintenance of the BMPs and describe a funding mechanism. Maintenance mechanisms may be provided either through the local jurisdiction through a maintenance agreement or by the project applicant. Ownership and maintenance responsibility for structural BMPs should be discussed at the beginning of the project planning, typically at the pre-application meeting with the planning and zoning agency. Provisions to finance and implement maintenance of BMPs can be a major stumbling block to project approval, particularly for small residential subdivisions. The following are alternative mechanisms that may be used to provide on-going maintenance for the BMPs included in the Project WQMP.

Project proponent agreement to maintain stormwater BMPs: The local jurisdiction may enter into a contract with the project proponent obliging the project proponent to maintain, repair and replace the stormwater BMP as necessary into perpetuity. Security of a funding mechanism with a "no sunset" clause may be required.

Assessment districts: The local jurisdiction may approve an Assessment District or other funding mechanism created by the project proponent to provide funds for stormwater BMP maintenance, repair and replacement on an ongoing basis. Any agreement with such a District shall be subject to the Public Entity Maintenance Provisions below.

Lease provisions: In those cases where the local jurisdiction holds title to the land in question, and the land is being leased to another party for private or public use, the local jurisdiction may assure stormwater BMP maintenance, repair and replacement through conditions in the lease.

Conditional use permits: For discretionary projects only, the local jurisdiction may assure maintenance of stormwater BMPs through the inclusion of maintenance conditions in the conditional use permit. Security may be required. Some jurisdictions include requirements to implement approved WQMPs in their municipal code.

Alternative mechanisms: The local jurisdiction may accept alternative maintenance mechanisms if such mechanisms are as protective as those listed above.

Public entity maintenance: The local jurisdiction with the responsibility for WQMP approval may approve a WQMP that identifies a public or acceptable quasi-public entity (e.g., the City, the County, or County Flood Control District, an existing assessment district, an existing utility district, or a conservation conservancy) as assuming responsibility for operation, maintenance, repair and replacement of the BMP. Unless otherwise acceptable to individual local agencies, public entity maintenance agreements shall ensure estimated costs are front-funded or reliably guaranteed, (e.g., through a trust fund, assessment district fees, bond, letter of credit or similar means). In addition, the local jurisdictions may seek protection from liability by appropriate releases and indemnities.

The project proponent must demonstrate that it will transfer the BMP maintenance to another public entity subject to the following provisions. The project proponent will negotiate maintenance requirements with the entity that it is proposing to accept maintenance responsibilities within its jurisdiction; and negotiate with the resource agencies responsible for issuing permits for the construction and/or maintenance of the facilities. If necessary, the public entity will also demonstrate through the CEQA review or the public entity's public review process that it can accept the maintenance responsibility. If a public entity is named as the responsible maintenance entity, then the local jurisdiction must include that entity in its CEQA review process as a Responsible Agency where applicable. The local jurisdiction must be identified as a third party beneficiary empowered to enforce any such maintenance agreement within their respective jurisdictions.

2.9. Incorporating USEPA Green Streets Guidance to the MEP

This section provides guidance for preparation of a Project WQMP that incorporates USEPA **Managing Wet Weather with Green Infrastructure: Green Streets** in a manner consistent with the MEP standard. Interpretation of this guidance specific to green street projects in Orange County are included here. Most of the guidance for completing the Project WQMP described in Sections 2.1 through 2.8 is generally applicable to green street projects. This section provides specific guidance about how this guidance should be adapted for LID and hydromodification requirements for qualifying projects.

2.9.1. Regulatory Context

2.9.1.1. North Orange County

[Placeholder for future addition after adoption of the 5th Term NOC MS4 Permit]

2.9.1.2. South Orange County

Per the SOC MS4 Permit, the following category of project may be exempted from being defined as Priority Projects at the discretion of the permittee with jurisdiction over project review:

> "Retrofitting or redevelopment of existing paved alleys, streets or roads that are designed and constructed in accordance with the USEPA Green Streets guidance."

This waives the need for a Project WQMP. However, to ensure that the project incorporates features that qualify it for this exemption, an analogous planning document should be developed and kept on file. This section provides guidance that can be used to develop such a document.

2.9.2. Site and Watershed Assessment Considerations for Applicable Green Streets Projects

Site and watershed assessment for applicable Green Streets projects includes many of the same considerations as described in **Section** 2.3. In addition to those elements described in **Section** 2.3, specific elements which should be given special consideration in the site assessment process for applicable Green Streets include:

- **Ownership of land adjacent to right of ways.** The opportunity to provide stormwater treatment may depend on the ownership of land adjacent to the right-of-way. Acquisition of additional right-of-way and/or access easements may be more feasible if land bordering the project is owned by relatively few land owners.
- **Location of existing utilities.** The location of existing storm drainage utilities can influence the opportunities for Green Streets infrastructure. For example, stormwater planters can be designed to overflow along the curb-line to an existing storm drain inlet, thereby avoiding the infrastructure costs associated with an additional inlet. The location of other utilities will influence the ability plumb BMPs to storm drains, therefore, may limit the allowable placement of BMPs to only those areas where a clear pathway to the storm drain exists.
- **Grade differential between road surface and storm drain system.** Some BMPs require more head from inlet to outlet than others; therefore, allowable head drop may be an important consideration in BMP selection. Storm drain elevations may be constrained by a variety of factors in a roadway project (utility crossings, outfall elevations, etc.) that cannot be overcome and may override stormwater management considerations.

- **Longitudinal slope.** The suite of LID BMPs which may be installed on steeper road sections is more limited. Specifically, permeable pavement and swales are more suitable for gentle grades. Other BMPs may be more readily terraced to be used on steeper slopes.
- **Potential access opportunities.** A significant concern with installation of BMPs in major right of ways is the ability to safely access the BMPs for maintenance considering traffic hazards. The site assessment should identify vehicle travel lanes and areas of specific safety hazards for maintenance crews and subsequent steps of the Project WQMP preparation process should attempt avoid placing BMPs in these areas.

2.9.3. Site Design and Drainage Plan for Applicable Green Streets Projects

Applicable Green Streets projects should apply the following LID site design measures to the MEP in the drainage plan as specified in the local permitting agency's codes:

- Minimize street width to the appropriate minimum width for maintaining traffic flow and public safety.
- Add tree canopy by planting or preserving trees/shrubs.
- Use porous pavement or pavers for low traffic roadways, on-street parking, shoulders or sidewalks.
- Integrate traffic calming measures in the form of bioretention curb extensions.

2.9.4. Selecting LID BMPs for Green Streets Projects

Infiltration feasibility should be conducted for green streets projects as described in section 2.5.1, with specific attention to protection of groundwater quality as discussed in **Appendix** C and the structural integrity of the adjacent road bed.

Applicable Green Streets projects should select BMPs consistent with the Green Streets guidance. The fundamental tenants of the approach described by the USEPA Green Streets guidance include:

- Selecting LID BMPs to the opportunities of the site and to attempt to address pollutants of concern and HCOCs,
- Developing innovative stormwater management configurations integrating "green" with "grey" infrastructure,
- Sizing BMPs opportunistically to provide stormwater pollution reduction to the MEP, accounting for the many competing considerations in right of ways.

Table 2-13 provides an inventory of LID BMPs which may be appropriate for applicable Green Streets projects. The performance criteria for applicable green streets projects do not require retention BMPs to be considered to the MEP before considering biotreatment and treatment control BMPs. A formal process of BMP prioritization and selection is not required for

applicable Green Streets projects, however infiltration infeasibility criteria still apply. Only feasible BMPs may be selected.

BMPs should be prioritized based on a comparison of drainage area characteristics to the opportunity criteria listed in Table 2-13. The USEPA Green Streets guidance describes how some of these BMPs may be used in combination to achieve optimal benefits in runoff reduction and water quality improvement. Specific examples and applications for residential streets, commercial streets, arterials streets, and alleys are provided in the USEPA guidance.

The drainage patterns of the project should be developed so that drainage can be routed to areas with BMP opportunities before entering storm drains. For example, if a median strip is present, a reverse crown should be considered, where allowed, so that stormwater can drain to a median swale. Likewise, standard peak-flow curb inlets should be located downstream of areas with potential for stormwater planters so that water can first flow into the planter, and then overflow to the downstream inlet if capacity of the planter is exceeded. It is more difficult to apply green infrastructure after water has entered the storm drain.

Conceptual drainage plans for redevelopment projects should identify tributary areas outside of the project site generates runoff that comingles with on-site runoff. The project is not required to treat off-site runoff; however treatment of comingled off-site runoff may be used to off-set the inability to treat areas within the project for which significant constraints prevent the ability to provide treatment.

Table 2-13: Potential BMPs for Applicable Green Streets Projects

BMP Type	Opportunity Criteria for Applicable Green Streets Projects
Street Trees, Canopy Interception	• Access roads, residential streets, local roads and minor arterials • Drainage infrastructure, sea walls/break waters • Effective for projects with any slope • Trees may be prohibited along high speed roads for safety reasons or must be setback behind the clear zone or protected with guard rails and barriers
Stormwater Curb Extensions / Stormwater Planters	• Access roads, residential streets, and local roads with parallel or angle parking and sidewalks • Can be designed to overflow back to curb line and to standard inlet • Shape is not important and can be integrated wherever unused space exists • Can be installed on relatively steep grades with terracing
Bioretention Areas	• Low density residential streets without sidewalks • Requires more space than curb extensions/ planters, most feasibly implemented in combination with minimized road widths
Permeable Pavement	• Parking and sidewalk areas of residential streets, and local roads • Should not receive significant run-on from major roads • Should not be subject to heavy truck/ equipment traffic • Light vehicle access roads
Permeable Friction Course Overlays	• High speed roadways unsuitable for full depth permeable pavement • Suitable for parking lots and all roadway types

Table 2-13: Potential BMPs for Applicable Green Streets Projects

BMP Type	Opportunity Criteria for Applicable Green Streets Projects
Vegetated Swales (compost amended were possible)	• Roadways with low to moderate slope • Residential streets with minimal driveway access • Minor to major arterials with medians or mandatory sidewalk set- • Access roads • Swales running parallel to storm drain can have intermittent discharge points to reduce required flow capacity
Filter strips (amended road shoulder)	• Access roads • Major roadways with excess ROW • Not practicable in most ROWs because of excessive width requirements
Proprietary Biotreatment	• Constrained ROWs • Typically have small footprint to tributary area ratio • Simple install and maintenance • Can be installed on roadways of any slope • Can be designed to overflow back to curb line and to standard inlet
Infiltration Trench	• Constrained ROWs • Can require small footprint where soils are suitable • Low to moderate traffic roadways • Infiltration trenches are not suitable for high traffic roadways • Requires robust pretreatment
Cartridge Media Filters	• Highly constrained ROW with little available surface area • Installed in underground vaults, manholes, or catch basins • Require minimum available head loss • Simple installation and maintenance
WSDOT Media Filter Drains	• See : http://www.ecy.wa.gov/programs/wq/stormwater/newtech/use_designations/091022EcologyEmbankmentGULD.pdf

2.9.5. LID BMP and Hydromodification Sizing for Applicable Green Streets Projects

Applicable green street projects are not required to meet the same sizing requirements for LID and hydromodification BMPs as other projects, but they are required to attempt to meet these standards to the MEP. The following steps are used to size both LID BMPs and hydromodification BMPs for applicable Green Streets projects:

1. Delineate drainage areas tributary to BMP locations and compute imperviousness.
2. Look up the recommended LID sizing method for the BMP selected in each drainage area using Appendix E.
3. Attempt to provide the calculated LID sizing criteria for the selected BMPs using the methods in Appendix E.
4. Determine if an HCOC exists using the methods described Section 2.3.5.
5. Determine if LID sizing criteria satisfy hydromodification criteria to mitigate any HCOCs.
6. Attempt to mitigate any remaining HCOCs using hydromodification BMPs according to Section 5.

7. If LID or hydromodification sizing criteria cannot be achieved, document the constraints that override the application of BMPs, and provide the largest portion of the sizing criteria that can be reasonably provided given constraints.
8. Design BMPs per the guidance provided in the BMP Fact Sheets (Appendix G).

Even if BMPs cannot be sized to meet the LID and/or hydromodification criteria, it is still essential to design the BMP inlet, energy dissipation, and overflow capacity for the full tributary area to ensure that flooding and scour is avoided. It is strongly recommended that BMPs which are designed to less than their target design volume be designed to bypass peak flows.

2.9.6. Alternative Compliance Options for Applicable Green Streets Projects

Applicable green streets projects are not required to meet alternative compliance options if stormwater management controls described in this section, or equivalent, are installed in a manner consistent with the MEP standard.

SECTION 3. SITE DESIGN PRINCIPLES AND TECHNIQUES

3.1. Introduction

This section focuses on LID site design practices; structural LID BMPs are discussed in **Section 4**. LID site design practices are required to be implemented wherever feasible and applicable on all Priority Projects. LID site design practices are also required for Non-Priority Projects, wherever feasible applicable.

The primary objective of site design principles and techniques is to reduce the hydrologic and water quality impacts associated with land development. The benefits derived from this approach include:

- Reduced size of downstream BMPs and conveyance systems;
- Reduced pollutant loading; and
- Reduced hydromodification impacts to receiving streams.

Site Design Principles and Techniques include the following design features and considerations:

- Site planning and layout;
- Vegetative protection, revegetation, and maintenance;
- Slopes and channel buffers;
- Techniques to minimize land disturbance;
- LID BMPs at scales from single parcels to watershed: and
- Integrated Water Resource Management Practices

Detailed descriptions for each of these Site Design Principles and Techniques are presented in the following sections.

3.2. Site Planning and Layout

3.2.1. Minimize Impervious Area

One of the principal causes of the environmental impacts of development is the creation of impervious surfaces. Impervious cover can be minimized through identification of the smallest possible land area that can be practically impacted or disturbed during site development. Below is a partial list of techniques that can reduce the amount of impervious area that will be created as part of a project. It is important to note that local land use ordinances and building codes may dictate minimum requirements for road widths, building setbacks and accessibility requirements which may not be overridden. However, in certain situations, it may be possible to modify local codes and ordinances or for a project proponent to obtain a waiver to promote

less impervious area, such as allowing narrower road widths, sidewalks on one side of the street, shared driveways, reciprocal parking, and reduced building set-backs. Some strategies for minimizing impervious surfaces may serve multiple functions by supporting other local planning objectives such as providing traffic-calming measures and promoting walkable and healthy communities.

3.2.1.1. Limit Overall Coverage of Paving and Roofs

This can be accomplished by designing compact, taller structures, narrower and shorter streets and sidewalks, smaller parking lots (fewer stalls, smaller stalls, and more efficient drive lanes), and indoor or underground parking. Examine site layout and circulation patterns and identify areas where landscaping can be substituted for pavement.

3.2.1.2. Detain and Retain Runoff Throughout the Site

On flatter sites, it typically works best to intersperse landscaped areas and integrate small scale retention practices among the buildings and paving. On hillside sites, drainage from upper areas may be collected in conventional catch basins and piped to landscaped areas and BMPs in lower areas. Or use low retaining walls to create terraces that can accommodate BMPs.

3.2.1.3. Example Planning Phase Techniques

- Build vertically rather than horizontally - add floors to minimize building footprint.
- Cluster development to reduce requirements for roads and preserve green space.
- Minimize lot setbacks (which in turn minimize driveway lengths).
- Reduce road widths to minimum necessary for emergency vehicles.
- Utilize shared driveways.

3.2.1.4. Example Design Phase Techniques

- Install sidewalks on only one side of private roadways to the extent allowed by accessibility requirements.
- Use alternative materials such as permeable paving blocks or porous pavements on driveways, sidewalks, parking areas, etc. Practices should be selected such that they do not present health and safety hazards, such as tripping hazards.
- Create smaller parking spaces intended for compact cars.

3.2.1.5. Example Construction Phase Techniques

- Minimize unnecessary compaction where possible, especially in locations where infiltration BMPs will be constructed. The infiltrative capacity of soils can be greatly reduced when they are compacted, often to the point that they perform similarly to impervious surfaces. Where possible, remediate compacted soils.
- Minimize construction footprint.

- Preserve existing vegetable and trees as feasible.

3.2.2. Maximize Natural Infiltration Capacity

A key component of LID is taking advantage of a site's natural infiltration and storage capacity. This will limit the amount of runoff generated, and therefore the need for mitigation BMPs. A site soils/geology assessment will help to define areas with higher potential for infiltration and surface storage.

These areas are typically characterized by:

- Principally Hydrologic Soil Group A or B soils and in some cases Group C soils.
- Mild slopes or depressions.
- Historically undeveloped areas.

3.2.2.1. Example Planning Phase Techniques

- Avoid placing buildings or other impervious surfaces on highly permeable areas.
- Cluster buildings and other impervious areas onto the least permeable soils.

3.2.2.2. Example Design Phase Techniques

- Where paving of permeable soils cannot be avoided, loss of infiltration capacity can be minimized by using permeable paving materials.
- Where possible, incorporate soil amendments and/or retentive grading to make areas self-containing and minimize runoff

3.2.2.3. Example Construction Phase Techniques

- Minimize construction footprint.
- Minimize incidental and unnecessary compaction where it is not necessary to meet the applicable grading code requirements.

3.2.3. Preserve Existing Drainage Patterns and Time of Concentration

Integrating existing drainage patterns into the site plan will help maintain a site's predevelopment hydrologic function. Preserving existing drainage paths and depressions will help maintain the time of concentration and infiltration rates of runoff, decreasing peak flows. The best way to define existing drainage patterns is to visit the site during a rain event and to directly observe runoff flowing over the site. If this is impossible, drainage patterns can be inferred from topographic data, though it should be noted that depression micro-storage features are often not accurately mapped in topographic surveys. Analysis of the existing site drainage patterns during the site assessment phase of the project can help to identify the best locations for buildings, roadways, and stormwater BMPs.

Where possible, add additional depression "micro" storage throughout the site's landscaping that mimics natural drainage patterns. Mild gradients can be used to extend the time of concentration, which reduces peak flows and increases the potential for additional infiltration. While risk of serious flooding must be minimized, the persistence of temporary "puddles" during storms is beneficial to infiltration. If a site is visited during dry weather, these areas can sometimes be identified by looking for surficial dried clay deposits.

Use drainage as a design element. Use depressed landscape areas, vegetated buffers, and bioretention areas as amenities and focal points within the site and landscape design. Bioretention areas can be almost any shape and should be located at low points. When configured as swales, bioretention areas can detain and treat low runoff flows and also convey higher flows.

3.2.3.1. Example Planning Phase Techniques

- Avoid channelization of natural streams.
- Establish set-backs and buffer areas from natural streams.
- Where natural streams will be converted to engineered streams, provide sinuosity to increase the time of concentration.
- Develop an effective conceptual drainage plan.

3.2.3.2. Example Design Phase Techniques

- Avoid channelization of natural streams.
- When designing channels, use mild slopes and increase channel roughness to extend time of concentration.
- When possible, use pervious channel linings to maximize opportunity for infiltration.
- Use vegetated, un-hardened conveyance elements.
- Intersperse localized retention features throughout site.

3.2.3.3. Example Construction Phase Techniques

- Minimize construction footprint.

Micro-scale on-lot retention is a component of preserving existing drainage patterns and times of concentration. Micro-scale on-lot retention is a HSC for the purpose of this TGD. A BMP fact sheet for localized on-lot retention is found in Appendix G. The fact sheet describes recommended design criteria and methods of quantifying the performance of this practice.

3.2.4. Disconnect Impervious Areas

Runoff from 'connected' impervious surfaces commonly flows directly to a paved surface (driveway, sidewalk, or to the curb line) and from there to the stormwater collection system with no opportunity for infiltration into the soil. For example, roofs and sidewalks commonly

drain onto parking lots, and the runoff is conveyed by the curb and gutter to the nearest storm inlet. Runoff from numerous impervious drainage areas may converge, combining their volumes, peak runoff rates, and pollutant loads. Disconnecting impervious areas from conventional stormwater conveyance systems allows runoff to be collected and managed at the source or redirected onto pervious surfaces such as vegetated areas. This reduces the amount of directly connected impervious area (DCIA), reduces the peak discharge rate by increasing the time of concentration, maximizes the opportunity for infiltration by reducing the velocity of flows, provides for greater contact time with the soil, and maximizes the opportunity for ET during transport.

Disconnection practices may be applied in almost any location, but impervious surfaces must discharge into a suitable receiving area for the practices to be effective. Information gathered during the site assessment will help determine appropriate receiving areas. Typical receiving areas for disconnected impervious runoff include landscaped areas and/or LID BMPs (i.e., filter strips or bioretention). Runoff must not flow toward building foundations or be redirected onto adjacent private properties. Setbacks from buildings or other structures may be required to ensure soil stability. Consult with the project geotechnical engineer to identify areas where infiltration can be accommodated.

It is important to bear in mind that water flows downhill; therefore receiving areas must be located down gradient from runoff discharges. In a residential setting, this could mean that roof runoff discharges to either the front yard or the back yard, depending on the site configuration. As compared to conventional development, some potential techniques for redirecting flows to vegetated areas may require local design standards to be revisited or a waiver obtained.

3.2.4.1. Example Planning Phase Techniques

- Plan site layout and mass grading to allow for runoff from impervious surfaces to be directed into distributed permeable areas such as turf, recreational areas, medians, parking islands, planter boxes, etc.
- Use vegetated swales for stormwater conveyance instead of traditional concrete pipes.
- Avoid channelization of natural on-site streams.

3.2.4.2. Example Design Phase Techniques

- Provide permeable areas within medians and parkways that are designed to accept runoff from adjacent areas (i.e. via curb cuts).
- Construct roof downspouts to drain to pervious areas such as planter boxes or adjacent landscaping. This approach is further described in **Section 4**.
- Use permeable paving materials such as paving blocks or porous pavements on driveways, sidewalks, parking areas, etc.

To minimize stormwater-related impacts, apply the following design principles to the layout of newly developed and redeveloped sites:

- Define the development envelope and protected areas, identifying areas that are most suitable for development and areas that should be left undisturbed.
- Set back development from creeks, wetlands, and riparian habitats.
- Preserve established trees as practicable (see **Section 3.3**)

Impervious area disconnection is characterized as a HSC for the purpose of this TGD. BMP fact sheets for localized on-lot retention and impervious area dispersion are found Appendix G. These fact sheets include recommended design criteria and methods of quantifying the benefits of impervious area disconnection.

3.3. Vegetative Protection, Selection Revegetation, and Soil Stockpiling

3.3.1. Protect Existing Vegetation and Sensitive Areas

A thorough site assessment will identify any areas containing dense vegetation or well-established trees. When planning the site, avoid disturbing these areas. Soils with thick, undisturbed vegetation have a much higher capacity to store and infiltrate runoff than do disturbed soils. Reestablishment of a mature vegetative community can take decades. Sensitive areas, such as wetlands, streams, floodplains, or intact forest, should also be avoided. Development in these areas is often restricted by federal, state and local laws.

Vegetative cover can also provide additional volume storage of rainfall by retaining water on the surfaces of leaves, branches, and trunks of trees during and after storm events. This capacity is rarely considered, but on sites with a dense tree canopy it can provide additional volume mitigation.

3.3.1.1. Example Planning Phase Techniques

- Establish set-backs and buffer zones surrounding sensitive areas.
- Incorporate established trees into site layout.

3.3.1.2. Example Design Phase Techniques

- Design site to deter human activity within sensitive areas (i.e. fences, signs, etc.).

3.3.1.3. Example Construction Phase Techniques

- Provide and maintain highly visible flagging and/or fencing around sensitive areas or vegetation that is to be protected.

3.3.1.4. Example Occupancy Phase Techniques

- Establish use/access restrictions to sensitive areas.

3.3.2. Revegetate Disturbed Areas

Maximizing plant cover protects the soil and improves ability of the site to retain stormwater, minimize runoff, and help to prevent erosion. Plants have multiple impacts on downstream water quality. First, the presence of a plant canopy (plus associated leaf litter and other organic matter that accumulates below the plants) can intercept rainfall, which reduces the erosive potential of precipitation. The Street Trees/Canopy Cover Fact Sheet provided in Appendix **G** facilitates quantification of the retention benefits of canopy cover. With less eroded material going to receiving waters, turbidity, chemical pollution, and sedimentation are reduced. Second, a healthy plant and soil community can help to trap and remediate chemical pollutants and filter particulate matter as water percolates into the soil. This occurs through the physical action of water movement through the soil, as well as through biological activity by plants and the soil microbial community that is supported by plants. Third, thick vegetative cover can maintain and even improve soil infiltration rates.

When selecting plants for re-vegetation, preference should be given to native vegetation, which is uniquely suited to the local soils and climate. However, consideration of the location of the plants in the landscape with regards to wildfire safety can sometimes make the use of native species unsuitable. The Orange County Fire Authority requires "fuel modification zones" adjacent to development and restricts species of plant that may be used in these zones. Additional information can be found by contacting local Master Gardeners or seeking the advice of local plant nurseries, which will have specific knowledge of plants suitable for your particular application. The Las Pilitas Nursery in Santa Margarita has compiled a detailed database of California native plants which is accessible online at: **http://www.laspilitas.com/comhabit/california_communities.html**. The website can be used to aid in determining the correct plant communities by searching by either ZIP code or town. In cases where use of native vegetation is impractical or impossible, use of non-natives adapted to similar climate regimes, such as the Mediterranean, may be appropriate. This strategy will maximize the successful establishment of plantings, and minimize the need for supplemental irrigation.

3.3.3. Soil Stockpiling and Site Generated Organics

The regeneration of disturbed topsoil can take years under optimal conditions, and sometimes can take many decades (Brady and Weil, 2002[11]). Proper stockpiling, storage, and reapplication of disturbed topsoil can greatly accelerate this process. Improper soil storage and restoration

[11] The Nature and Properties of Soils, 13th Edition, Nyle C. Brady, Ray R. Weil, 2002.

can significantly decrease the biological activity of the soil, decrease the successful establishment of plantings, and increase the ability of undesirable invasive species to dominate the disturbed landscape. Proper stockpiling generally includes protecting the stockpile to prevent excessive compaction and covering the stockpile to prevent significant erosion and leaching of nutrients.

Soil stockpiling and the use of in situ grubbed plant material and duff as mulch or soil amendments is encouraged. This will reduce the need for importation of top soil to improve soil quality, and will encourage reestablishment of soil flora and fauna after site disturbance. Successful soil stockpiling and reuse begins in the early stages of project planning.

The use of topsoil harvested from the local site can improve the productivity and rate of re-vegetation of a disturbed site. In addition to stockpiled soil, vegetative material grubbed from the site and free of invasive species can be tilled back into the soil to increase organic content.

Restoration of disturbed areas using native soils which have been properly stockpiled during the construction phase of the project is the preferred method of post construction soil restoration. Proper assessment of the site during the design phase of the project is critical to maintaining soil quality, both structural and biological, during the period the soil is stockpiled. Determination of the volume of soil to be stockpiled and designating an area large enough on site to accommodate the stockpiled soil should be considered early in project design.

Consideration must be given to maintenance of the flora and fauna present in the stockpiled soil in addition to its physical condition. Improper storage such as soil that is too wet or stockpiled too deeply, can render what were active biological soil communities sterile. This will severely impact the ability of the soil to support a healthy plant community. If necessary, a local soil scientist familiar with regional soils can provide testing services to evaluate soil condition prior to and after construction and recommend appropriate remediation steps to restore the soil's predevelopment ability to infiltrate stormwater runoff and support a healthy plant community.

Additional information about the impact of soil stockpiling can be found in the following document which was prepared for the District 11 office of the California Department of Transportation:

Restoration in the California Desert - **http://www.sci.sdsu.edu/SERG/techniques/topsoil.html**

3.3.4. Firescaping

Fire is a part of the ecosystems of Southern California. Over the years, wildfires have repeatedly destroyed homes and caused loss of life. In response to this natural phenomenon, extensive research has been done and, in the interest of public safety, guidelines have been codified into law. When considering any planting or re-vegetation plan, consideration must be given to minimizing the risks of fire with proper plant selection and maintenance. Keep in mind that all plants are flammable given the right conditions; selection and maintenance of plants to mitigate

flammability go hand-in-hand. A plant with a low flammability rating which is allowed to accumulate dead wood or excessive levels of duff in and around the plant will elevate the risk of flammability significantly.

California law (Public Resources Code 4291) requires a minimum 100-foot space around homes on level ground to protect the structure and provide a safe area for firefighters. If a home is located on a slope, additional distance is required and plant spacing, selection, and design must be modified to maintain proper fire safety margins.

A four zone system has been developed to create a maximum buffer around structures located in high risk wildfire zones. Each zone has very specific landscaping and management requirements to minimize flammability of the landscape. The four zones are broken down as follows:

- Zone One – The garden or clean and green zone
- Zone Two – The greenbelt or reduced fuel zone
- Zone Three – The transition zone
- Zone Four – Native or Natural Zone / Open Space

The landscape plant selection and design for any bioretention or re-vegetation project should be compliant with the requirements of the specific zone in which it will be located. For assistance in determining the correct zone plant selection and spacing, contact your local fire department or insurance company for assistance.

3.3.5. Water Efficient Landscaping

As water use, the frequency of drought, and the impact of organic waste generated from landscape management increases in California, methods to deal with these problems have been developed. Water efficient landscaping, also called "drought tolerant landscaping", California-friendly landscaping, or "native landscaping", or "xeriscaping", has become a widely-accepted alternative to traditional landscape design in dry areas.

Water efficient landscaping is a landscape design and plant selection scheme that is used to minimize required resources and waste generated from a landscape. Defined as "quality landscaping that conserves water and protects the environment" the principles of water efficient landscaping should be employed in any project that creates or restores the landscape. Consulting local resources, such as your local county extension agent, Master Gardeners, Landscape Architects, or local garden centers and nurseries, will help to select plant material suitable for a specific geographic location.

Water efficient landscaping is based on seven principles:

- Soil analysis
- Planning and design

- Appropriate plant selection
- Practical turf areas
- Efficient irrigation
- Use of mulches
- Appropriate maintenance

Water efficient landscaping has many benefits which include:

- Reduced water use
- Decreased energy use
- Reduced heating and cooling costs resulting from optimal placement of trees and plants
- Minimal runoff from both stormwater and irrigation resulting in reduction of sediment, fertilizer and pesticide transport
- Reduction in yard waste that would normally be landfilled
- Creation of habitat for wildlife
- Lower labor and maintenance costs
- Extended life of existing water resources infrastructure.

A water efficient landscape can reduce outdoor water consumption by as much as 50 percent without sacrificing the quality and beauty of landscaped areas. It is also an environmentally sound landscape, requiring less fertilizer and fewer chemicals. Water efficient landscape is also low maintenance, saving time, effort, and money.

Street trees/canopy cover are elements of vegetative protection, revegetation, and maintenance and are characterized as a HSC for the purpose of this TGD. A BMP fact sheet for street trees/canopy interception is found in Appendix G. Fact sheets include recommended design criteria and methods of quantifying the benefits of street trees/canopy interception.

The selection and design of vegetative-based LID BMPs that are specifically sized to treat the DCV is discussed further in **Section 4**.

3.4. Slopes and Channel Buffers

Project plans should include site design BMPs to decrease the potential for erosion of slopes and/or channels. The following design principles should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

1. Convey runoff safely from the tops of slopes.
2. Avoid disturbing steep or unstable slopes.
3. Avoid disturbing natural channels.
4. Install permanent stabilization BMPs on disturbed slopes as quickly as possible.
5. Vegetate slopes with native or drought tolerant vegetation.
6. Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems, unless infiltration would cause geotechnical hazards.

7. If hydromodification control is not provided before discharge to the channel, install permanent stabilization BMPs in channel crossings as quickly as possible, and ensure that increases in runoff velocity and frequency caused by the project do not erode the channel.
8. Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters should be installed in such a way as to minimize impacts to receiving waters.
9. Instead of discharging to steep reaches, consider collecting and conveying runoff to downgradient discharge points.
10. On-site conveyance channels should be lined, where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. Irrigation demand of vegetated systems should be considered. If velocities in the channel are large enough to erode grass or other vegetative linings, rock, riprap, concrete soil cement or geo-grid stabilization may be substituted or used in combination with grass or other vegetation stabilization.
11. Other design principles which are comparable and equally effective.

These practices should be implemented, as feasible, consistent with local codes and ordinances. Projects involving an alteration to bed, bank, or channel of a Water of the US may require approval of regulatory agencies with jurisdiction over water bodies, (e.g., the U.S. Army Corps of Engineers, the Regional Boards and the California Department of Fish and Game).

3.5. Techniques to Minimize Land Disturbance

Minimizing the amount of site clearing and grading can dramatically reduce the overall hydrologic impacts of site development. This applies primarily to new construction but the principles can be adapted to retrofit and infill projects as well.

Soil compaction resulting from the movement of heavy construction equipment can reduce soil infiltration rates by 70-99% (Gregory et al, 2006)[12]. Even low levels of compaction caused by light construction equipment can significantly reduce infiltration rates. In addition, compaction can destroy the complex network of biota in the soil profile that support the soil's ability to capture and mitigate pollutants. Soil compaction severely limits the establishment of healthy root systems of plants that may be used to revegetate the area. For these reasons, it is very important to avoid unnecessary damage to soils during the construction process. The use of

[12] Gregory, J.H.; Dukes, M.D.; Jones, P.H.; and G.L. Miller, 2006. Effect of urban soil compaction on infiltration rate. *Journal of Soil and Water Conservation 2006 61(3):117-124 Online at:* http://www.floridadep.org/water/wetlands/erp/rules/stormwater/docs/compaction.pdf

clearly defined protection areas will help to preserve the existing capacity of the site to store, treat and infiltrate stormwater runoff.

3.5.1.1. Example Planning Phase Techniques

- Many of the planning techniques identified in the above sections will help minimize the construction footprint.

3.5.1.2. Example Construction Phase Techniques

- Minimize the size of construction easements.
- Locate material storage areas and stockpiles within the development envelope.
- Limit ground disturbance outside of areas that require grading.
- Identify and clearly delineate access routes for the movement of heavy equipment.
- Establish and delineate vegetation and soil protection areas.
- Avoid compaction or heavy equipment on sites designated for infiltration BMPs

Additional techniques for minimizing disturbance and protecting or restoring site conditions during construction phase include:

Establish Vegetation and Soil Protection Areas

Vegetative protection areas (e.g. stream, river, lake and other watercourse buffers, vegetation protection areas, existing trees) should be clearly delineated with highly visible fencing materials to prevent incursion of equipment or the stockpiling of materials during construction. Tree trunks should be sheathed during construction to prevent or minimize damage to the bark.

Use of Mulch and Load Distributing Matting

Mulch blankets can be used to protect soil from compaction during construction. The use of timbers or other types of load distributing materials can also be used to limit the effect of heavy equipment movement on the site.

Pre / Post Construction Soil and Plant Treatments

Consideration should be given to pre-construction treatment of the soil to mitigate the stresses on existing shrubs and trees. This can include soil aeration and specific fertilization protocols that would encourage plant vitality. A local restoration ecologist should be engaged well in advance of the start of construction to develop a plan based on specific site conditions since some of these practices are carried out prior to construction.

Inspection Guidelines and Procedures

Management of soil, water, and vegetation protection measures during the construction process will only be effective if it is carefully implemented and meticulously policed during all phases of construction. Significant damage can be done in a short timeframe, and the cost of damage

remediation tends to be far greater than the cost of avoiding it. Areas intended for infiltration should be treated especially carefully. Avoid the use of heavy machinery or discharge of sediment-laden runoff in these areas. Heavy machinery will compact the soils and fine grained materials in sediment will reduce the soil's infiltration capability.

Techniques implemented on the construction site to minimize the construction footprint should be included in the project documentation. Contractors working on the project should review and agree to comply with them while working on the jobsite. Construction site inspections should include inspection of such protocols to ensure they are maintained throughout construction.

3.6. Integrated Water Resource Management Practices

Selection and incorporation of site design principles into new development and significant redevelopment projects, whether on-site or off-site can have significant multiple benefits on a subwatershed, watershed and county-wide basis. For example, Orange County Water District is supportive of regional infiltration BMPs as an approach to retaining more urban runoff in the groundwater basin. As another example, the San Diego Creek Natural Treatment System (NTS) Master Plan (**www.irwd.com/environment/natural-treatment-system.html**) includes, among other concepts, constructed wetlands integrated with flood control facilities. These types of facilities would provide retention and biotreatment as well as treatment of retrofit dry weather flows while maintaining the original flood control functionality of the basin. Wetland facilities also provide habitat for many bird species, including endangered species, can provide aesthetic benefits, and in some cases may also provide recreational benefits. Finally, LID and hydromodification control BMPs may provide significant flood control benefits, therefore the system design processes described in this TGD should be coordinated with flood control design (not covered by this TGD) to most efficiently support both functions.

SECTION 4. LID BMP SELECTION AND DESIGN

4.1. Introduction

This section provides additional detail on LID BMP selection, sizing, and design to support Step 5 (Section 2.5) of this TGD and Section 5 of the Project WQMP.

Section 4.2 describes the criteria for determining the feasibility of harvest and use and infiltration associated with each BMP location. This is intended to support the identification of the appropriate category of LID BMP to use in each DMA.

Section 4.3 provides additional detail about each category of LID BMP, including guidance for how they can be incorporated into designs, references for sizing methods, and references to BMP Fact Sheets for design criteria.

Section 4.4. identifies and provides guidance on the general and specific design criteria associated with LID BMPs. If a standard BMP approach from the BMP Fact Sheets is selected, this section does not need to be consulted as these design criteria have been incorporated into the of the criteria described in the BMP Fact Sheets. However, the guidance and criteria in Section 4.4 are relevant as a guide where deviations or project-specific adaptions of the fact sheets are proposed.

This section is not intended to stand alone. It is intended to be used within the overall framework for site investigation, site design, drainage planning, and LID selection described in Section 2.5.

4.2. LID BMP Selection

This section expands on and supports the BMP selection process that is summarized in Section 2.5.2.

4.2.1. Detailed Process for LID BMP Selection

A standard process and criteria for selection of on-site LID BMPs is detailed in this section. This process and criteria is intended to apply to the majority of project cases. Standardization of the selection process helps ensure a consistent basis for project development. For projects using on-site LID BMPs (the majority of projects), the selection process in this section is applicable. Criteria for the use of less common compliance pathways, including treatment control BMPs, off-site BMPs, and alternative approaches are detailed in the Model WQMP and are not covered in this section.

This process is based on complying with applicable MS4 requirements for LID BMP selection as detailed in Section 2.5 of the Model WQMP and Section 2.5.1 of the TGD. It is also based on the underlying principles described in Section 1.4. In this regard, this section adds some practical provisions and guidelines for BMP selection and design intended to improve reliability and resiliency that exceed the minimum requirements of the permit. Figure 4-1 describes the specific decision steps and TGD references to support these determinations and associated documentation. This is a more detailed version of Figure 2-2.

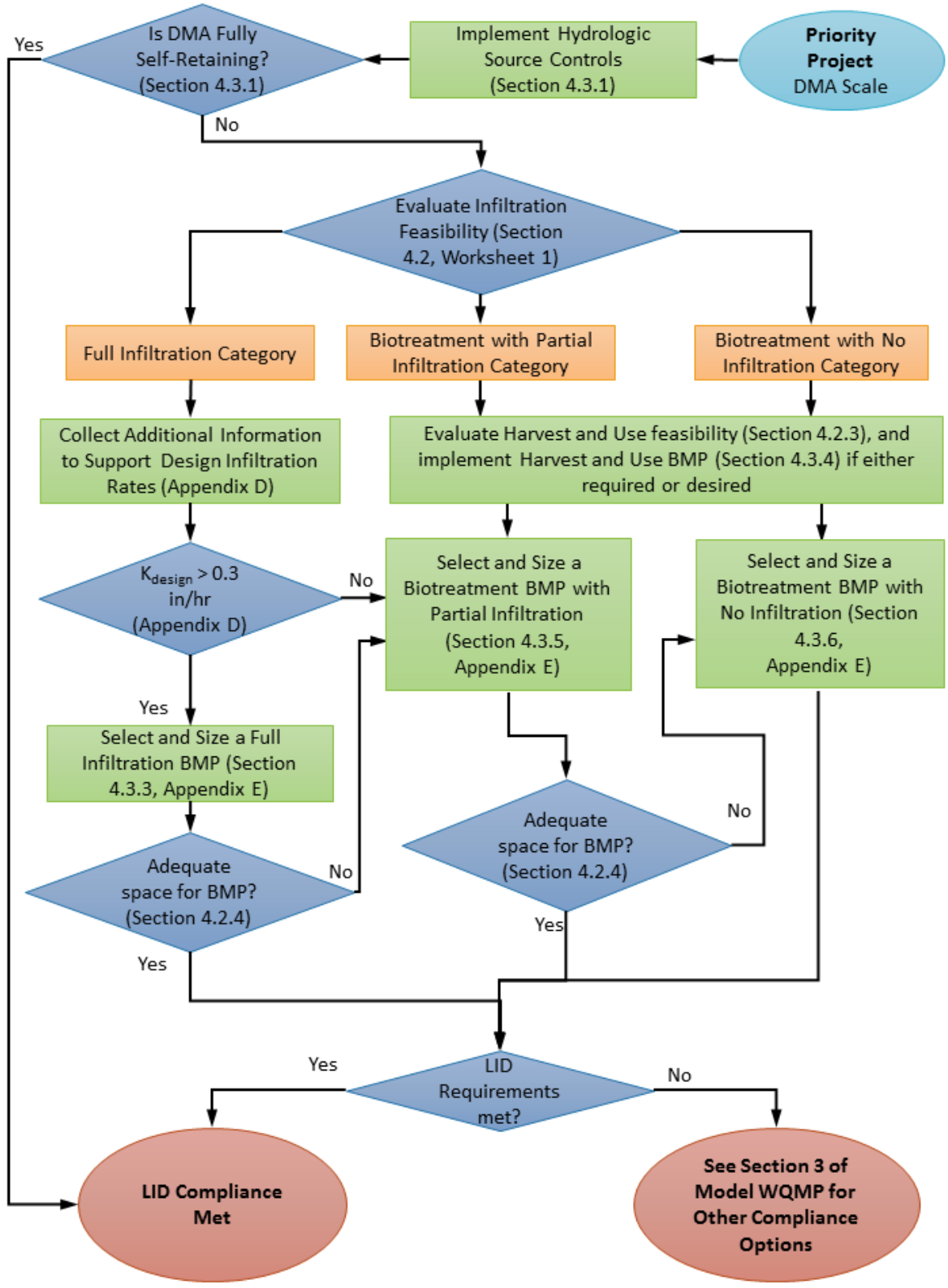


Figure 4-1: LID BMP Selection and Sizing Flow Chart

4.2.2. Infiltration Feasibility Criteria

Determining the feasibility of infiltration at each DMA and BMP location is the most critical factor in appropriate, effective, and safe BMP implementation. In minor cases, the feasibility of harvest and use (Section 4.2.3) may also influence BMP selection.

Based on the feasibility of infiltration at the site using the information collected about the site (Section 2.3), each DMA and structural BMP location should be categorized into one of three categories defined qualitatively below. Feasibility is a function of the physical ability to infiltrate stormwater and the risk of impacts to property, people, or the environment introduced by stormwater infiltration.

Table 4-1. Definition of Infiltration Feasibility Categories

Infiltration Feasibility	Physical feasibility		Risk of Impacts
Full Infiltration	Infiltration capacity at the BMP location(s) are measured and found to be reliable to support full infiltration of the DCV.	AND	The use of full infiltration of the DCV does not introduce risk of impacts to property, people, or the environment that cannot be reasonably mitigated.
Biotreatment with Partial Infiltration	Infiltration capacity is measured or estimated using acceptable methods and is not reliable to support infiltration of the DCV (or reliability cannot be reasonably determined).	AND	The use of biotreatment BMPs that provide partial infiltration of stormwater does not introduce risk of impacts to property, people, or the environment that cannot be reasonably mitigated.
Biotreatment without Infiltration	There is no reasonable opportunity to achieve appreciable infiltration of a portion of the DCV.	OR	Any degree of infiltration would pose risk of impacts to property, people, or the environment that cannot be reasonably mitigated.

4.2.2.1. General Criteria

Evaluation of infiltration feasibility must consider the following factors, as applicable:

- The physical rate at which water will reliably infiltrate and the ability to reasonably determine this. This is a function of soil properties, physical groundwater conditions, proposed fill, and other factors (See Section 4.2.2.2).

- Protection of groundwater from contamination as a result of stormwater infiltration. This includes assessment of pollutant sources in stormwater, treatment capacity of BMPs and soils, and existing soil or groundwater contamination (See Section 4.2.2.3).
- Geotechnical risk or hazards that are expected to arise from stormwater infiltration. (See Section 4.2.2.4)
- Groundwater balance and associated issues such as change in flow regime of water bodies, conflicts with water rights, or risk of increase of inflow and infiltration in to sanitary sewers. (See Section 4.2.2.6)

Each of these factors must be based on "substantial evidence" consistent with CEQA. Substantial evidence is defined as "Facts, reasonable assumptions predicated on facts, or expert opinion supported by facts. Substantial evidence does not include argument, speculation, unsubstantiated opinion or narrative, or evidence which is clearly erroneous or inaccurate" (Public Resources Code Section 21080(e)). Specific criteria and acceptable methods recommended to provide substantial evidence are provided in the following subsections and referenced appendices. Where deviations from these recommendations and methods are proposed, the applicant must clearly describe how the approach employed meets the definition of substantial evidence.

In evaluating each factor, reasonable approaches must also be considered for how the project could improve the feasibility of infiltration through site design, BMP design, or other project development aspects. Examples of reasonable and unreasonable mitigation approaches for improving the feasibility of infiltration are identified in each of the following subsections.

Only those factors necessary to provide adequate technical support for BMP selection are required to be considered. For example, if a single factor is investigated and determined to disallow any level of infiltration, then it is not necessary to investigate and consider other factors.

The overall framework allows that certain determinations may be made based on the use of regional maps supported by available site data rather than requiring site investigations. This is generally applicable for small projects only, as defined in 4.2.2.6.

As new information becomes available through more detailed site investigation efforts, or through construction-phase testing, this information must be incorporated into selection of BMPs.

Worksheet 1 provides a basis for categorizing each DMA into one of the three infiltration feasibility categories. The infiltration infeasibility criteria are listed below. More specific guidance on determining infiltration infeasibility related to groundwater protection is provided in Appendix C. Worksheet 2 (Appendix C) is used to summarize groundwater-related feasibility criteria as supporting information for Worksheet 1. Methods for determining the

measured infiltration rate and using the appropriate factor of safety on infiltration rates is provided in Appendix D; the results of this evaluation can be summarized in Worksheet 3.

4.2.2.2. Physical Capacity of BMP Location for Infiltration

Site-specific evaluation of infiltration capacity shall be conducted to determine the ability to reliably infiltrate stormwater at the identified BMP locations. The potential uncertainty in infiltration rates of full-scale facilities following construction activities must be considered in this assessment. Note that physical capacity for infiltration is only one factor in infiltration feasibility and this factor alone does not necessarily support feasibility findings.

Full Infiltration

Where all of the following conditions exist, full infiltration BMPs shall be evaluated further:

- Depth to seasonally high mounded groundwater with full infiltration of the DCV is at least 5 feet (this threshold relates to physical infiltration capacity only; greater separation is required to protect groundwater quality in some conditions); AND
- The "feasibility screening infiltration rate" (K_{screen}) or "design infiltration rate" (K_{design}) computed using appropriate methods and factors of safety as described in Appendix D, is at least 0.3 inches per hour[13];
    - Where K_{screen} or K_{design} is between 0.3 and 2 inches per hour, the design should include a description of the contingency that will be activated if infiltration rates fall below this range as part of more detailed investigation or through the construction process; AND
    - Where K_{screen} or K_{design} are greater than 2 inches per hour, a contingency approach is not required, but may still be advisable.

Biotreatment with Partial Infiltration

Where any of the following conditions exist, biotreatment BMPs with partial infiltration shall be considered:

- K_{screen} is between 0.05 and 0.3 inches per hour (K_{obs} is between 0.1 to 0.6 inches per hour); OR
- K_{screen} is greater than 0.3 inches per hour (K_{obs} is greater than 0.6 inches per hour), but a site specific evaluation of groundwater mounding indicates that full infiltration would

[13] K_{screen} is computed using a factor of safety of 2.0, so a K_{screen} of 0.3 inches per hour is equivalent to an observed infiltration rate of 0.6 inches per hour. K_{design} uses a factor of safety based on a number of different factors described in Appendix D, but is always more higher than 2.0, so a K_{design} of 0.3 inches per hour is equivalent to an observed infiltration rate of *at least* 0.6 inches per hour.

result in a mound such that the depth to mounded seasonal high groundwater is less than 5 feet; OR

- The project is located within a zone mapped as hydrologic soil group D and available information at the proposed BMP site supports this classification as soil types such as silt, clay, or bedrock that have no reasonable potential to support full infiltration; OR
- The only reasonable BMP locations and elevations are located in proposed fill soils such that the infiltration rate cannot be reasonably estimated with confidence prior to construction of the project.

Biotreatment without Infiltration

Where the following conditions are demonstrated to exist, the project applicant may demonstrate that biotreatment BMP without any infiltration is appropriate:

- Reliable K_{screen} is demonstrated via testing at the specific BMP location to be less than 0.05 inches per hour (K_{obs} is less than 0.1 inches per hour).

Results of Design Phase and Construction Phase Testing

If full infiltration is proposed, then the site investigation approach and project implementation process must provide adequate assurance that the full-scale infiltration rate of the built facility will support full infiltration at or above the design infiltration rate. A contingency plan may be needed, which could be activated if the results of detailed design phase testing or construction phase testing yield design infiltration rates less than used in BMP design. See Section 4.3.3.1 for additional guidance on developing a contingency plan. It is mandatory that BMP feasibility determinations and BMP selection be updated if new information is obtained that conflicts with the original determination.

Small Project Modifications

Where a small project is located in a zone mapped as hydrologic soil group D, the project must utilize available information to confirm this determination, if available, but is not required to collect additional observations or measurements if available information is not available to confirm the mapped soil determination (low permeability soils).

Examples of Reasonable Risk Mitigation Approaches

Examples of reasonable mitigation approaches to improve the physical capacity of infiltration on include

- Infiltration screening at the site scale and design of the site to locate BMPs within areas where infiltration appears most feasible, while also considering other overriding factors in site design, such as access points, topography, and approved development density.

- Minor depths of over-excavation and backfill with permeable soils at BMP locations to allow infiltrated water access more permeable strata or penetrate fill materials.

Guidelines for measuring or estimating infiltration rates and selecting appropriate factors of safety are provided in Appendix D.

4.2.2.3. Groundwater Protection Criteria

Assessment of potential risks to groundwater contamination shall first consider the findings related to potential infiltration rates described in Section 4.2.2.2. The actual amount of infiltration that may occur given physical constraints must be considered in determining whether additional limitations on infiltration are required.

Full Infiltration

The presence of ANY of the following conditions at the proposed BMP location shall prohibit full infiltration of the DCV:

- Seasonally high groundwater or mounded groundwater is less than 5 feet below the designed bottom of the infiltration facility. (See **Appendix C** for specific guidance.)
- Seasonally high groundwater or mounded groundwater is less than 10 feet below the designed bottom of the infiltration facility and the BMP type is considered to have elevated risk of groundwater contamination (e.g., infiltration basins, infiltration trenches, dry wells, subsurface vaults, and similar BMPs) and the receiving aquifer supports beneficial uses. (See **Appendix C** for specific guidance.)
- The infiltration facility is less than 100 feet horizontally from a water supply well, non-potable well, drain field, or spring. (See **Appendix C** for specific guidance.)
- The BMP tributary area contains high risk land use activities which would result in significant risks to drinking water quality and groundwater quality that cannot be reasonably and technically mitigated through methods such as isolation of sources and/or pretreatment of runoff to address pollutants of concern prior to infiltration. (See **Appendix C** for specific guidance)
- For brownfield sites or adjacent sites, where stormwater infiltration of the full DCV would result in a significant risk of mobilizing or moving contamination that cannot be reasonably and technically avoided, as documented by a site-specific or available watershed study. The documenting study shall have sufficient resolution to positively identify areas of the property where unremediated contamination is located and where stormwater infiltration should be restricted to prevent pollutant mobilization. (See **Appendix C** for specific guidance.)
- Where a groundwater pollutant plume (man-made or natural) is under the site or in close proximity and there is substantial evidence that full infiltration of the DCV would cause or contributing to plume movement that cannot be reasonably and technically avoided, as documented by a site-specific study or available watershed study. The

documenting study shall have sufficient resolution to positively identify areas where stormwater infiltration should be restricted. (See **Appendix C** for specific guidance))

Biotreatment with Partial Infiltration

The presence of ANY of the following conditions at the proposed BMP location shall further prohibit the use of biotreatment BMPs that are designed to achieve partial infiltration of the DCV:

- Seasonally high groundwater or mounded groundwater is less than 5 feet below the designed bottom of the infiltration facility. (See A**ppendix C** for specific guidance.)
- The infiltration facility is less than 100 feet horizontally from a water supply well, non-potable well, drain field, or spring. (See **Appendix C** for specific guidance.)
- The BMP tributary area contains high risk land use activities which would result in significant risks to drinking water quality and groundwater quality that cannot be reasonably and technically mitigated through methods such as isolation of sources and/or pretreatment of runoff to address pollutants of concern prior to infiltration. (See **Appendix C** for specific guidance)
- For brownfield sites or adjacent sites, where stormwater infiltration of the any portion of the DCV would result in a significant risk of mobilizing or moving contamination that cannot be reasonably and technically avoided, as documented by a site-specific or available watershed study. The documenting study shall have sufficient resolution to positively identify areas of the property where unremediated contamination is located and where stormwater infiltration in any volume should be restricted to prevent pollutant mobilization. (See **Appendix C** for specific guidance.)
- Where a groundwater pollutant plume (man-made or natural) is under the site or in close proximity and there is substantial evidence that any level of stormwater infiltration would cause or contributing to plume movement that cannot be reasonably and technically avoided, as documented by a site-specific study or available watershed study. The documenting study shall have sufficient resolution to positively identify areas where stormwater infiltration should be restricted. (See **Appendix C** for specific guidance))

Biotreatment without Infiltration

If any of the conditions in the previous section apply, a biotreatment BMP without any infiltration should be selected. In critical areas related to stormwater contaminants, contaminated sites, or groundwater plumes, the investigations above should consider whether biotreatment BMPs need to be lined with an impermeable liner to avoid any level of infiltration.

Documentation prepared by the project applicant or findings from available local studies are acceptable to document the conditions above.

Small Project Modifications

Small projects defined in Section 4.2.2.6 may document that the BMP location is within a mapped plume identified on the regional maps provided in Appendix N to document the basis for not considering infiltration in any quantity except where a published report provides the basis for allowing full infiltration or biotreatment with partial infiltration in these areas.

More specific guidance on determining infiltration infeasibility related to groundwater protection is provided in **Appendix C**.

Examples of Reasonable Risk Mitigation Approaches

Examples of reasonable mitigation measures to improve the feasibility of infiltration include:

- Remediation of minor areas of contaminated soil on a site
- Designing stormwater BMPs with isolation and pretreatment systems
- Hydrologically isolating areas of the site that have higher risk of stormwater contaminants so that infiltration can be more feasibly applied to lower risk area.
- Using BMP types that have lower risk of groundwater contamination and/or are more compatible with available groundwater separation (for example, using bioretention rather than dry wells where there is moderate risk of stormwater quality issues or where groundwater is moderately shallow)

Major cleanup of soil or groundwater contamination is not a reasonable requirement for the purpose of allowing stormwater infiltration. Additionally, it is not reasonable to require a project to wait for proximate cleanup activities to be completed in order for infiltration to become feasible.

Additional Recommendations

Project proponents are encouraged to consult with the local groundwater agency as soon as possible in the WQMP development process whenever infiltration BMPs are proposed. The project proponent is especially encouraged to consult with the groundwater agency for any proposed full infiltration BMP if any of the following apply:

- The BMP uses a pipe or conveyance to direct flow to a subsurface system (dry well, vault, infiltration trench, etc.)
- The BMP is comprised of surface infiltration with a cumulative tributary area that exceeds 5,000 square feet
- The BMP is proposed to be located over known soil or groundwater contamination

Appendix C contains guidance on consulting with the local groundwater agency and a template and cover letter for facilitating consultation.

4.2.2.4. Geotechnical Criteria

Assessment of potential geotechnical risks shall first consider the findings related to potential infiltration rates described in Section 4.2.2.2. The actual amount of infiltration that may occur given physical constraints must be considered in determining whether infiltration would pose appreciable geotechnical risks.

Full Infiltration

Full infiltration of the DCV shall be prohibited where there is substantial evidence that stormwater infiltration would result in significantly increased risks of geotechnical hazards, such as liquefaction or landslides, that cannot be reasonably and technically mitigated to an acceptable level, as documented in a geotechnical report prepared by the geotechnical professional for the project. As default values, full infiltration of the DCV in a given location is deemed to result in a significant risk to geotechnical hazards if any of the following conditions apply:

- The location is less than 50 feet away from slopes steeper than 15 percent
- The location is less than eight feet from building foundations or an alternative setback established by the geotechnical expert for the project.
- The depth of proposed fill is greater than 10 feet.
- A study prepared by a geotechnical professional or an available watershed study determines that stormwater infiltration would result in significantly increased risks of geotechnical hazards on or adjacent to the project site that cannot be reasonably and technical mitigated. The documenting study shall have sufficient resolution to positively identify locations on a project site where stormwater infiltration should be restricted.

The geotechnical report shall support or revise these values, as applicable.

Biotreatment with Partial Infiltration

Biotreatment with partial infiltration of the DCV shall be prohibited where the specific spatial extents and the technical basis for this prohibition is documented in geotechnical report prepared by the geotechnical professional for the project. There are no default setbacks for partial infiltration. Given that some infiltration of rainwater occurs in all sites regardless of stormwater management approach, it is presumed that incidental infiltration does not present an incremental geotechnical risks unless demonstrated otherwise. This shall not be interpreted to transfer any liability for geotechnical design and recommendations to the reviewing jurisdiction.

Small Project Modifications

The default setback values for full infiltration may be accepted as the basis for determining infeasibility of full infiltration without a geotechnical report. This approach may be used at the

discretion of the project applicant and reviewer. However, if infiltration will be used this does not waive the responsibility of the project applicant to provide appropriate site-specific documentation of recommended setbacks.

Examples of Reasonable Mitigation Approaches

It may be appropriate to require reasonable mitigation approach such that the feasibility of infiltration can be improved. Examples of reasonable mitigation approaches include:

- Attempting to locate BMPs in areas where they are outside of applicable set-backs and in areas without fill or with lower depths of fill
- Over-excavation and backfill with more permeable materials in cases where the depth of fill is relatively shallow (less than approximately 5 feet below the invert of the BMP).
- Using a somewhat more robust foundation or retaining wall design of the same type as otherwise proposed such that some infiltration can be allowed; it would be unreasonable to require a project to utilize a different type of foundation or retaining wall design solely to accommodate infiltration.

Consideration of reasonable mitigation approach should be documented in the investigation prepared by the project geotechnical professional.

4.2.2.5. Groundwater Balance and Associated Issues

Assessment of potential risks associated with ground water balance shall first consider the findings related to potential infiltration rates described in Section 4.2.2.2. The actual amount of infiltration that may occur given physical constraints must be considered in determining whether further limits on infiltration are appropriate.

Full Infiltration or Biotreatment with Partial Infiltration

Infiltration shall be limited or prohibited where any of the following issues are identified and appropriately documented. These issues are anticipated to be rare and specific thresholds cannot be provided.

- There is substantial evidence that an increase in infiltration over pre-developed conditions would cause impairments to downstream beneficial uses, such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters. The level of allowable increase in infiltration must be documented in a site-specific study or watershed plan, and it must be demonstrated that stand-alone infiltration BMPs would exceed the allowable level of increase in infiltration or what level could be infiltrated as a partial consideration.
- There is substantial evidence that infiltration from the project would result in increase in inflow and infiltration (I&I) to the sanitary sewer that cannot be sufficiently mitigated, and it is beyond the reasonable scope of the project to rehabilitate the sanitary sewer to

mitigate for I&I. Infiltration activities that have the potential to contribute to a significant increase in I&I should be coordinated with the local sewer agency to ensure project drainage plans are protective of sewer hydraulic capacity. It is recommended that coordination be initiated as early as possible during the Preliminary/Conceptual WQMP development process as part of the CEQA process (preferred) or otherwise.

- Infiltration of runoff from the project would violate downstream water rights. While it is not anticipated that infiltration of runoff would violate water rights in Orange County, water law in California is complex, and this TGD does not exclude the possibility that a rightful water rights claim could restrict infiltration of stormwater.

Screening Criteria to Determine Need for Further Investigation

Water balance is generally only of concern where all of the following criteria are met:

- Observed infiltration rates exceed 0.6 inches per hour,
- An ephemeral streams located within 250 feet of the potential infiltration location,
- The estimated or mapped depth to seasonally high groundwater less is than 20 feet.

Small Project Modifications

Small projects may find that full infiltration is infeasible if all of the following are met:

- Observed infiltration rates exceed 0.6 inches per hour
- An ephemeral streams located within 250 feet of the potential infiltration location, and
- The estimated or mapped depth to seasonally high groundwater less is than 20 feet.

If a small project seeks to demonstrate that partial infiltration is not feasible based on water balance or related factors, then a site-specific report is required. Partial infiltration does not typically have the potential to change the natural water balance of a site greatly.

Worksheet 1, below, provides a format for documenting infiltration feasibility findings.

Worksheet 1: Infiltration Feasibility Categorization

Categorization of Infiltration Feasibility Condition			***Page 1 of 5***
Part 1: Physical Limitations of Infiltration Based on the criteria for physical limitations of infiltration described in Section 4.2.2.2, what level of physical feasibility of infiltration is the maximum that the BMP location will support?			
	Physical Infiltration Feasibility Category	**Mark applicable category**	**Next step**
1	Full Infiltration of the DCV		Continue to Part 2
	Biotreatment with Partial Infiltration		Continue to Part 3
	Biotreatment with No Infiltration		Select and Utilize Biotreatment without Infiltration
Provide summary of basis: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

Categorization of Infiltration Feasibility Condition		***Page 2 of 5***	
Part 2: Risks Limiting Full Infiltration of the DCV –*Would infiltration of the full DCV introduce risks of undesirable consequences that cannot reasonably be mitigated?*		***Yes***	***No***
2	**Would infiltration of the DCV pose significant risk for groundwater related concerns?** Use criteria described in Section 4.2.2.3 and results from Worksheet 2 (Appendix C) to describe groundwater-related infiltration feasibility criteria.		
Provide basis: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
3	**Would infiltration of the full DCV pose significant risk of increasing risk of geotechnical hazards that cannot be mitigated to an acceptable level**? Use criteria described in Section 4.2.2.4		
Provide basis: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
4	Would infiltration of the DCV cause an increase in groundwater flow or decrease in surface runoff over predevelopment conditions that would cause **impairment to downstream beneficial uses, such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters?**		
Provide basis: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

Categorization of Infiltration Feasibility Condition		***Page 3 of 5***	
Part 2 (continued): Risks Limiting Full Infiltration of the DCV –*Would infiltration of the full DCV introduce risks of undesirable consequences that cannot reasonably be mitigated?*		***Yes***	***No***
5	Is there substantial evidence that infiltration of the DCV would **result in a significant increase in I&I to the sanitary sewer** that cannot be sufficiently mitigated?		
Provide basis: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
6	Would infiltration of the DCV **violate downstream water rights**?		
Provide basis: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
Part 2 Result	If the answer to all questions 2-6 are “No”, then the DMA is categorized as “Full Infiltration” for the purposes of LID BMP type selection. Describe finding. At the Preliminary/Conceptual WQMP phase, describe the additional design-phase testing required to confirm this determination and identify contingencies for final design. At the Final Project WQMP phase, identify any required construction-phase testing and identify the design contingencies that should result based on construction-phase testing. If the answer to any of questions 2-6 is “Yes” then the site cannot be categorized as “Full Infiltration”. Continue to Part 3: Partial Infiltration Feasibility		

Categorization of Infiltration Feasibility Condition		***Page 4 of 5***	
Part 3: Partial Infiltration Feasibility Criteria –*Would infiltration of any appreciable volume of stormwater result in risks of undesirable consequences that cannot reasonably be mitigated?*		***Yes***	***No***
8	**Would use of biotreatment BMPs with partial infiltration pose significant risk for groundwater related concerns?** Refer to criteria in Section 4.2.2.3 and Worksheet 1 (Appendix C) for guidance on groundwater-related infiltration feasibility criteria.		
Provide basis: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
9	**Would the use of biotreatment BMPs with partial infiltration pose elevated risks of geotechnical hazards that cannot be mitigated to an acceptable level**? Refer to Section 4.2.2.4.		
Provide basis: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
10	**Would the use of biotreatment BMPs with partial infiltration elevate risks or introduced conflicts related to groundwater balance, inflow and infiltration, or water rights?** Refer to Section 4.2.2.5. Note: this is uncommon and must be supported by site-specific analysis if it is used as a basis to reject biotreatment with partial infiltration.		
Provide basis: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

Categorization of Infiltration Feasibility Condition		***Page 5 of 5***
Part 3 Result	If the answer to all questions 8-10 are "No", then the DMA is categorized as "Biotreatment with Partial Infiltration" for the purposes of LID BMP type selection. If the answer to any of questions 8-10 is "Yes" then the site is categorized as "Biotreatment with No Infiltration" for the purposes of LID BMP type selection.	

4.2.2.6. Definition of Small vs. Large Projects for Infiltration Feasibility Screening Methods

In certain cases, alternative investigation approaches may be acceptable for small projects as defined in other sections of this TGD. The definition of project size categories is provided in Table 4-2.

Table 4-2: Definition of Project Size Categories

	Residential	Commercial, Institutional	Industrial
Small Projects	Less than 10 acres and less than 30 DU	Less than 5 acres and less than 50,000 SF floor area	Less than 2 acre and less than 20,000 SF floor area
Large Projects	Greater than 10 acres or greater than 30 DU	Greater than 5 acres or greater than 50,000 SF floor area	Greater than 2 acre or greater than 20,000 SF floor area

4.2.3. Harvest and Use Feasibility Criteria

Harvest and use shall be considered for projects that have a demand adequate to satisfy the LID sizing criteria described in Section 2.5.1. Projects are required to consider harvest and use if the reliable wet season demand for harvest water is adequate to use the DCV within 48 hours. This is expected to be very rare. Guidance for calculating harvested water demand is provided in Appendix F.

If there is any reliable demand for harvested water, then it is acceptable, but not required, to utilize harvest and use as part of meeting LID performance criteria. This could involve the use of larger harvesting systems that can compensate for smaller demand and still capture 80 percent of average annual runoff and/or the use of harvesting systems in combination with other LID BMPs.

4.2.4. Demonstrated Space Constraints and Influence on LID BMP Selection

Deficiency in suitable space for LID BMPs may be a legitimate technical issue that appropriately influences BMP selection and design. Under certain conditions, a demonstrated space constraint may support deviations from the standard LID BMP hierarchy and BMP selection menu described in this section.

4.2.4.1. Criteria for Demonstrating Limited Space and Modifying BMP Selection based on Space Constraint

There are two demonstrations that need to be provided in order to utilize space constraints as a basis for deviating from the standard BMP selection hierarchy:

- Demonstration that the site design has been developed to allow LID BMPs to the MEP
- Demonstration that the modified LID BMP selection resulting from the space constraint is consistent with the intent of the goal of maximizing volume retention

Both of these demonstrations must be made based on substantial evidence is subject to the discretion of the reviewer. Guidance on these demonstrations is provided below.

Site Design to Allow LID BMPs to the MEP

The Project WQMP must include a site design narrative that explains how the project was configured to allow as much space as possible. This narrative must identify any overriding factors in site design, such as inflexibility in access points, inflexibility in other code requirements, high intensity land use goals/prior approvals and/or other factors. This narrative should conform to one of the following options:

Option 1: Default Space Allocation

- At least the recommended portion of the site specified in **Table 4-3** (or a more stringent table developed by local jurisdictions) shall be provided in the site plans for surface plus subsurface BMPs. Local jurisdictions may develop a more stringent table (i.e., greater area required to be provided) at their discretion. In the absence of such a table, **Table 4-3** shall be the default; and
- The site shall be configured such that runoff can be routed to BMPs located in the available area(s) of the site; and
- The site shall be laid out such that BMPs are located in areas that best support full infiltration or partial infiltration of the DCV, as practicable given the constraints of the site, and
- Satisfaction of these criteria shall be documented in exhibits and/or narrative descriptions.

Option 2: Project Specific Space Allocation

- A site specific study shall be prepared as part of the Project WQMP that documents that the site cannot be designed to allow more area for BMPs. The study may consider:
    - Site conditions/constraints (e.g., depth to groundwater, topography, existing utilities)
    - Zoning/code requirements (e.g., target density, accessibility, traffic circulation, health and safety, setbacks, etc.)

- Economic feasibility

Adherence to Modified LID Hierarchy to Maximize Volume Reduction

The Project WQMP must illustrate a good faith and technically-based attempt to utilize LID BMPs based on the feasibility category identified for the site and make modifications to the selection in a manner consistent with the LID hierarchy goal of maximizing volume reduction:

- In conditions that would otherwise support full infiltration, rejection of full infiltration based on space constraints must be based on sizing calculations using the lowest reasonable factor of safety on design infiltration rate supported by a good faith investigation. Deficiency in site investigation shall not be the basis for an artificially-high factor of safety that leads to rejection of full infiltration.
- If full infiltration is rejected, the next option considered must be biotreatment with partial infiltration. Because biotreatment with partial infiltration does not require a certain minimum underlying infiltration rate, this should allow for a smaller factor of safety and more space efficient design that must be considered before considering biofiltration with no infiltration.
- In conditions that would otherwise support biotreatment with partial infiltration, preference should be given to using a biotreatment BMP with partial infiltration with a reduced sizing factor within an acceptable range of design standards (i.e., a semi-compact non-proprietary biotreatment BMP) before considering a more compact proprietary system that is not accompanied by partial infiltration design elements. In other words, the BMP could have a footprint that is smaller than the target footprint for volume reduction (Section 4.4.3). This would still be preferable rather than defaulting to a compact proprietary biofiltration BMP. However, if space is so deficient that the system risks premature clogging, then using a compact biofiltration BMPs (which has been tested at high loading rates) is more appropriate.

Table 4-3: Default Space Allocations for LID BMPs by Project Type in Absence of Project-Specific Findings

Project Type		Default Space Allocation for LID BMPs (% of impervious area in DMA)[1, 2]
New Development	SF/MF Residential < 7 du/ac	8
	SF/MF Residential 7 – 18 du/ac	6
	SF/MF Residential > 18 du/ac	4
	MF Residential > 30 du/ac	3
	Mixed Use, Commercial, Institutional/Industrial w/ FAR < 1.0	8
	Mixed Use, Commercial, Institutional/Industrial w/ FAR 1.0 – 2.0	6
	Mixed Use, Commercial, Institutional/Industrial w/ FAR > 2.0	4
	Mixed Use, Commercial, Institutional/Industrial w/ FAR > 4.0	3
	Podium (parking under > 75% of project)	3
	Projects with zoning allowing development to lot lines	2
	Surface Parking	4
	Structure Parking	2
Redevelopment	SF/MF Residential < 7 du/ac	5
	SF/MF Residential 7 – 18 du/ac	4
	SF/MF Residential > 18 du/ac	3
	MF Residential > 30 du/ac	2
	Mixed Use, Commercial, Institutional/Industrial w/ FAR < 1.0	5
	Mixed Use, Commercial, Institutional/Industrial w/ FAR 1.0 – 2.0	4
	Mixed Use, Commercial, Institutional/Industrial w/ FAR > 2.0	3
	Podium (parking under > 75% of project)	2
	Projects with zoning allowing development to lot lines	1
	Surface Parking	3
	Structure Parking	2

[1] Must be provided in an area that is 1) is suitable for a LID BMPs and 2) receives runoff from impervious areas.
[2]Criteria for site design are only required to be met if the Project WQMP seeks to modify the BMP selection process based on a demonstrated space constraint; full compliance with LID requirements may be feasible with smaller space allowances
Key: du/ac = dwelling units per acre, FAR = Floor Area Ratio = ratio of gross floor area of building to gross lot area; MF = Multi Family, SF = Single Family

4.2.4.2. Examples of Influence of Space Constraints on BMP Selection

Two examples of the influence of space constraints on BMP selection are presented below.

Space Constraint as a Basis to use Biotreatment with Partial Infiltration Instead of a Full Infiltration BMP

Based on available space and reliable infiltration rates, there are conditions and project types under which a site would be categorized as full infiltration but it would not be feasible to infiltrate the full DCV in 48 hours or otherwise achieve 80 percent capture of average annual runoff.

At a design infiltration rate of 0.3 inches per hour (the observed infiltration rate adjusted with a prudent factor of safety per Appendix D), infiltration of the DCV in 48 hours requires a maximum effective depth of 1.2 feet and results in a sizing factor of 4 to 6 percent of the impervious area of the site depending on location. This footprint is larger than the default space allowance for some project types, particularly in redevelopment cases.

Before dismissing full infiltration, actual space availability and requirements must be determined. The Project WQMP must demonstrate the site has been designed per the criteria in Section 4.2.4.1 and must demonstrate using an appropriate sizing method that infiltration BMPs would require more space than is available. Consideration must be given to whether HSCs could be used to reduce the DCV. Approaches like permeable pavement could significantly reduce the DCV and may not interfere with site use. Finally, it must be confirmed that the design infiltration rate used in sizing calculations is based on a realistic factor of safety and is not inappropriately inflated to compensate for inadequate sight investigation or failure to address clogging risks with pretreatment.

If these demonstrations are made, then it would be most appropriate for BMPs to be selected from the biotreatment with partial infiltration category. This allows a higher and more certain filtration rate to be used in sizing calculations and likely allows a smaller footprint.

Space Constraint as a Basis to Use Compact Proprietary Biofiltration instead of Non-proprietary Biotreatment with Partial Infiltration

Compact proprietary biofiltration systems that meet the acceptance criteria in Appendix J are a type of biotreatment BMP that have been specifically designed and tested to operate within very compact footprints and have defined maintenance requirements associated with this design. If supplemental retention is provided with a proprietary biofiltration BMP (See fact sheet BIO-5), then there is no preference between non-proprietary over proprietary biotreatment BMPs. Both system provide adequate treatment and maximize volume reduction.

If supplemental retention is not provided, these biofiltration systems achieve little to no volume reduction, so they are a lower priority option than non-priority biotreatment systems that

achieve partial infiltration (See Section 2.5) in the case where both are feasible. However, when the available space for BMPs is smaller than the range that is suitable for non-proprietary systems (i.e., would require them to operate with a surface loading rate that is outside of their intended range), then the use of compact proprietary biofiltration BMPs without supplemental retention may be acceptable. The following steps should be used to show this:

The Project WQMP must demonstrate the site has been designed per the criteria in Section 4.2.4.1 (Criteria for Demonstrating Limited Space) and demonstrate, using an appropriate sizing method, that non-proprietary BMPs would require more space than is available. Consideration must be given to whether HSCs could be used to reduce the DCV and allow BMPs to fit.

If the result is that the space is less than can support a non-proprietary BMPs within acceptable design assumptions (e.g., depths, media filtration rates, hydraulic loading), then it would be preferable to use a compact proprietary system, subject to the acceptance criteria in Appendix J, rather than implementing a non-proprietary design outside of its range of acceptable design parameters.

4.3. LID BMP Sizing and Design References

This section details the standard types of LID BMPs and the sizing and design references for these BMPs.

4.3.1. Hydrologic Source Controls

The first step in the LID BMP selection process is to consider HSCs, such as downspout disconnects and other controls based on opportunities in the project layout. HSCs can be considered to be a hybrid between site design practices and LID BMPs. They are distinguished from site design BMPs in that they do not reduce the tributary area or reduce the imperviousness of a drainage area; rather they reduce the runoff volume that would result from a drainage area with a given imperviousness compared to what would result if HSCs were not used. HSCs are differentiated from LID BMPs in that they tend to be more highly integrated with site designs and tend to have less defined design and operation. For example, it may not be possible to precisely describe the storage volume and drawdown rate of a pervious area receiving drainage from downspout disconnects; however these systems can be very effective at reducing runoff.

There are no numeric standards requiring the use of HSCs. Therefore, for projects that fully conform to LID sizing requirements and fully address HCOCs, the use of HSCs is optional (although the use of other LID site design BMPs is required). However, if a project cannot feasibly meet LID sizing requirements or cannot fully address HCOCs, all applicable HSCs must be implemented as part of demonstrating that the BMP system has been designed to retain the maximum feasible portion of the DCV. Under these cases, the Project WQMP must demonstrate conformance with the requirement to select and use all applicable HSCs. This

conformance analysis generally must take the following form, or equivalent methods of documenting that the requirements of the Model WQMP are met:

- Conformance should be demonstrated for each DMA within the project
- Using the checklist of HSCs contained in Section 4 of the WQMP Template, or equivalent, note all HSCs that have been provided for the drainage area.
- For HSCs that have not been provided, provide rationale for why they are not applicable or mutually exclusive with another more effective BMP.
- Using Worksheet 4 in **Appendix E**, the effect of HSCs should be accounted in tabulating overall system performance. The use of HSCs results in smaller design volumes for downstream BMPs. **Appendix E** provides additional guidance in accounting for the benefits of HSCs.

HSCs can be a cost-effective part of a meeting LID requirements. Some HSCs are also effective at removing pollutants. HSCs that effectively remove pollutants are allowed to have their captured storm water volume count towards the DCV, consequently reducing the size of downstream structural BMPs. Where claimed, the contribution of HSCs can be quantified in terms of inches of the design capture storm depth or a percentage of average annual runoff volume that is reduced, depending on the BMP type and sizing method being used. Each of these has the effect of reducing the sizing criteria for downstream structural BMPs as described in **Appendix E**.

If the volume of runoff retained by HSCs in a DMA is greater than or equal to the design capture storm depth for the DMA, the DMA is considered to be "self-retaining" and no additional BMPs are required to treat discharges from the drainage area to meet LID or treatment control requirements. Soil amendments and other techniques can be used to make areas become self-retaining. HSC-6 in the BMP fact sheets contains additional guidance on self-retaining areas.

Appendix G.1 provides fact sheets for the types of HSCs that are recognized by this TGD.

HSC-1: Localized On-Lot Infiltration
HSC-2: Impervious Area Dispersion
HSC-3: Street Trees
HSC-4: Residential Rain Barrels
HSC-5: Green Roof / Brown Roof
HSC-6: Self-Retaining Areas

Permeable pavement (INF-5) is considered to be a self-retaining HSC in cases where the permeable pavement is designed to manage only rainfall that falls directly on the pavement and a small adjacent tributary area no more than 50 percent of the size of the permeable pavement footprint.

4.3.2. Fact Sheets for Miscellaneous Design Elements

Appendix G.2 provides fact sheets for miscellaneous BMP design elements including soil amendments and engineered bioretention soil media. These are used as components of many other BMP types including some HSCs in order to improve their ability to retain stormwater and pollutants.

4.3.3. Full Infiltration BMPs

If the infiltration feasibility category for a DMA is determined to be "Full Infiltration" based on the method discussed in Section 2.5 and Section 4.2, then full infiltration BMPs must be selected. Full infiltration BMPs are Infiltration LID BMPs that are engineered to capture, store, and infiltrate the DCV and have no design surface discharge (underdrain or outlet structure) until the DCV is exceeded. These types of BMPs may also have losses to ET, but are characterized by having their most dominant volume losses due to infiltration. Methods for sizing full infiltration BMPs to capture and retain the entire DCV are provided in Appendix E. **Appendix G.3** provides fact sheets for several types of full infiltration BMPs which include their siting, design, and maintenance criteria.

INF-1: Infiltration Basin
INF-2: Infiltration Trench
INF-3: Bioretention with no Underdrain
INF-4: Drywell
INF-5: Permeable Pavement (concrete, asphalt, and pavers)
INF-6: Underground Infiltration

Guidelines pertaining to the selection, siting, design and permitting/registration of dry wells are provided in **Appendix I**.

4.3.3.1. Contingency Recommendations and Contingency Design Options

It is the project applicant's responsibility to select BMPs based on the LID hierarchy and feasibility criteria. It is also the project applicant's responsibility assure that post-construction operations will conform to applicable sizing criteria and operate safely without creating nuisance conditions. A change in understanding of site conditions that occurs during the detailed design or construction phase shall not be a basis to proceed with a design that is non-compliant, inoperable or unsafe. If the design infiltration rate is not met in post-construction conditions, this may be a basis for the local jurisdiction to withhold acceptance of the BMPs and delay closure of applicable permits.

Project plans and WQMPs can address uncertainty through the inclusion of contingency design elements in BMPs. A contingency design element consists of an adaptation to the BMP design that can be made contingent on new information obtained from infiltration testing as part of detailed design or during construction. A contingency plan identifies the testing required and

the thresholds at which a contingency design element would be activated. If the contingency plan potentially involves changing the type of facility, calculations must be presented describing that the system would still conform to applicable LID sizing criteria if the contingency is activated. This may require primary and contingency calculations to be included in the Project WQMP. Examples of contingency design elements are provided in Table 4-4.

Contingency planning is strongly recommended where:

- The "feasibility screening infiltration rate" or the "design infiltration rate" (Appendix D) is between 0.3 and 2 inches per hour,
- Where it has not been possible to conduct testing adequate to confirm infiltration rates as part of design, or
- Where there is significant potential for disturbance during the construction phase,

A contingency plan may not be needed for sites with relatively high infiltration rates, rigorous design-phase testing, and limited proposed construction-phase disturbance.

Table 4-4. Potential Contingency Design Elements for Infiltration BMPs in Marginal or Uncertain Conditions

Infiltration BMP Type	Potential Contingency Design Elements in Marginal or Uncertain Conditions (some or all)
INF-1: Infiltration Basin	• Include an optional biofiltration media layer and underdrain system that can allow conversion to a biofiltration BMP (BIO-1) within the same footprint. • Provide a contingency to construct a larger footprint. • Provide contingency for the use of dry wells if needed to improve infiltration rates.
INF-2: Infiltration Trench	• Provide a contingency to construct a larger footprint. • Provide contingency for the use of dry wells if needed to improve infiltration rates.
INF-3: Bioretention with no Underdrain	• Design with a capped underdrain and outlet riser such the underdrain can be opened if to convert to a BIO-1. • Provide contingency for the use of dry wells attached to underdrains.
INF-4: Drywell	• Provide a contingency to add additional dry wells.
INF-5: Permeable Pavement (concrete, asphalt, and pavers)	• Provide a contingency to construct a larger footprint. • Provide contingency for the use of dry wells if needed to improve infiltration rates.
INF-6: Underground Infiltration	• Pre-treat influent using a proprietary biofiltration BMP to reduce clogging potential and allow that any water not infiltrated will have already been bio treated. • Provide a contingency to construct a larger footprint. • Provide contingency for the use of dry wells if needed to improve infiltration rates.

4.3.4. Harvest and Use BMPs

Harvest and use (aka Rainwater Harvesting) BMPs are LID BMPs that capture and store stormwater runoff for later use. These BMPs are engineered to store a specified volume of water and have no design surface discharge until this volume is exceeded. The utilization of captured water used should comply with codes and regulations (discussed in Appendix F) and should not result in runoff to storm drains or receiving waters. The use of harvest and use BMPs shall be consistent with the BMP selection process described in Section 2.5.1 and detailed in Section 4.2.

Sizing and design of harvest and use must be based on a reliable wet season harvested water demand (See Appendix F for guidance).

Appendix E contains methods for sizing harvest and use BMPs both as stand-alone LID BMPs and as a retention component in a treatment train with biotreatment BMPs. Appendix G.**4** provides fact sheets for two types of harvest and use configurations which include their siting, design, and maintenance criteria.

HU-1: Above-Ground Cisterns
HU-2: Underground Detention

If harvest and use BMPs are used, they shall comply with Orange County Sanitation District Wastewater Discharge Regulations as well as all relevant building and plumbing codes, where applicable. Guidance on building and plumbing codes relevant to stormwater harvest and reuse is located in Appendix F. The Orange County Health Care Agency should be involved in this process, as applicable, at the discretion of project engineer and plan reviewer, to ensure that harvest and use systems do not pose a significant risk to human health and conform to applicable health codes.

4.3.5. Biotreatment BMPs with Partial Infiltration

If the infiltration feasibility category for a DMA is determined to be "Biotreatment with Partial Infiltration" as discussed in Section 2.5 and 4.2, then partial infiltration biotreatment BMPs must be implemented and must also be selected to address pollutants of concern.

Biotreatment BMPs with partial infiltration are LID BMPs meeting the MS4 Permit definition of "biofiltration" that are specifically designed to provide some volume reduction through infiltration of a portion of the stormwater that is managed by these BMPs.

Treatment mechanisms include media filtration (through biologically-active media), vegetative filtration (straining, sedimentation, interception, and stabilization of particles resulting from shallow flow through vegetation), general sorption processes (i.e., absorption, adsorption, ion-exchange, precipitation, surface complexation), biologically-mediated transformations, and other processes to address both suspended and dissolved constituents.

Biotreatment BMPs with partial infiltration are identified in the list below and Fact Sheets are included in Appendix G.5:

BIO-1: Bioinfiltration (bioretention with raised underdrain)
BIO-2: Vegetated Swale
BIO-3: Vegetated Filter Strip
BIO-4: Dry Extended Detention Basin
BIO-5: Proprietary Biotreatment with Supplemental Retention

4.3.5.1. Biofiltration BMPs

Only biotreatment BMPs that fit the definition of biofiltration BMPs may be used as LID BMPs. Other types of biotreatment BMPs may only be used as treatment control or

pretreatment BMPs. They are included in the list of biotreatment BMPs only because they may be available to fulfill LID requirements in NOC in the future after adoption of the 5th Term NOC MS4 Permit. Until that time, they are essentially treatment control BMPs for the purposes of the MS4 permit. Biofiltration BMPs are vegetated treat-and-release BMPs that filter stormwater through amended soil media that is biologically active, support plant growth, and also promote infiltration and/or evaporation. Bioinfiltration (BIO-1) and some types of proprietary biotreatment with supplemental retention (BIO-5) are the only kinds of biotreatment BMPs that fit the criteria to be biofiltration. Therefore, only these biotreatment BMPs may be used as LID BMPs.

4.3.5.2. Design to Maximize Volume Reduction and Pollutant Removal

Biotreatment BMPs with partial infiltration must be designed to maximize volume reduction through infiltration and ET and to maximize pollutant removal through proper media selection and design. This affects design parameters and the sizing method used when sizing biotreatment BMPs, as discussed in Appendix E. Appendix E contains methods for sizing each type of partial infiltration biotreatment BMP both as a stand-alone BMP and including supplemental retention including downstream infiltration, upstream HSCs, and/or upstream harvest and use cisterns.

- Biotreatment BMPs with partial infiltration have specific sizing standards that require a larger volume to be treated. Appendix E contains methods for sizing partial infiltration biotreatment BMPs to meet this criterion.
- Biofiltration BMPs with partial infiltration are subject to a target footprint sizes to maximize incidental volume reduction and avoid premature clogging. Appendix E contains guidance on determining these target footprint sizes.
- Biotreatment BMPs with partial infiltration are required to include certain design features, including stone storage sumps and/or amended soil to specifically target incidental volume reduction. Appendix G.5 describes the specific design features that apply to each BMP type.

4.3.5.3. Selecting Biotreatment BMPs to Address Pollutants of Concern

In addition to meeting the MS4 permit definition of "biofiltration BMP", biotreatment BMPs must be selected and designed to effectively treat the Primary and Other POCs for the DMA.

Table 4-5 contains the expected performance for each biotreatment BMP type for various POCs. Performance is rated High, Medium, or Low based on recent analyses of BMP performance monitoring data from the International BMP Database. The BMP ratings are based on the observed effluent quality, observed differences between influent and effluent quality (magnitude and significance), and assumed unit operations and processes (UOPs) provided by each BMP. A biotreatment BMP must be selected that provides medium or high effectiveness for all POCs. If a single BMP does not provide medium or high effectiveness for all POCs, select a BMP that provides medium or high effectiveness for the primary POCs. If a single BMP does

not provide medium or high effectiveness for all primary POCs, select multiple BMPs for use in a treatment train that collectively provide medium or high effectiveness for all primary POCs. The performance of biotreatment BMPs that do not meet the definition of biofiltration is included in this table in case they will be used as treatment control BMPs, which also must effectively treat Primary and Other POCs from the DMA (Section 4.3.7).

In order for a BMP to achieve the level of performance anticipated by Table 4-5, the BMP must:

- Be designed to contemporary design standards based on the criteria contained in the BMP Fact Sheets (**Appendix G**), the guidance manuals referenced from these fact sheets, and Section 4.4.

- Include the assumed UOPs listed in this table. BMPs not found on this list may be acceptable on the basis of the UOPs they provide if they are based on published design criteria. Table 4-6 relates UOPs to the pollutant classes they address and was used as the basis for expected BMP performance when monitoring data were not available or inconclusive.

Media selection is an important component in biotreatment BMP design to maximize infiltration and ET and address pollutants of concern. Guidance on media selection for biotreatment BMPs is located in Appendix G.2. Media selection can affect the BMP performance for various POCs.

Table 4-5: Relative Treatment Performance Rates for Biotreatment BMPs

Biotreatment BMP	Assumed Principal Unit Operations and Processes Provided	Suspended solids / sediment/ turbidity	Nitrogen compounds	Phosphorus	Heavy metals	Microbial / viral pathogens	Oils and grease	Dissolved toxic organic compounds	Trash and debris
Bioretention system (BIO-6)	1. Particulate Settling 2. Size Exclusion 3. Inert Media Filtration 4. Sorption/Ion Exchange 5. Microbial Competition/Predation • Biological Uptake • Volume loss (via infiltration, ET)	**H**	**L**	**L**	**H**	**M**	**H**	**M**	**H**
Bioretention system with internal water storage zone and nutrient sensitive media design (BIO-1)	Bioretention UOPs, plus: 1. Microbially Mediated Transformations (if designed with internal water storage zone)	**H**	**M**	**M**	**H**	**M**	**H**	**M**	**H**
Dry extended detention basin (BIO-4) (For treatment control only)	1. Particulate Settling 2. Size Exclusion 3. Floatable Capture 4. Vegetative Filtration (with low-flow channel) 5. Volume loss (via infiltration, ET)	**M**	**L**	**M**	**M**	**L**	**M**	**L**	**H**
Dry extended detention basin with vegetated sand filter outlet structure (Modified BIO-4) (For treatment control only)	Dry extended detention basin UOPs, plus: 1. Inert Media Filtration	**H**	**L**	**M**	**M**	**M**	**M**	**L**	**H**
Vegetated Swale (BIO-2) (For treatment control only)	1. Vegetative Filtration 2. Sorption/Ion Exchange 3. Volume loss (via infiltration, ET)	**M**	**L**	**L**	**M**	**L**	**M**	**M**	**M**
Vegetated Filter Strip (BIO-3) (For treatment control only)	1. Vegetative Filtration 2. Sorption/Ion Exchange 3. Volume loss (via infiltration, ET)	**M**	**L**	**L**	**M**	**L**	**M**	**M**	**L**

Biotreatment BMP	Assumed Principal Unit Operations and Processes Provided	Suspended solids / sediment/ turbidity	Nitrogen compounds	Phosphorus	Heavy metals	Microbial / viral pathogens	Oils and grease	Dissolved toxic organic compounds	Trash and debris
Wet detention basins and constructed stormwater wetlands (BIO-8 and BIO-9) (For treatment control only except for subsurface-flow wetlands)	1. Particulate Settling 2. Size Exclusion 3. Floatable Capture 4. Sorption/Ion Exchange 5. Microbially Mediated Transformations 6. Microbial Competition/Predation 7. Biological Uptake **8.** Solar Irradiation **9.** Volume loss (via infiltration, ET)	**H**	**M**	**M**	**M**	**M**	**H**	**M**	**H**
Proprietary Biotreatment and Treatment Control (BIO-5 and BIO-7)	**10.** Varies by product.	Where proprietary BMPs satisfy the criteria described in Section 4.4.7, it is appropriate to conclude that H or M performance for POCs is demonstrated.							

Sources

Strecker, E.W., W.C Huber, J.P. Heaney, D. Bodine, J.J. Sansalone, M.M. Quigley, D. Pankani, M. Leisenring, and P. Thayumanavan, "Critical assessment of Stormwater Treatment and Control Selection Issues." Water Environment Research Federation, Report No. 02-SW-1. ISBN 1-84339-741-2. 290pp

International Stormwater Best Management Practices (BMP) Database 2014 Performance Summaries
http://www.bmpdatabase.org/Docs/2014%20Water%20Quality%20Analysis%20Addendum/BMP%20Database%20Categorical_StatisticalSummaryReport_December2014.pdf

Oil and grease, Organics, and Trash and Debris based on review of unit operations and processes; comprehensive dataset not generally available. BMP must include design elements to address pollutants of concern.

Table 4-6: Pollutants Addressed by Unit Operations and Processes

Unit Operations and Process	Suspended solids / sediment	Particulate-bound pollutants	Dissolved Fraction			Microbial / viral pathogens	Oils and grease	Toxic organic compounds	Trash and debris
			Nitrogen compounds	Phosphorus	Heavy metals				
Volume Loss (via Infiltration and ET)	X	X	X	X	X	X	X	X	
Particulate Settling (Density separation)	X	X							X
Size exclusion (trash racks, outlet structures. Media filtration)	X	X							X
Floatable Capture (Density separation -outlet structures designed to remove floatables)							X		X
Vegetative Filtration	X	X					X		X
Inert Media Filtration	X	X			X[1]	X	X		X
Sorption/Ion Exchange within media or soils				X	X		X	X	
Microbially Mediated Transformation (oxidation, reduction, or facultative processes)			X	X	X		X	X	
Microbial Competition/ Predation						X			
Biological Uptake			X	X	X	X	X	X	
Solar Irradiation						X		X	

1 – Inert media filters (i.e. sand) in fact have shown the ability to remove dissolved constituents either after they have been "seasoned" (i.e. organics have built up in the media) or they contain specialized inorganic media (e.g., iron coated sand) which can result in dissolved metals removals.

Principal Source

Strecker, E.W., W.C Huber, J.P. Heaney, D. Bodine, J.J. Sansalone, M.M. Quigley, D. Pankani, M. Leisenring, and P. Thayumanavan, "Critical assessment of Stormwater Treatment and Control Selection Issues." Water Environment Research Federation, Report No. 02-SW-1. ISBN 1-84339-741-2. 290pp

4.3.6. Biotreatment BMPs without Infiltration

If the infiltration feasibility category for a DMA is determined to be "Biotreatment with No Infiltration" as discussed in Section 2.5 and Section 4.2, then biotreatment BMPs that do not provide appreciable infiltration are appropriate to implement. Biotreatment BMPs without infiltration are similar to biotreatment BMPs with partial infiltration except that they do not provide significant volume reduction. They provide the same characteristics and treatment mechanisms and are designed to the same general sizing standards, but they are not designed with specific features to promote volume reduction. They may be lined to prevent any amount of infiltration, especially in areas where infiltration would otherwise occur but is not desirable.

Biotreatment BMPs are identified in the list below and Fact Sheets are included in Appendix G.6:

BIO-6: Bioretention with Underdrain and Impervious Liner
BIO-7: Proprietary Biotreatment
BIO-8: Wet Detention Basin
BIO-9: Constructed Wetland (Subsurface Flow Configuration)
BIO-10: Other Biotreatment BMPs with an Impervious Liner

Biotreatment BMPs must also be selected to address pollutants of concern per the process described in Section 4.3.5.3.

Similar to biotreatment BMPs with partial infiltration, biotreatment BMPs without infiltration must meet the criteria to be called biofiltration BMPs in order to meet LID BMP requirements. The only biotreatment BMPs without infiltration meeting the criteria to be called biofiltration BMPs are bioretention with underdrain and impervious liner (BIO-6), some types of proprietary biotreatment (BIO-7), and subsurface flow wetlands (variation of BIO-9).

4.3.7. Treatment Control BMPs

In some cases, treatment control BMPs may be used as part of LID requirements in combination with other alternative compliance methods. These cases are not covered in this TGD as they are expected to be rare. See Section 2.5 of the Model WQMP for criteria pertaining to the usage of treatment control BMPs.

Guidance on sizing and design of treatment control BMPs is included in this TGD for cases where a project applicant may use them according to the requirements in the Model WQMP and for cases where they may be selected as a pretreatment option for LID BMPs.

Appendix G.7 provides fact sheets containing siting, design, and maintenance criteria for several types of treatment control BMPs as well as references to other guidance documents.

TRT-1: Sand Filters
TRT-2: Cartridge Media Filter

Biotreatment BMPs that do not meet the definition of biofiltration BMPs are also considered treatment control BMPs.

Similar to biotreatment BMPs, treatment control BMPs must be selected to address the POC for the DMA for which they are proposed. Table 4-7 contains the expected performance for each treatment control BMP type for various POCs. If biotreatment BMPs that do not meet the definition of biofiltration BMPs are used as treatment control BMPs, their expected performance for various POCs is included in Table 4-5.

Table 4-7: Relative Treatment Performance Ratings of Treatment Control BMPs

Unit Operations and Process	Assumed Principal Unit Operations and Processes Provided	Suspended solids / sediment/ turbidity	Nitrogen compounds	Phosphorus	Heavy metals	Microbial / viral pathogens	Oils and grease	Dissolved toxic organic compounds	Trash and debris
Sand Filter (inert)	11. Size Exclusion 12. Floatable Capture 13. Inert Media Filtration	**H**	**M**	**M**	**M**	**M**	**H**	**M**	**H**
Sand Filter (specialized Media)	Sand Filter UOPs, plus: 14. Sorption/Ion Exchange	**H**	**M**	**M**	**M/H**	**M**	**H**	**M**	**H**
Cartridge Media Filter	15. Size Exclusion 16. Floatable Capture 17. Inert Media Filtration **18.** Sorption/Ion Exchange	**H**	**M**	**M**	**M**	**M**	**H**	**M**	**H**
Hydrodynamic Separator	19. Particulate Settling (coarse only) 20. Size Exclusion 21. Floatable Capture	**M**	**L**	**L**	**L**	**L**	**M**	**L**	**H**

Sources

Strecker, E.W., W.C Huber, J.P. Heaney, D. Bodine, J.J. Sansalone, M.M. Quigley, D. Pankani, M. Leisenring, and P. Thayumanavan, "Critical assessment of Stormwater Treatment and Control Selection Issues." Water Environment Research Federation, Report No. 02-SW-1. ISBN 1-84339-741-2. 290pp

International Stormwater Best Management Practices (BMP) Database 2014 Performance Summaries
http://www.bmpdatabase.org/Docs/2014%20Water%20Quality%20Analysis%20Addendum/BMP%20Database%20Categorical_StatisticalSummaryReport_December2014.pdf

Oil and grease, Organics, and Trash and Debris based on review of unit operations and processes; comprehensive dataset not generally available. BMP must include design elements to address pollutants of concern.

4.4. Supplemental LID BMP Design Guidance

4.4.1. Clogging of Infiltration and Filtration Systems

As sediment accumulates in soil and media in LID BMPs and treatment control BMPs, the permeability of the soil or media tends to decline over time. This applies to infiltration surfaces as well as filtration surfaces. Clogging with sediment is typically a progressive process and it is most often the determining factor in required maintenance frequency and usable design life of infiltration and filtration BMPs. As a target, the design life of BMPs relative to major maintenance to alleviate clogging should be at least 10 years.

The lifespan of infiltration and filtration BMPs between major maintenance events is a function of the following factors:

- **Presence of Disturbed Soil:** Sediment loads from disturbed or erodible soils (e.g., dirt roads, dirt parking, erodible slopes) can exceed normal urban sediment loads by orders of magnitude if there is active erosion occurring. The actual load that may occur is challenging or impossible to estimate. Even a few percent of a watershed could erode enough sediment to immediately clog an infiltration or filtration system. Therefore these areas must be kept hydrologically isolated from infiltration or filtration BMPs under all conditions or must be adequately stabilized.
- **Sediment and Gross Solids Concentration in Contributing DMAs**: Land covers that are expected to generate elevated sediment or gross solids concentrations include open space, gravel travel lanes or parking, areas with a high intensity of industrial or commercial uses, and areas with significant steep landscaping. Areas such as rooftops, low traffic roads or paths, well-established, dense vegetation, and depressed landscaped areas do not generate as much sediment.
- **Unit Surface Loading Rate**: The unit surface loading rate is the mass of sediment per unit area of the infiltrating surface (i.e., pounds of sediment per square foot). This is a function of the runoff volume treated, the concentration of sediment in runoff treated, and the infiltrating surface area of the BMP. A higher loading rate (e.g. larger mass of sediment per unit area of the BMP) will cause clogging and degradation faster than a low loading rate. In vegetated systems, plant action can sometimes mitigate low levels of sediment load to provide stable operation, but can be overwhelmed if sediment accumulation occurs too quickly. Typically, BMPs designed with a higher design infiltration or filtration rate and/or a deeper ponding depth have a higher unit loading rate.
- **Vegetation and Weathering Processes (surface vs. subsurface facilities):** Processes associated with vegetation root growth and other biological and weathering processes can reverse or slow compactive and clogging processes in soils and extend the lifespan of these facilities before maintenance is needed. BMPs containing subsurface infiltration galleries or media filters do not contain the same biological activity as BMPs with media exposed to the surface. This lack of biological activity can lead to decreased rates of

pollutant breakdown and aeration, so they are especially vulnerable to clogging. Experience with these types of BMPs in Orange County has shown that they can become clogged within several years, in some cases.

- **Pretreatment Approach:** Pretreatment can be helpful in improving BMP performance and extended BMP usable life for BMPs. There are a range of approaches that can be used for pretreatment (these approaches are discussed further in the following section):
    - Sacrificial mulch or sand layers
    - Settling chambers
    - Approved proprietary "pretreatment" devices
    - Biofiltration or treatment control BMPs, including approved proprietary "treatment" devices
- **Factor of safety on infiltration or filtration rate**: A simple way to build in more resiliency is to design with a higher factor of safety. This allows for more decline in infiltration or filtration rate before the BMP falls below its design level of service and needs to be maintained.
- **Outlet control on biofiltration/filtration systems**: An filtration rate outside of the generally accepted range of 5 to 10 inches may not allow treatment processes to occur in non-proprietary systems. However, designing filtration media for this relatively small range can be challenging and can allow a limited decline in infiltration rate before maintenance is required. Through the use of outlet control on the underdrains of the system, the media can be specified with higher permeability (20 to 40 inches per hour) providing a larger factor of safety on clogging and the actual filtration rate can be controlled to 5 to 10 inches per hour.

4.4.1.1. Design Approaches to Demonstrate Acceptable Clogging Risk

Projects can use Table provided in Appendix E.4.1 to demonstrate that the potential for premature clogging is adequately addressed when designing infiltration or filtration BMPs. Reference to this table is included in applicable sizing methods in Appendix E.3.

This approach involves all of the following:

- Utilize a prudent factor of safety based on the methodology presented in Appendix D, and
- Develop drainage plans to hydrologically isolate areas with exposed soil, gravel, dirt or otherwise high sediment load from entering the BMP under any reasonable condition, and
- Adhere to target minimum footprint sizing factors based on BMP type, DMA tributary area characteristics, and pretreatment approach per the table provided Appendix E.4.1.

4.4.2. Selection of Pretreatment BMPs

There is a large range of potential pretreatment approaches and BMPs. Pretreatment BMPs may be necessary or strongly encouraged to reduce clogging (See Section 4.4.1). Pretreatment BMPs may also be required to avoid potential impacts to groundwater quality (See Appendices C and I). These recommendations or requirements stem from other sections of this TGD. To support appropriate selection and design of pretreatment approaches, Table 4-8 identifies pretreatment BMPs and identifies appropriate uses. Guidance on incorporating of these pretreatment BMPs into overall BMP systems is provided in Appendix G, Fact Sheet MISC-5.

Table 4-8. Pretreatment Options and Descriptions

Pretreatment Approach or BMP Type	Description	Sediment Removal Performance	GW Protection Performance	Appropriate Uses
Settling chambers or sacrificial forebay	At least 10 percent (preferably 20 percent) additional volume beyond DCV set aside for pre-settling	Moderate	Negligible	Where land use is low risk or in combination with other approaches
Catch basin inserts	Systems intended to strain coarse solids from stormwater as it enters catch basins.	Negligible	Negligible	For trash control only; no significant benefit for clogging or GW quality.
Sacrificial mulch layer	Mulch layer provided on the surface of vegetated systems with commitments to yearly maintenance	Moderate	Limited	Bioretention systems where clogging risk is low
Sacrificial sand layer	A course sand layer above the infiltrating surface with a filtration rate 5 to 10 times higher than underlying soil; ability and commitment to replacement of layer	Moderate	Negligible	Non-vegetated surface or subsurface systems where sand layer can be removed and replaced
Amended media layers	An engineered bioretention soil media layer (Meeting specification for MISC-2) installed in the surface of a bioretention BMP or infiltration basin to pre-filter sediment and treat other pollutants.	Moderate to high	Medium to high	Bioretention or infiltration systems; Ensure that media layer K_{design} has an appropriate factors of safety over the underlying K_{design} to not become the limiting surface
Approved "pretreatment" devices	A system with an approved General Use Level Designation for "pretreatment" by Washington State TAPE or equivalent.	Moderate	Limited	Underground or surface systems with adequate head for pretreatment device and low to moderate clogging risk
Non-proprietary biotreatment or treatment control BMPs	A biotreatment or treatment control BMP with M or H performance for pollutants of concern	High	Medium to high	Where clogging risk and/or groundwater risks are elevated.
Approved "treatment" devices	A system with an approved General Use Level Designation for "basic treatment" by Washington State TAPE or equivalent.	High	Medium to high	Where clogging risk and/or groundwater risks are elevated.

4.4.3. Design for Maximizing Incidental Volume Reduction in Biofiltration BMPs

Biofiltration BMPs must be designed to maximize volume reduction where feasible. This is primarily achieved by selecting biotreatment BMPs with partial infiltration (BIO-1 or BIO-5) wherever conditions allow for partial infiltration to be feasibly achieved. This is also achieved through providing the target biotreatment BMP footprints as described in Appendix E.4. If these two approaches are used, then no further calculations related to volume reduction are needed.

Where projects seek to deviate from standard approaches, the following criteria must be met to demonstrate that volume reduction has been maximized:

- All applicable HSCs must be provided except where they are mutually exclusive with other LID BMPs
- Biotreatment BMPs must use amended media to maximize ET and pollutant removal and maximize contact time of runoff with media
- For biotreatment BMPs with underdrains, retention shall be provided below the underdrain that meets the following criteria:
    - A gravel storage layer shall be installed below the invert elevation of the underdrains, as applicable.
    - Rock should be assumed to have a porosity of 0.4 unless otherwise supported, and
    - The depth of rock should be selected so that the underdrain layer empties in 48 hours. Where the infiltration rate of the underlying soil is not known, a rate of 0.15 in/hr shall be assumed, resulting in a gravel depth of 18 inches.
    - As a target, one-third of the DCV should be included below the elevation of the underdrains.
- Soils shall be amended to promote infiltration

4.4.4. Design for Trash Capture

Where trash is identified as a primary pollutant of concern, BMPs must be designed to remove trash. Additionally, operation of the BMP must not be compromised by trash accumulation.

Additional requirements for trash capture may result from implementation of the Statewide Trash Amendments within future terms of MS4 Permits. Implementing trash control into BMPs now may help avoid retrofits in later permit terms.

Trash control approaches may include:

- Inlet screens or trash racks
- Trash racks and screens in in the stormwater conveyance system

- Trash racks or screens within BMPs or on BMP overflows
- Hydrodynamic separators or other approved pretreatment devices

Systems must be designed to remove trash that is 5 millimeters and greater.

Selection of trash control approaches should include an assessment of the rate of trash generation that is expected (including consideration of source controls used), the capacity of systems to hold trash without causing nuisance conditions, and the frequency of maintenance that is expected.

4.4.5. Design to Accommodate Off-site Run-on

If off-site run-on occurs to an on-site BMP, the BMPs need only be sized to treat the run-off generated on-site. However, this creates additional design considerations.

- Routing additional area to the BMP may cause the BMP to treat more water relative to its size than if it were only receiving the design storm from on-site flows, so it may require more frequent maintenance. The maintenance frequencies for various maintenance activities in the BMP fact sheets should be increased to account for the increased load of pollutants, sediment, and runoff from the off-site areas relative to the size of the BMP.
- Pollutants of concern must account for off-site areas. This runoff will comingle with project site runoff and therefore all pollutants of concern in the comingled runoff needs to be addressed.
- Inlet and outlet structures must be designed to accommodate or appropriately bypass excess flows resulting from the additional area.
- A project proponent may choose to divert offsite flows around or through the project site without treating them or routing them to on-site BMPs provided that these flows do not comingle with water from the project site that requires treatment.

Where off-site run-on occurs, the project proponent may choose to size and design a LID BMPs to treat all or a portion of off-site flows in order to generate DCV credits which could be transferred to other development projects unable to treat the DCV. Such a system of transfer would need to be in place for this option to apply. The project proponent would need to consult the local jurisdiction for requirements for specific guidelines and requirements for using on-site BMPs to treat off-site flows and generate DCV credits. See Section 3 of the Model WQMP for specific criteria related to DCV credits.

4.4.6. Design to Facilitate BMP Design and Maintenance

All structural BMPs will require regular maintenance and inspection in order to properly capture and/or treat runoff. The BMP fact sheets contain BMP-specific maintenance activities and frequencies and design features that are intended to support inspection and maintenance. Ongoing maintenance should be considered when designing the BMP. The measures in this

section are intended to aid the BMP designer in maintenance considerations to control costs and meet BMP requirements.

4.4.6.1. Controlling maintenance costs

The most effective way to reduce maintenance costs for structural BMPs is to design the BMP to reduce the required frequency of maintenance activities and extend the BMP usable life. The most effective way to do this is to prevent or reduce sediment and pollutants generated on-site from being delivered to the BMP using source controls, site design BMPs, and using an appropriate pretreatment approach.

Second, BMPs should be located and designed so that they can be readily maintained, including:

- Provide access roads, as applicable.
- Provide pretreatment systems or sacrificial areas that are intended to concentrate the spatial extent of pollutant accumulation and maintenance activities.
- Locate system in areas accessible for maintenance (i.e., not underneath a structure or other site feature)
- Locate system in areas that will not require permits and costly mitigation to perform maintenance activities.
- Establishing maintenance protocols that establish the system as a treatment system and limit the potential future interpretations as a jurisdictional area.

4.4.6.2. Minimize entrainment of captured pollutants

Structural BMPs are required to be designed to minimize the entrainment and bypass of captured pollutants in the course of routine maintenance, normal operation, or overflow. If not properly designed, pollutants and sediment which have been removed from stormwater by the BMP may become entrained in stormwater during maintenance or during large storm events and washed downstream. If maintenance access is not properly considered, then maintenance activities could cause compaction of soils, damage to BMPs, or release of pollutants downstream.

In addition to the maintenance considerations included in the BMP fact sheets, the following measures should be used to ensure that pollutants trapped in the BMP do not become entrained

- Use trash screens or containers that do not allow for trash to be washed downstream at high flow rates
- Design systems as off-line systems where higher flows bypass the system.
- If systems cannot be off-line, provide an internal bypass that conveys higher flows around areas where sediment and debris is intended to accumulate (e.g., allow bypass of the forebay during higher flows)

- Maintain pretreatment, forebays, detention, or debris collection frequently, before they fill completely
- Design the BMP and pretreatment to be readily accessible for maintenance including equipment needed for maintenance. Depending on the BMP type, this may require consideration of heavy, large equipment such as heavy trucks, forklifts, vactor trucks, etc. These vehicles can be bulky and difficult to maneuver. A level pad adjacent to the BMP, preferably with no vegetation or irrigation system should be provided, where appropriate, for large equipment access
- Provide manhole and cleanout access for all underground infrastructure including perforated pipes, storm drains, detention, and infiltration galleries. All manholes should have a ladder or steps for access

4.4.6.3. Design mechanisms to allow for inspection and verification

Structural BMPs will require regular inspection to verify that they are working properly. To facilitate this, BMPs must be constructed to allow for inspection and verification of capture of the DCV. This may require measurement of volumes, flow rates, sediment, or water quality parameters. To accommodate inspection and verification, the following measures should be considered when designing BMPs:

- Structural BMPs shall include inspection ports for observing all underground components that require inspection and maintenance; a diameter of at least 6 inches is recommended to accommodate a range of water level measurement equipment.
- Silt level posts or other marking shall be included in all BMP components that will trap and store sediment, trash, and/or debris, so that the inspector may determine how full the BMP is with sediment.
- Expectations for vegetation coverage, size, and type should be provided on the structural BMP and/or landscaping plans as appropriate to allow assessment of conditions and needs for maintenance.
- Signage indicating the location and boundary of the structural BMP is recommended

4.4.6.4. Conformance to product-specific maintenance requirements

Proprietary BMPs that are approved by Washington TAPE must have defined maintenance activities and frequencies. The O&M Plan for the site must require that these BMPs be operated according to the maintenance protocols approved by TAPE and require that any project- or climate-specific protocols be developed through adaptive operation over time.

4.4.7. BMP Design Considerations for Facilities Built at a Larger Scale

Regional BMPs meeting specific criteria can be used as a path for compliance with LID, treatment control, and hydromodification criteria for projects that participate in these projects. See Section 3 of the Model WQMP for specific criteria. Additionally, projects developed at a

large scale may include the use of centralized LID BMPs at a larger scale, similar to designs that could result though regional BMP pathways.

For the purpose of developing BMP sizing and design for larger-scale facilities, the design guidance included in this TGD should be consulted to develop designs for regional facilities. Specific issues encountered in larger-scale facilities include:

- Larger, more concentrated inflows, possibly requiring more robust energy dissipation and scour protection.
- In the case of biofiltration systems, surface distribution systems may be needed to spread water over the filtration surface to prevent concentrated points of source or overloading the parts of the media bed closer to the inlet. This could be achieved through the use of turf-reinforcement matting in shallow distribution swales.
- Different zones of the system may experience inundation at different intervals, potentially requiring different zones for planting and maintenance.
- Outlet control of underdrain system in biofiltration- or filtration-type systems is likely to be strongly preferred to encourage water to pool over the entire facility and avoid short circuiting in areas that experience most frequent loading.
- Procurement of media and plants in large volume may require specific considerations.
- Excavation and/or media placement methods may require equipment in the floor of the system if the system is too large to reach from the perimeter. Any areas that are compacted must be restored and infiltration or filtration rates should be confirmed following bulk grading and/or media placement.
- The entity responsible for maintenance should have capability and financial resources to perform O&M activities and accommodate unforeseen costs at the larger scale of the facility.

Additionally, for projects constructed at a large scale, project-specific design judgement is likely to be needed.

4.4.8. Additional Design Guidance Materials

The BMP fact sheets contained in Appendix G should provide the recommended guidance for most applications. However, not all development/redevelopment projects and scenarios can be considered. When additional guidance is needed beyond the BMP fact sheets, the project proponent should use other BMP guidance manuals such as those listed in the table below. Note that site-specific adaptation of guidance may be necessary based on differences in climate, pollutants, or permit requirements.

Table 4-9: BMP Reference Manuals for BMP Design Guidance

Manual Name	Description	Link
Minnesota Stormwater Manual	Comprehensive guidance on stormwater management including concepts, pollutant fate and transport, permitting, BMP modeling and credits, non-structural and structural practices, and construction and post-construction issues. Online wiki and easily accessible and navigable.	http://stormwater.pca.state.mn.us/index.php/Main_Page Links to other relevant stormwater manuals: http://stormwater.pca.state.mn.us/index.php/Links_to_other_manuals
Stormwater Management Manual for Western Washington (SWMMWW)	Provides guidance on the measures necessary to control the quantity and quality of stormwater produced by new development and redevelopment, such that they comply with water quality standards and contribute to the protection of receiving waters	https://fortress.wa.gov/ecy/publications/SummaryPages/1410055.html
Stormwater Best Management Practice Design and Maintenance Manual	Provides design criteria and guidelines for developers, to assist the County in the review and approval of stormwater treatment BMP designs, and to provide guidance on BMP maintenance requirements for those devices that will be publicly maintained.	http://dpw.lacounty.gov/des/design_manuals/StormwaterBMPDesignandMaintenance.pdf
Low Impact Development Standards Manual	Comply with the requirements of the 2012 NPDES MS4 permit for stormwater and non-stormwater discharges from the MS4 within the coastal watersheds of Los Angeles County (CAS004001, Order No. R4-2012-0175).	http://ladpw.org/ldd/lib/fp/Hydrology/Low%20Impact%20Development%20Standards%20Manual.pdf
New Development and Redevelopment BMP Handbook	Provide general guidance for selecting and implementing Best Management Practices (BMPs) to reduce pollutants in runoff in newly developed areas and	https://www.casqa.org/sites/default/files/BMPHandbooks/BMP_NewDevRedev_Complete.pdf

Manual Name	Description	Link
	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.	
Model BMP Design Manual San Diego Region	This Manual addresses updated onsite post-construction storm water requirements for Standard Projects and Priority Development Projects (PDPs), and provides updated procedures for planning, preliminary design, selection, and design of permanent storm water BMPs based on the performance standards presented in the MS4 Permit. This manual is intended to be used as the basis for jurisdiction-specific BMP Design Manuals.	http://www.projectcleanwater.org/images/stories/Docs/LDW/BMPDM/SD%20Model%20BMP%20Design%20Manual%20Feb%202016.pdf
Portland Stormwater Management Manual	Provides policy and design requirements for stormwater management throughout the City of Portland. The requirements in the manual apply to all development, redevelopment, and improvement projects within the City of Portland on private and public property and in the public right-of-way.	http://www.portlandoregon.gov/bes/64040
Design Standards Manual and Appendices	Provides guidance on water quality and quantity sizing, best management practice (BMP) selection and design, and provides focused checklists to ensure permit submittal completeness. The DSM was tailored to address specific Port issues and challenges including wildlife attractant restrictions and other Federal Aviation Administration (FAA) requirements, stormwater run-on from off-site areas, impairment pollutants for receiving waters (TMDL and 303(d) listed), low impact development (LID), green infrastructure, sustainability and climate change.	https://www2.portofportland.com/Inside/MasterSpecsDesignStandards
Georgia Stormwater Management Manual (GSMM)	Provides guidance on the latest and best post-construction stormwater management practices available to Georgia communities to minimize the negative impacts of increasing stormwater runoff and its associated pollutants.	http://www.georgiastormwater.com/

SECTION 5. HYDROMODIFICATION CONTROL SELECTION AND DESIGN

5.1. Introduction

This section describes approaches for designing systems to address HCOCs. HCOCs are defined in Section 2.6.1. The basic options for hydromodification control include:

- Demonstrating that the BMPs provided to conform with LID BMP requirements provide the hydrologic performance necessary to meet HCOC criteria
- Adapting or augmenting the design of LID BMPs such that the combined stormwater management systems conform to both LID and hydromodification criteria, or
- Providing separate systems that conform to hydromodification criteria and do not modify the LID BMPs provided as part of Step 5 (See Section 2.5).

Additionally, there are possible pathways for conducting in-stream rehabilitation and protection project in order to exempt the project from site-specific compliance or potentially reduce on-site standards as discussed in Section 2.3.5. The potential role of in-stream projects is discussed briefly in Section 5.5.4, however design approaches described in this section focus on on-site approaches likely to be used by the majority of projects.

This section provides general guidelines for hydromodification design (Section 5.2), followed by design approaches specific to complying with applicable criteria (Section 5.4) and discusses different types of hydromodification control BMPs and design considerations for them (Section 5.5). The SOC HMP describes the calculation methods used in SOC.

Street, road, and surface drainage projects are not addressed specifically in this section, but similar principles presented in this section are applicable for these projects. Section 2.9 is intended to present the criteria and design process associated with street, road, and surface drainage projects.

5.2. General Guidelines for Hydromodification Design

This section provides brief guidelines and clarifications for incorporating hydromodification into the overall BMP plan. This is not intended to serve as a stepwise process, as there are many potential ways that a designer may prefer to approach hydromodification. Examples of hydromodification design approaches are provided in Section and 5.4 and Appendix B.

5.2.1.1. Defining Points of Compliance

The locations where HCOCs for a project are evaluated are called points of compliance. Points of compliance are the locations where the relevant parameters are compared between pre-development (natural condition) and post-development conditions to determine if an HCOC exists or not and whether they have been adequately mitigated. Points of compliance are not necessarily the same as outlets from DMAs delineated for the purposes of determining LID compliance. The following minimum criteria apply for each point of compliance:

- A point of compliance must be defined at the nearest point to the project where all of the project runoff to a given outfall is combined.
    - If a project has a single pipe/channel that discharges off-site or to a susceptible water body, then this pipe at the point where it crosses the project boundary or discharges to the susceptible water body is the point of compliance.
    - If there are multiple pipes/channels that leave the site, but combine before discharging to a susceptible receiving water, then the point of compliance should be the location where the pipes combine.
- Points of compliance must be defined so that they are at the same location in the pre-development (natural condition) and post-development condition to the extent possible.
- Where a project has multiple outfalls to a susceptible receiving water, the point of compliance must be defined at each point where runoff from the project discharges to the susceptible receiving water.
    - For example, if a project discharges to a susceptible stream at three separate points, a point of compliance should be defined at each point.
- Points of compliance may be defined at the outlet of each DMA. This is not required if other provisions are met, but if this is done, then compliance with criteria at the outlet of each DMA is acceptable to assure that the project complies on an overall basis.

5.2.1.2. Area to Include in Compliance Calculations

By default, analyses of points of compliance should only account for area within the project boundary. Therefore, if a point of compliance is defined off-site that includes runoff from both on-site and off-site areas, the off-site area tributary to this point of compliance should not be included in the analysis.

For example, the project is located on parcel that has two connection points to the storm sewer system and the point of compliance is at a location further downstream in the piped network where the two connections come back together. There is additional off-site area that enters the pipe before the point of compliance. In this case, the model should evaluate only the project area that is tributary to the point of compliance.

The primary exception is if upstream or downstream area will be managed as part of a BMP that is proposed for the project. In this case, the drainage to that BMP is fundamental to the design and full tributary area to the BMP should be included in the analysis. The pre-development condition in this case should also include the full tributary area to the BMP and must consider this area in its pre-development natural condition.

5.2.1.3. Similarities and Synergies with LID Design

There are a number of similarities and synergies that can be leveraged when developing integrated BMPs systems that meet both LID and hydromodification design requirements.

- Volume reduction, where feasible, is also an effective approach for hydromodification management. An infiltration compartment can help manage flows at the lower part of the flow duration curve and improve BMP sizing efficiency.

- HSCs and effective site design can improve the efficiency of both LID and hydromodification BMPs. This can involve reduction in flow volume and flow rate and increase in time of concentration. Additionally, isolating critical course sediment areas is beneficial for LID BMP maintenance requirements and is also required as part of compliance with hydromodification criteria.

- In many cases, the scale of analysis can be the same. It is acceptable for points of compliance for hydromodification to be defined at the outlet of DMAs used to determine LID compliance. Compliance with hydromodification requirements at each DMA is not required, but if compliance at each DMA is demonstrated, this assures compliance for the project as a whole. This generally makes for a simpler analysis, but may result in somewhat larger hydromodification BMP requirements if there is a relatively long travel time between the DMA outlets and the actual point of compliance because it ignores this portion of the total travel time and the associated routing.

- Because hydromodification BMPs are designed up to a 10-year flowrate, there are compartments that are only used infrequently and can be "stacked" over LID compartments without creating conditions that interfere with water quality operations frequently enough to be of concern.

5.2.1.4. Influence of Infiltration and Harvesting Feasibility on Design Integration

Infiltration and harvesting feasibility should have a significant influence on how designs are integrated. For example:

- Infiltration or harvest and use BMPs can be accounted for in hydromodification calculations
- Incidental losses that occur in hydromodification systems (e.g., open-bottom vaults) can be credited against volume reduction targets; this could justify more compact LID BMPs in combination with losses in hydromodification BMPs.

Examples of design integration for sites with different infiltration feasibility conditions re provided in Appendix B.

5.2.1.5. Differences Between Hydromodification Design and LID Design

There are a number of key differences between hydromodification and LID design and compliance determinations:

- Hydromodification management pertains to hydrologic management at a point of compliance. Unlike LID design which is applied at each DMA separately, this does allow the possibility that within the area contributing to a point of compliance, some areas are over-controlled while others are under-controlled if the net effect at the point of compliance meets requirements.

- Hydromodification BMP design considers larger storm events than LID BMP design. Different tools and methods are required to analyze these storms compared to methods used for LID sizing.

- There is no preference for volume retention versus detention for hydromodification control. While infiltration or harvest and use could be advantageous in design, these processes do not need to be considered beyond what is required to satisfy LID requirements.

- Hydromodification design is most often iterative as it is based on demonstrating that a given hydrologic condition is met rather than meeting a design sizing basis.

5.2.1.6. Potential Design Conflicts when Incorporating Hydromodification into LID Designs

In any case where LID BMPs are modified in order to also serve a hydromodification purpose, difference in operating objectives need to be considered and potential conflicts resolved. Examples of potential conflicts and approaches for addressing these conflicts include:

Issue: Hydromodification design could result in addition of storage depth that exceeds recommended LID storage depth

Approaches:

- Locate additional storage below ground to help with this.

- Demonstrate that the additional storage depth above the recommended LID depth would only be filled rarely (a couple times per year)
- Provide fencing if ponding depth exceeds 18 inches

Issue: Hydromodification design could result in higher flow-through rates for detention design than desirable to support settling or filtration.

Approach: Ensure that flow through rates for storage volumes up to LID standards are consistent with LID BMP design criteria. This may result in less optimal detention designs but is mandatory if these facilities are to also address LID criteria.

Issue: Hydromodification design could result in long drawdown times of surface storage

Approaches:

- Locate more storage below ground.
- Do not locate LID treatment systems downstream of detention, which can result in excessively long wetted periods.

Issue: Hydromodification design could result in greater sediment load per unit filter area and result in earlier clogging because the BMP captures a greater fraction of long term runoff, including large events that may mobilize more sediment

Approaches:

- Provide better pretreatment
- Provide an outlet for detained water that allows this water to bypass treatment (for the portion of the facility volume than the LID sizing criteria)
- Increase footprint and reduce depth
- Do not locate LID treatment systems downstream of detention, which can result in excessively high loading per unit area.
- Conduct project-specific calculations to demonstrate that clogging is addressed (See Section 4.4.1 and Appendix E.4).

Issue: Hydromodification design could require larger peak flows to be routed into the facility

Approaches:

- Provide adequate energy dissipation and scour protection
- See design guidance for minimizing entrainment of captured pollutants (Section 4.4.5)

Other conflicts may be identified and must be addressed as part of the design and review process.

5.3. Hydromodification Design Approaches in North Orange County

[Placeholder for future addition after adoption of the 5th Term NOC MS4 Permit]

Table 5-1. Guidelines for Selecting Hydromodification Design Approach in NOC

5.4. Hydromodification Design Approaches in South Orange County

In South Orange County, project proponents must develop hydromodification designs using the methods in the HMP and mitigate any impacts to critical coarse sediment yield areas. This section contains example design approaches to meet both of these requirements while integrating with LID designs.

Selection between approaches depends on the types of BMPs feasible for the site and designer preference based on site-specific condition. Table 5-2 provides guidelines for selecting approaches and the following subsections provide guidelines for these approaches. Conceptual examples of design approaches and conformance calculations are provided in Appendix B.

In each of these cases, the analysis of pre-development (existing) and post-project flow durations must occur at each point of compliance for the project. If these criteria are met at the discharge point from each LID BMP, then they can be assumed to be met at each point of compliance.

If the site is an existing graded and developed site, the pre-development condition should be based on the slopes and soils currently present at the site, but with impervious cover removed and representative local vegetative cover used in the pre-development condition.

Table 5-2. Guidelines for Selecting Hydromodification Design Approach in SOC

Suggested Approach		Favorable Conditions for Suggested Approach
1	Demonstrate that LID BMPs Conform to Flow Duration Control Requirements (Section 5.4.1)	This case is very rarely applicable except in cases with D soils and low impervious cover. Most of the time, hydromodification control will require a larger BMP size than LID BMPs.
2	Provide Supplemental Infiltration or Flow Duration Control within Combined Facilities (Section 5.4.2)	Where the allowable release rates for flow duration control do not conflict with drawdown times of LID (i.e., water ponded for too long) or require orifice sizes that are too small to maintain. Where space allows for enlargement of combined LID/hydromodification facilities.
3	Provide Separate LID and Flow Duration Control Systems (Section 5.4.3)	Where it is not practicable or not preferable to design facilities with combined purposes. Where hydromodification storage needs to be below ground due to space cosntraints

5.4.1. Approach 1: Demonstrate that LID BMPs Eliminate HCOCs

This option involves no changes to the design of LID BMPs. However, it involves conducting separate hydrologic analyses of these systems using SOHM to demonstrate that the system meet the criteria in Section 2.6.1.2.

This option could also involve minor changes to the outlet control of these systems, provided that LID sizing and design criteria are still demonstrated to be met after these modifications.

5.4.2. Approach 2: Provide Supplemental Infiltration or Flow Duration Control within Combined Facilities

This option could involve increasing the footprint of LID facilities, adding storage compartments above or below LID storage compartments, and/or incorporating multiple-stage outlet structures so that systems conform to both LID and hydromodification criteria.

It is critical that this integration does not interfere with LID biofiltration treatment processes. Typical conflicts may include:

- Ponding and media saturation occurs for longer than 24 hours on a typical basis. Biofiltration BMPs should drain to at least 12 inches below the media surface within 24 hours after a typical DCV event.
- Media filtration rates exceed what is appropriate for treatment (5 to 10 inches per hour).
- Orifices are so small for flow duration control that they may become clogged, which could greatly upset treatment processes due to plant die-off, requiring major rehabilitation.

Meeting flow duration and LID criteria is inherently an iterative process. A suggested design approach is to:

- First use SOHM to determine the overall sizing and flow control parameters needed to conform with flow duration control criteria. How large of a volume is needed? How fast can low flows be released? What is the drawdown time from various points in the facility?
- Determine if there is space to simply increase the LID footprint, maintaining a standard LID depth profile, to provide the required volume for flow duration control. Check that drawdown times do not violate biofiltration design standards.
- If not, determine if there is an opportunity to provide the overall required volume using an adapted profile. This could include:

  - A detention storage volume over the LID biofiltration storage volume, such that the biofiltration volume drains in an acceptable time and the detention storage is not utilized more than about 2 times per year on average.

  - Add a detention layer below the LID biofiltration storage volume, such that extended detention would occur without extended surface ponding.

- Conduct flow duration and LID sizing checks on the combined system to demonstrate that both standards are met.

5.4.3. Approach 3: Provide Separate LID and Flow Duration Control Systems

This option involves designing separate LID and flow duration control systems. These systems may be designed at the same scale (e.g., both for the same DMA, but not integrated), or at different scales (e.g., LID at the DMA scale and flow duration control at the point of compliance).

- LID BMP would be sized based on LID sizing methods

- Flow duration control would be designed using SOHM, which could also account for the effect of LID features.

In general, individual sizing and design methods would be used.

There is one case in which a separate design approach could still be synergistic: If a DMA is classified as biotreatment with partial infiltration, it would not typically be permissible to use a compact proprietary biofilter that does not maximize infiltration. However, if a flow duration control detention system could be designed with a permeable bottom and design features to promote infiltration (sump area; design approaches to minimize compaction under the system), then the footprint of the soft-bottomed detention system could be used as the basis for maximizing retention and compact biofiltration systems could be used to treat flow at a rate of 150 percent of the DCV before it enters the flow duration control system. The footprint of the flow duration control system should be similar or larger to the footprint of a traditional biofiltration BMP with partial infiltration (approximately 3 percent of impervious area).

5.4.4. Mitigate Impacts to Critical Coarse Sediment Yield Areas

In addition to meeting flow duration control criteria, the SOC MS4 Permit and the HMP also require that Priority Projects avoid critical sediment yield areas or implement measures to allow critical coarse sediment to be discharged to the receiving waters, such that there is no net impact to the receiving water. See the HMP for guidance on identifying critical course sediment areas and avoiding or mitigating these areas, if present on site.

5.5. Hydromodification Control BMP Types

The design approaches described in Section 5.4 refer to various types of hydromodification control BMPs. This section provides an introduction to each type of hydromodification control BMP.

5.5.1. On-Site / Distributed Controls

This type of BMP refers to LID BMPs that have been specifically sized and designed to meet applicable hydromodification control criteria. The design criteria applicable to the LID of interest, as described in Section 4 and Appendix G, still applies if it is used for hydromodification control. Deviations within the ranges allowed for LID design are acceptable. For example, adding additional depth of gravel below a bioretention system with underdrains can typically be done without concerns about increased ponding time or reduction in treatment performance.

5.5.2. Combination Basins

Combination basins refers to detention basins that have LID BMPs incorporated into the floor of the basin. Under most typical conditions, the LID BMP (of whatever type) in the floor of the basin operates as if it were located in any other location. Under storm events that are more critical for meeting the applicable flow control criteria, the ponding depth in the basin would exceed the LID storage volume and fill or partly fill the detention storage volume. Where this occurs infrequently and appropriate design approaches are followed, these two functions can coexist within a single facility. Specific design approaches and considerations for combination basins are discussed in 5.4.2.

5.5.3. Flow Control Basins or Vaults

Flow control basins or vaults should follow standard design approaches for detention basins or underground vaults described in applicable BMP design manuals. These BMPs do not serve a water quality purpose and should be designed to:

- Meet hydraulic flow control objectives applicable to the project
- Avoid nuisance conditions such as standing water
- Avoid public safety issues
- Facilitate inspection and maintenance

5.5.4. In-Stream Controls

In some cases, hydromodification management can also be achieved by in-stream controls, including drop structures, bed and bank reinforcement, grade control structures, floodplain reconnection, and other approaches. The requirements for selecting in-stream controls versus on-site controls must always be based on a project-specific analysis and appropriate permitting

process. This TGD does not provide guidance on this process. The Water Quality Improvement Plan includes a Conceptual Geomorphically Referenced Basis of Design approach which may become applicable for certain land development projects seeking to pursue in-stream controls in the future.

.

SECTION 6. SOURCE CONTROL MEASURES

6.1. Introduction

Source Control BMPs reduce the potential for stormwater runoff and pollutants from coming into contact with one another. Source Control BMPs are defined as any administrative action, design of a structural facility, usage of alternative materials, and operation, maintenance, inspection, and compliance of an area to eliminate or reduce stormwater pollution. Each Priority Project and non-Priority Project is required to implement all Source Control BMP(s) that are applicable to the project.

Applicable Source Control BMPs (which includes subcategories of routine non-structural BMPs, routine structural BMPs and BMPs for individual categories/project features) are required to be incorporated into all new development and significant redevelopment projects regardless of their priority, including those identified in an applicable regional or watershed program, unless they do not apply due to the project characteristics. California Stormwater Quality Association (CASQA) BMP Fact Sheet numbers are included in parentheses where applicable.

6.2. Non-Structural Measures

N1 Education for Property Owners, Tenants and Occupants

For developments with no Property Owners Association (POA) or with POAs of less than fifty (50) dwelling units, practical information materials will be provided to the first residents/occupants/tenants on general housekeeping practices that contribute to the protection of stormwater quality. These materials will be initially developed and provided to first residents/occupants/tenants by the developer. Thereafter such materials will be available through the Permittees' education program. Different materials for residential, office commercial, retail commercial, vehicle-related commercial and industrial uses will be developed. The developer is free to draw on existing materials from the County of Orange and other sources in developing these educational materials, and existing materials may be adapted and tailored to the project, as needed.

For developments with POA and residential projects of more than fifty (50) dwelling units, project conditions of approval will require that the POA periodically provide environmental awareness education materials, made available by the municipalities, to all of its members. Among other things, these materials will describe the use of chemicals (including household type) that should be limited to the property, with no discharge of wastes via hosing or other direct discharge to gutters, catch basins and storm drains. Educational materials available from the County of Orange can be downloaded here:
http://www.ocwatersheds.com/PublicEd/resources/default.aspx

N2 Activity Restrictions

If a property owner association (POA) is formed, conditions, covenants and restrictions (CCRs) must be prepared by the developer for the purpose of surface water quality protection. An example would be not allowing car washing outside of established community car wash areas in multi-unit complexes. Alternatively, use restrictions may be developed by a building operator through lease terms, etc. These restrictions must be included in the Project WQMP.

N3 (SC-73) Landscape Management

Identify on-going landscape maintenance requirements that are consistent with those in the County Water Conservation Resolution (or city equivalent) that include fertilizer and/or pesticide usage consistent with Management Guidelines for Use of Fertilizers (DAMP Section 5.5). Statements regarding the specific applicable guidelines must be included in the Project WQMP.

N4 BMP Maintenance

The Project WQMP shall identify responsibility for implementation of each non-structural BMP and scheduled cleaning and/or maintenance of all structural BMP facilities.

N5 Title 22 CCR Compliance

Compliance with Title 22 of the California Code of Regulations (CCR) and relevant sections of the California Health & Safety Code regarding hazardous waste management is enforced by County Environmental Health on behalf of the State. The Project WQMP must describe how the development will comply with the applicable hazardous waste management section(s) of Title 22.

N6 Local Water Quality Permit Compliance

The Permittees, under the Water Quality Ordinance, may issue permits to ensure clean stormwater discharges from fuel dispensing areas and other areas of concern to public properties.

N7 (SC-11) Spill Contingency Plan

A Spill Contingency Plan is prepared by building operator or occupants for use by specified types of building or suite occupancies. The Spill Contingency Plan describes how the occupants will prepare for and respond to spills of hazardous materials. Plans typically describe stockpiling of cleanup materials, notification of responsible agencies, disposal of cleanup materials, documentation, etc.

N8 Underground Storage Tank Compliance

Compliance with State regulations dealing with underground storage tanks, enforced by County Environmental Health on behalf of State.

N9 Hazardous Materials Disclosure Compliance

Compliance with Permittee ordinances typically enforced by respective fire protection agencies for the management of hazardous materials. The Orange County, health care agencies, and/or other appropriate agencies (i.e., Department of Toxics Substances Control) are typically responsible for enforcing hazardous materials and hazardous waste handling and disposal regulations.

N10 Uniform Fire Code Implementation

Compliance with Article 80 of the Uniform Fire Code enforced by fire protection agency.

N11 (SC-60) Litter Control

For industrial/commercial developments and for developments with POAs, the owner/POA should be required to implement trash management and litter control procedures aimed at reducing pollution of drainage water. The owner/POA may contract with their landscape maintenance firms to provide this service during regularly scheduled maintenance, which should consist of litter patrol, emptying of trash receptacles, and noting trash disposal violations by tenants/homeowners or businesses and reporting the violations to the owner/POA for investigation.

N12 Employee Training

Education program (see N1) as it would apply to future employees of individual businesses. Developer either prepares manual(s) for initial purchasers of business site or for development that is constructed for an unspecified use makes commitment on behalf of POA or future business owner to prepare. An example would be training on the proper storage and use of fertilizers and pesticides, or training on the implementation of hazardous spill contingency plans.

N13 (SD-31) Housekeeping of Loading Docks

Loading docks typically found at large retail and warehouse-type commercial and industrial facilities should be kept in a clean and orderly condition through a regular program of sweeping and litter control and immediate cleanup of spills and broken containers. Cleanup procedures should minimize or eliminate the use of water if plumed to the storm sewer. If wash water is used, it must be disposed of in an approved manner and not discharged to the storm drain system. If there are no other alternatives, discharge of non-stormwater flow to the sanitary sewer must be at an acceptable discharge point such as a cleanout, oil/water separator, grease interceptor, or industrial sewer connection. All sewer discharges shall be in accordance with the Orange County Sanitation District's Wastewater Discharge Regulations and/or Washwater Disposal Guidelines.

N14 (SC-74) Catch Basin Inspection

For industrial/commercial developments and for developments with privately maintained drainage systems, the owner is required to have at least 80 percent of drainage facilities

inspected, cleaned and maintained on an annual basis with 100 percent of the facilities included in a two-year period. Cleaning should take place in the late summer/early fall prior to the start of the rainy season. Drainage facilities include catch basins (storm drain inlets) detention basins, retention basins, sediment basins, open drainage channels and lift stations. Records should be kept to document the annual maintenance.

N15 (SC-43, SC-70) Street Sweeping Private Streets and Parking Lots

Streets and parking lots are required to be swept prior to the storm season, in late summer or early fall, prior to the start of the rainy season or equivalent as required by the governing jurisdiction.

N16 (SD-30, SC-20) Retail Gasoline Outlets

Retail gasoline outlets (RGOs) are required to follow the guidelines of this TGD and Model WQMP and non-structural source control operations and maintenance BMPs shown in the CASQA Structural Source Control Fact Sheet SD-30, and Non-structural Source Control Fact Sheet (SC-20).

Other Non-structural Measures for Public Agency Projects

As required by the Model WQMP other non-structural measures shall be implemented and included in the Project WQMP as applicable for new public agency Priority Projects as described in the Municipal Activity fact sheets http://www.ocwatersheds.com/MunicipalActivities.aspx. These include BMPs FF-1 through FF-13 for Fixed Facilities and DF-1 for Drainage Facilities. These are listed in **Section 6.4**, below.

6.3. Structural Measures

The following measures are applicable to all project types. CASQA BMP Fact Sheet numbers are included in parentheses where applicable; these fact sheets provide further detail on these BMPs.

6.3.1. S1 (SD-13) Provide Storm Drain System Stenciling and Signage

Storm drain stencils are highly visible source control messages, typically placed directly adjacent to storm drain inlets. The stencils contain a brief statement that prohibits the dumping of improper materials into the municipal storm drain system. Graphical icons, either illustrating anti-dumping symbols or images of receiving water fauna, are effective supplements to the anti-dumping message. Stencils and signs alert the public to the destination of pollutants discharged into stormwater. The following requirements should be included in the project design and shown on the project plans:

1. Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language (such as: "NO DUMPING-DRAINS TO OCEAN") and/or graphical icons to discourage illegal dumping.

2. Post signs and prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.
3. Maintain legibility of stencils and signs.

See CASQA Stormwater Handbook BMP Fact Sheet SD-13 for additional information.

6.3.2. S2 (SD-34) Design Outdoor Hazardous Material Storage Areas to Reduce Pollutant Introduction

Improper storage of materials outdoors may increase the potential for toxic compounds, oil and grease, fuels, solvents, coolants, wastes, heavy metals, nutrients, suspended solids, and other pollutants to enter the municipal storm drain system. Where the plan of development includes outdoor areas for storage of hazardous materials that may contribute pollutants to the municipal storm drain system, or include transfer areas where incidental spills often occur, the following stormwater BMPs are required:

1. Hazardous materials with the potential to contaminate urban runoff shall either be: (1) placed in an enclosure such as, but not limited to, a cabinet, shed, or similar structure that prevents contact with storm water or spillage to the municipal storm drain system; or (2) protected by secondary containment structures (not double wall containers) such as berms, dikes, or curbs.
2. The storage area shall be paved and sufficiently impervious to contain leaks and spills.
3. The storage area shall have a roof or awning to minimize direct precipitation and collection of stormwater within the secondary containment area.
4. Any stormwater retained within the containment structure must not be discharged to the street or storm drain system.
5. Location(s) of installations of where these preventative measures will be employed must be included on the map or plans identifying BMPs.

See CASQA Stormwater Handbook Section 3.2.6 and BMP Fact Sheet SD-34 for additional information.

6.3.3. S3 (SD-32) Design Trash Enclosures to Reduce Pollutant Introduction

Design trash storage areas to reduce pollutant introduction. All trash container areas shall meet the following requirements (limited exclusion: detached residential homes):

1. Paved with an impervious surface, designed not to allow run-on from adjoining areas, designed to divert drainage from adjoining roofs and pavements diverted around the area, screened or walled to prevent off-site transport of trash; and
2. Provide solid roof or awning to prevent direct precipitation.

Connection of trash area drains to the municipal storm drain system is prohibited.

Potential conflicts with fire code and garbage hauling activities should be considered in implementing this source control.

See CASQA Stormwater Handbook Section 3.2.9 and BMP Fact Sheet SD-32 for additional information.

6.3.4. S4 (SD-12) Use Efficient Irrigation Systems and Landscape Design

Projects shall design the timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the municipal storm drain system. The following methods to reduce excessive irrigation runoff shall be considered, and incorporated on common areas of development and other areas where determined applicable and feasible by the Permittee:

1. Employing rain shutoff devices to prevent irrigation after precipitation.
2. Designing irrigation systems to each landscape area's specific water requirements.
3. Using flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
4. Implementing landscape and irrigation plan consistent with County Water Conservation Ordinance or city equivalent, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.
5. The timing and application methods of irrigation water shall be designed to minimize the runoff of excess irrigation water into the municipal storm drain system.
6. Employing other comparable, equally effective, methods to reduce irrigation water runoff.
7. Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider other design features, such as:

    - Use mulches (such as wood chips or shredded wood products) in planter areas without ground cover to minimize sediment in runoff.
    - Install appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant material where possible and/or as recommended by the landscape architect.
    - Leave a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible.
    - Choose plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth.

Irrigation practices shall comply with local and statewide ordinances related to irrigation efficiency.

This source control measure must be carefully implemented, inspected and maintained for all priority and non-Priority Projects as a required element to address the Highest Priority Water Quality Condition associated with unnatural dry weather flow regime established in the Water Quality Improvement Plan.

6.3.5. Dry Weather Flow Source Prohibition for Areas Not Draining to LID BMPs

Activities that are a potential source of dry weather flows, including irrigation, routing of air conditioner condensate to storm drains, car washing discharges to MS4, street washing discharges to MS4 and other applicable activities that have the potential to produce non-stormwater discharges to the MS4 must be prohibited with the following exceptions:

- Areas of the project that drain to LID BMPs with full or partial infiltration capacity
- Areas of the project that drain to harvesting systems
- Areas permitted to drain to the sanitary sewer system
- Areas of the project that drain to landscaped pervious areas capable of retaining the dry weather runoff.
- Use of advanced, low-water use irrigation systems with a commitment to routine monitoring of systems to ensure overspray or other over-irrigation runoff does not occur.
- Non-stormwater discharges exempted per Section E.1.b of the MS4 Permit.

6.3.6. This source control measure must be implemented, inspected and maintained for all priority and non-Priority Projects as a required element to address the Highest Priority Water Quality Condition associated with unnatural dry weather flow regime established in the Water Quality Improvement Plan. S5 Protect Slopes and Channels

Projects shall protect slopes and channels as described in **Section 3.4** of this TGD.

6.3.7. S6 (SD-31) Loading Dock Areas

Loading /unloading dock areas shall include the following:

1. Cover loading dock areas, or design drainage to preclude run-on and runoff, unless the material loaded and unloaded at the docks does not have potential to contribute to stormwater pollution, and this use is ensured for the life of the facility.
2. Direct connections to the municipal storm drain system from below grade loading docks (truck wells) or similar structures are prohibited. Stormwater can be discharged through a permitted connection to the storm drain system with a treatment control BMP applicable to the use.
3. Other comparable and equally effective features that prevent unpermitted discharges to the municipal storm drain system.
4. Housekeeping of loading docks shall be consistent with N13.

See CASQA Stormwater Handbook Section 3.2.8 for additional information.

6.3.8. S7 (SD-31) Maintenance Bays

Maintenance bays shall include the following:

1. Repair/maintenance bays shall be indoors; or, designed to preclude urban run-on and runoff in an equally effective manner.
2. Design a repair/maintenance bay drainage system to capture all wash water, leaks and spills. Provide impermeable berms, drop inlets, trench catch basins, or overflow containment structures around repair bays to prevent spilled materials and wash-down waters from entering the storm drain system. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the municipal storm drain system is prohibited. If there are no other alternatives, discharge of non-stormwater flow to the sanitary sewer may be considered only if allowed by the local sewerage agency through permitted connection.

Other features which are comparable and equally effective that prevent discharges to the municipal storm drain system without appropriate permits.

See CASQA Stormwater Handbook Fact Sheet SD-31 for additional information.

6.3.9. S8 (SD-33) Vehicle Wash Areas

Projects that include areas for washing /steam cleaning of vehicles shall use the following:

1. Self-contained or covered with a roof or overhang.
2. Equipped with a wash racks, and with the prior approval of the sewerage agency (Note: Discharge monitoring may be required by the sewerage agency).
3. Equipped with a clarifier or other pretreatment facility.
4. If there are no other alternatives, discharge of non-stormwater flow to the sanitary sewer may be considered only allowed by the local sewerage agency through permitted connection. Alternately, non-storm water discharges may require a separate NPDES permit in order to discharge to the MS4. Some local jurisdictions also have permitting systems in place for these situations.
5. Other features which are comparable and equally effective that prevent unpermitted discharges, to the municipal storm drain system.

This source control measure must be carefully implemented, inspected and maintained for all priority and non-Priority Projects as a required element to address the Highest Priority Water Quality Condition associated with unnatural dry weather flow regime established in the Water Quality Improvement Plan. Any separate MS4 permitting of these facilities administered by local jurisdiction must be consistent with the Water Quality Improvement Plan.

See CASQA Stormwater Handbook Sections 3.2.7 and 3.2.10 and Fact Sheet SD-33 for additional information.

6.3.10. S9 (SD-36) Outdoor Processing Areas

Outdoor process equipment operations, such as rock grinding or crushing, painting or coating, grinding or sanding, degreasing or parts cleaning, landfills, waste piles, and wastewater and solid waste handling, treatment, and disposal, and other operations determined to be a potential threat to water quality by the Permittee shall adhere to the following requirements.

1. Cover or enclose areas that would be the sources of pollutants; or, slope the area toward a sump that will provide infiltration or evaporation with no discharge; or, if there are no other alternatives, discharge of non-stormwater flow to the sanitary sewer may be considered only allowed by the local sewerage agency through permitted connection.
2. Grade or berm area to prevent run-on from surrounding areas.
3. Installation of storm drains in areas of equipment repair is prohibited.
4. Other features which are comparable or equally effective that prevent unpermitted discharges to the municipal storm drain system.
5. Where wet material processing occurs (e.g. Electroplating), secondary containment structures (not double wall containers) shall be provided to hold spills resulting from accidents, leaking tanks or equipment, or any other unplanned releases (Note: If these are plumbed to the sanitary sewer, the structures and plumbing shall be in accordance with Section 7.II - 8, Attachment D, and with the prior approval of the sewerage agency). Design of secondary containment structures shall be consistent with "Design of Outdoor Material Storage Areas to Reduce Pollutant Introduction".

Some of these land uses (e.g. landfills, waste piles, wastewater and solid waste handling, treatment and disposal) may be subject to other permits including Phase I Industrial Permits that may require additional BMPs.

See CASQA Stormwater Handbook Section 3.2.5 for additional information.

6.3.11. S10 Equipment Wash Areas

Outdoor equipment/accessory washing and steam cleaning activities shall use the following:

1. Be self-contained or covered with a roof or overhang.
2. Design an equipment wash area drainage system to capture all wash water. Provide impermeable berms, drop inlets, trench catch basins, or overflow containment structures around equipment wash areas to prevent wash -down waters from entering the storm drain system. Connect drains to a sump for collection and disposal. Discharge from equipment wash areas to the municipal storm drain system is prohibited. If there are no other alternatives, discharge of non-stormwater flow to the sanitary sewer may be considered, but only when allowed by the local sewerage agency through a permitted connection.
3. Other comparable or equally effective features that prevent unpermitted discharges to the municipal storm drain system.

6.3.12. S11 (SD-30) Fueling Areas

Fuel dispensing areas shall contain the following:

1. At a minimum, the fuel dispensing area must extend 6.5 feet (2.0 meters) from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 foot (0.3 meter), whichever is less.
2. The fuel dispensing area shall be paved with Portland cement concrete (or equivalent smooth impervious surface). The use of asphalt concrete shall be prohibited.
3. The fuel dispensing area shall have an appropriate slope (2% - 4%) to prevent ponding, and must be separated from the rest of the site by a grade break that prevents run-on of stormwater.
4. An overhanging roof structure or canopy shall be provided. The cover's minimum dimensions must be equal to or greater than the area of the fuel dispensing area in the first item above. The cover must not drain onto the fuel dispensing area and the downspouts must be routed to prevent drainage across the fueling area. The fueling area shall drain to the project's Treatment Control BMP(s) prior to discharging to the municipal storm drain system.

See CASQA Stormwater Handbook Section 3.2.11 and BMP Fact Sheet SD-30 for additional information.

6.3.13. S12 (SD-10) Site Design and Landscape Planning (Hillside Landscaping)

Hillside areas that are disturbed by project development shall be landscaped with deep-rooted, drought tolerant plant species selected for erosion control, satisfactory to the local permitting authority.

6.3.14. S13 Wash Water Controls for Food Preparation Areas

Food establishments (per State Health & Safety Code 27520) shall have either contained areas or sinks, each with sanitary sewer connections for disposal of wash waters containing kitchen and food wastes. If located outside, the contained areas or sinks shall also be structurally covered to prevent entry of stormwater. Adequate signs shall be provided and appropriately placed stating the prohibition of discharging washwater to the storm drain system.

6.3.15. S14 Community Car Wash Racks

In complexes larger than 100 dwelling units where car washing is allowed, a designated car wash area that does not drain to a storm drain system shall be provided for common usage. Wash waters from this area may be directed to the sanitary sewer (with the prior approval of the sewerage agency); to an engineered infiltration system; or to an equally effective alternative. Pretreatment may also be required.

This source control measure must be carefully implemented, inspected and maintained for all priority and non-Priority Projects as a required element to address the Highest Priority Water

Quality Condition associated with unnatural dry weather flow regime established in the Water Quality Improvement Plan. Elimination of flow is required; it is not adequate to remove pollutants from car washwater.

6.4. Municipal Non-Structural Source Control Measures

The following measures are applicable to fixed facility municipal projects such as maintenance yards, schools, and libraries. Generally, these controls are more applicable to municipal projects than the fact sheets contained in **Section 6.2**, however other structural and nonstructural controls described in **Section 6.2** and **6.3** shall be used where applicable. The links below contain the most recent versions of the Fixed Facility fact sheets, which can also be found at **http://www.ocwatersheds.com/MunicipalActivities.aspx**.

- **FF-1, Bay/Harbor Activities**
- **FF-2, Building Maintenance and Repair**
- **FF-3 Equipment Maintenance and Repair**
- **FF-4, Fueling**
- **FF-5, Landscape Maintenance**
- **FF-6, Material Loading and Unloading**
- **FF-7, Material Storage, Handling, and Disposal**
- **FF-8, Minor Construction**
- **FF-9, Parking Lot Maintenance**
- **FF-10, Spill Prevention and Control**
- **FF-11, Vehicle and Equipment Cleaning**
- **FF-12, Vehicle and Equipment Storage**
- **FF-13, Waste Handling and Disposal**

APPENDICES

SOUTH ORANGE COUNTY

TECHNICAL GUIDANCE DOCUMENT

April 1 2017

SECOND DRAFT FOR REVIEW

Version Notes:

This release of the TGD is intended to be used to support project development in South Orange County. In combination with the Model WQMP, this document is intended to serve as the "Model BMP Design Manual" for South Orange County pursuant to the requirements of the San Diego Regional MS4 Permit (Order No. 2013-0001 as amended by Orders 2015-0001 and 2015-0100).

THIS DOCUMENT IS NOT FOR USE IN NORTH ORANGE COUNTY AT THIS TIME. A subsequent reissuance of this TGD is anticipated in the future to support project development in North Orange County upon adoption of the 5th

TABLE OF CONTENTS

APPENDIX A. EXAMPLES OF BMP DESIGN INTEGRATION IN NORTH ORANGE COUNTY [PLACEHOLDER] A-1
APPENDIX B. EXAMPLES OF BMP DESIGN INTEGRATION IN SOUTH ORANGE COUNTY B-1
Introduction to Integrated Structural BMP Sizing Approach B-1
Example 1: Upsizing an LID BMP to Meet Hydromodification Requirements B-1
Example 2: LID and Hydromodification Control in a Combination Basin B-2
Example 3: LID BMP Followed by Supplemental Detention/Retention in Series B-4
APPENDIX C. GROUNDWATER-RELATED INFILTRATION FEASIBILITY CRITERIA C-1
C.1 Intended Use C-1
C.2 Depth to Groundwater and Mounding Potential C-2
C.3 Groundwater Plumes C-7
C.4 Guidelines for BMP Selection by Tributary Land Use Activities C-8
C.5 Well Head Protection and Septic Systems C-11
C.6 Stormwater Runoff Pollutants C-11
C.7 Technical Requirements for Site Specific Study of Infiltration Impacts on Groundwater Quality C-11
C.8 Groundwater-Related Feasibility Criteria Worksheet C-13
C.9 Consultation with Applicable Groundwater Management Agencies C-15
APPENDIX D. GUIDELINES FOR INFILTRATION RATE EVALUATION D-1
D.1 Introduction and General Guidelines D-1
D.2 Guidance on Application and Interpretation of Methods D-8
D.3 Computing the Design Factor of Safety for the Design Infiltration Rate D-11
D.4 Additional Considerations for Infiltration Rates D-17
D.5 References D-18
APPENDIX E. HYDROLOGIC CALCULATIONS AND SIZING METHODS FOR LID AND TREATMENT CONTROL BMPS E-1
E.1 Introduction E-1
E.2 Calculations E-1
E.3 BMP Sizing Methodologies E-20
E.4 Other Sizing Resources and Considerations E-61
APPENDIX F. HARVEST AND USE DEMAND CALCULATIONS AND DESIGN CONSIDERATIONS F-1
F.1 Introduction F-1
F.2 Harvested Water Demand Calculation F-1
F.3 Feasibility Evaluation and BMP Sizing F-11
F.4 Guidance and Considerations for Harvest and Use BMPs from California Plumbing Code and Other Sources F-12
APPENDIX G. BMP FACT SHEETS G-1

G.1 Hydrologic Source Control Fact Sheets (HSC) G-3
G.2 Miscellaneous Design Elements Fact Sheets (MISC) G-17
G.3 Full Infiltration BMP Fact Sheets (MISC) G-35
G.4 Harvest and Use BMP Fact Sheet (HU) G-69
G.5 Biotreatment BMP with Partial Infiltration Fact Sheets (BIO) G-73
G.6 Biotreatment BMP without Infiltration Fact Sheets (BIO) G-111
G.7 Treatment Control BMP Fact Sheets (TRT) G-127
APPENDIX H. TECHNICAL BASIS FOR GREEN ROOF DESIGN CRITERIA H-1
H.1 Functional Definition of "Self-Retaining" for Green roofs H-1
H.2 Analysis Inputs H-2
H.3 Analysis Methods H-3
H.4 Results H-3
APPENDIX I. GUIDELINES FOR USE OF DRY WELLS IN STORMWATER MANAGEMENT APPLICATIONS I-1
I.1 Introduction I-1
I.2 Underlying Performance Standards I-5
I.3 Guidelines for Selection and Siting of Dry Wells as Stormwater BMPs I-6
I.4 Design and Construction Standards I-8
I.5 Project Development Process I-12
I.6 Checklist for Well Permit Application ..... **Error! Bookmark not defined.**
APPENDIX J. PROPRIETARY BMP ACCEPTANCE PROCESS J-1
J.1 Introduction J-1
J.2 Acceptance Process J-1
J.3 Acceptable Certifications Based on BMP Role J-2
J.4 TAPE Performance Standards J-4
APPENDIX K. APPROVED METHODS FOR QUANTIFYING AND MITIGATING HCOCS IN NORTH ORANGE COUNTY [PLACEHOLDER] K-1
APPENDIX L. ADDITIONAL GUIDANCE ON HYDROMODIFICATION MANAGEMENT IN SOUTH ORANGE COUNTY [PLACEHOLDER] L-1
APPENDIX M. WORKSHEETS M-1
APPENDIX N. EXHIBITS N-1
N.1 Rainfall Zones Map N-2
N.2 Infiltration Feasibility Constraints Maps N-3

TABLES

Table C-1: Recommendations/Requirements for BMP Selection to Minimize Groundwater Quality Impacts C-10
Table C-2: Definition of Project Size Categories C-12
Table D-1. Role of Infiltration Testing D-1
Table D-2: Definition of Project Size Categories D-3

Table D-3: Suitability and Limitations of Infiltration Rate Investigation Methods for Different Phases of Project D-0
Table D-4. Definition of Infiltration Rates Used in Screening and Design D-3
Table D-5. Correction Factors for Temperature of Test Water D-4
Table D-6: Suitability Assessment Related Considerations for Infiltration Facility Safety Factors D-13
Table D-7: Design Related Considerations for Infiltration Facility Safety Factors D-14
Table E-1: Calculations used in BMP Sizing Methodologies E-2
Table E-2: Fraction of Average Long Term Runoff Reduced (Capture Efficiency) by HSCs E-6
Table E-3: BMP Sizing Methodologies E-20
Table E-4. Infiltration Surface Area to Avoid Premature Clogging E-62
Table E-5: Inputs and Results of Clogging Calculations E-63
Table F-1: Toilet and Urinal Water Usage per Resident or Employee (gallons) F-3
Table F-2: Monthly Reference ET Rates for Orange County (Inches) F-6
Table F-3: Species, Density, and Microclimate Factors from WUCOLs for High, Moderate, Low and Very Low Water Use Plant Palettes F-7
Table F-4: Planning Level Recommendations for Landscape Coefficient (K_L) F-7
Table F-5: Modified EAWU Daily Average Irrigation Demand by Location and Landscape Coefficient F-7
Table F-6: Determination of Need for Plumbing Permit for Harvest and Use BMP Scenarios F-14
Table F-7: Minimum Treatments Required for Various Harvest and Use BMP Applications . F-15
Table F-8: Minimum Water Quality Standards for Various Harvest and Use BMP Applications F-16
Table F-9: Text requirements for indoor components of harvest and use BMPs (Per Table 601.2.2 of the 2013 California Plumbing Code) F-19
Table F-10: Recommended minimum alternative water source testing, inspection, and maintenance frequency where no manufacturer's recommendations exist (Per 2013 California Plumbing Code Table 1601.5) F-20
Table H-1: Green Roof Moisture Retention Depth Required for 40 Percent Volume Reduction, Los Angeles/Orange County H-4
Table I-1: Identification of Pretreatment Requirements Based on Tributary Land Use/Land Cover I-10
Table J-1. Acceptable WA TAPE Certifications, or Equivalent, for Polltuants of Concern J-3
Table J-2. Performance Standards for WA TAPE Performance Categories J-4

FIGURES

Figure B-1: LID BMP with supplemental detention built into the BMP B-4
Figure B-2: LID BMP followed by supplemental detention/retention in series B-5
Figure C-1: Example Calculations of Maximum Mounding Height by Facility Configuration from USGS Calculator (Carlton, 2010) C-6

Figure C-2: North Orange County Groundwater Basin Protection Boundary and Plume Protection Boundaries (See Appendix NN.2 for high resolution exhibit) C-9
Figure E-1: Nomograph for computing initial time of concentration (Orange County Hydrology Manual, 1986) E-11
Figure E-2: Roughness coefficients (Manning's n) for sheet flow (TR-55 Manual) E-14
Figure E-3: Average Velocities for Estimating Travel Time for Shallow Concentrated Flow (TR-55 Manual) E-15
Figure E-4. Capture Efficiency Nomograph for Constant Drawdown BMPs in Orange County E-27
Figure E-5: Bioretention volume compartments for sizing purposes E-32
Figure E-6: Bioretention with raised underdrain volume compartments for sizing purposes. E-38
Figure E-7. Capture Efficiency Nomograph for Flow-based Biotreatment BMPs in Orange County E-45
Figure E-8: Capture Efficiency Nomograph for Harvest and Use Systems with Irrigation Demand in Orange County E-52
Figure E-9. Target Biofiltration Footprint to Maximize Volume Reduction E-64
Figure F-1: Figure Required on Hose Bibbs on rainwater piping systems (Per Figure 1702.9 of the 2013 California Plumbing Code F-19
Figure H-1: Green Roof Performance Relationships for Los Angeles and Orange County, Landscape Coefficient (KL) = 0.5 (Low water use plant palette) H-5
Figure H-2: Green Roof Performance Relationships for Los Angeles and Orange County, Landscape Coefficient (K_L) = 0.75 (Moderate water use plant palette) H-6
Figure I-1. Conceptual Diagram of Dry Well Components I-2
Figure N-1: Orange County Rainfall Zones Map N-2
Figure N-2: Infiltration Feasibility Constraints Maps N-3

EXAMPLES

Example C.1: Application of USGS Groundwater Mounding Tool Using a Hypothetical Range of Infiltration Scenarios C-5
Example E.1: Hydrologic Source Control Calculation Form (Worksheet 4) E-5
Example E.2: Convert storm depth into a runoff volume accounting for self-retaining areas ... E-7
Example E.3: Back-computing storm depth from runoff volume E-8
Example E.4: Convert storm intensity into a runoff flow rate accounting for self-retaining areas E-17
Example E.5: **Using the Simple DCV Method to Size a Full Infiltration BMP** E-22
Example E.6: Computing Design Criteria to Achieve Target Capture Efficiency, Full Infiltration BMP E-28
Example E.7: **Using Biofiltration Routing Method for Sizing Bioretention BMPs with Underdrains** E-35
Example E.8: **Static Volume Method for Sizing Biofiltration BMPs in SOC** E-40
Example E.9: Sizing to Achieve Target Average Annual Capture Efficiency, Flow-based Biotreatment BMPs E-46
Example E.10: Computing the Capture Efficiency of a Harvest and Use BMP E-53
Example E.11: Sizing to Achieve Target Average Annual Capture Efficiency, Flow-based Biotreatment BMPs E-57

WORKSHEETS

No table of figures entries found.

APPENDIX A. EXAMPLES OF BMP DESIGN INTEGRATION IN NORTH ORANGE COUNTY [PLACEHOLDER]

[Placeholder for future addition after adoption of the 5th Term NOC MS4 Permit]

APPENDIX B. EXAMPLES OF BMP DESIGN INTEGRATION IN SOUTH ORANGE COUNTY

Introduction to Integrated Structural BMP Sizing Approach

Priority Projects must demonstrate compliance with LID and hydromodification control requirements separately. However, these provisions overlap significantly and some BMPs may fulfill or partially fulfill both requirements. Substantial guidance is provided in the body of this TGD (Section 2.6, Section 5) regarding design integration approaches in cases where hydromodification requirements apply. These sections also discuss the potential conflicts in design and the associated checks that must accompany design integration.

The purpose of this appendix is to provide examples of integrated BMP systems that can simultaneously meet the requirements for both LID and hydromodification for projects in SOC. This appendix is not intended to replace or establish different processes than described in Section 2.6 or Section 5.

Example 1: Upsizing an LID BMP to Meet Hydromodification Requirements

Scenario

- A 2-acre project will be 90 percent impervious.
- Infiltration is partially feasible at the project site and the project proposes to use bioretention with elevated underdrains to meet LID standards.

Summary of LID Calculations and Results

- Based on LID sizing calculations in Section E.3, the required BMP footprint is 2,350 sq-ft. The BMP is designed with an 18-inch gravel storage layer below the underdrains of the system.
- The estimated infiltration rate is 0.15 inches per hour, which will drain the 18 inches of stone (7.2-inch effective water depth) in 48 hours
- This configuration would comply with LID requirements but is not large enough to comply with hydromodification requirements.

Integrated Design Approach

1) An SOHM model of the pre-development (naturally-occurring) and post-development condition of the site is developed.

2) A BMP with a profile matching the LID profile is modeled, and an orifice is added to the underdrains of the system to control outflow rates to 10% of the pre-development 2-year flowrate. Infiltration losses, if any, should be included in this model. The footprint of the BMP is increased incrementally to determine the required volume to meet flow duration control standards.
3) If this footprint fits the site, then proceed to the next step. If the footprint is too large for the site, return to step 2 and consider a modification of the LID design with a deeper gravel profile.
4) Check the drawdown time of the surface storage, such that the water surface drains to at least 12 inches below the media surface within 24 hours following precipitation. If this cannot be met, then a greater portion of storage may need to be provided below the underdrain.
5) Check that the sizing calculations for the LID BMP still conform, after accounting for the slower drawdown time.

Applicability and Limitations

- A similar process could be used for any type of LID BMP to retain or biofilter the required LID volume to meet hydromodification requirements.
- Adding an orifice to the underdrains to meet a low flow threshold could greatly increase drawdown time. If there are increases in drawdown time, these must be reflected in LID sizing calculations and design checks to ensure nuisance conditions will not result.
- The option of upsizing an LID BMP to serve hydromodification purposes may result in a higher peak flow into the system, which should be accounted for in the inlet energy dissipation and scour protection.

Example 2: LID and Hydromodification Control in a Combination Basin

Scenario

- A 2-acre project will be 90 percent impervious.
- Infiltration is partially feasible at the project site and the project proposes to use bioretention with elevated underdrains to meet LID standards.
- It is known that the site will not allow LID footprint to be expanded, and therefore LID will need to be combined with flow duration control to meet hydromodification standards.

Summary of LID Calculations and Results

- Based on LID sizing calculations in Section E.3, the required BMP footprint is 2,350 sq-ft. The BMP is designed with an 18-inch gravel storage layer below the underdrains of the system.

- The estimated infiltration rate is 0.15 inches per hour, which will drain the 18 inches of stone (7.2-inch effective water depth) in 48 hours

- This configuration would comply with LID requirements but is not large enough to comply with hydromodification requirements.

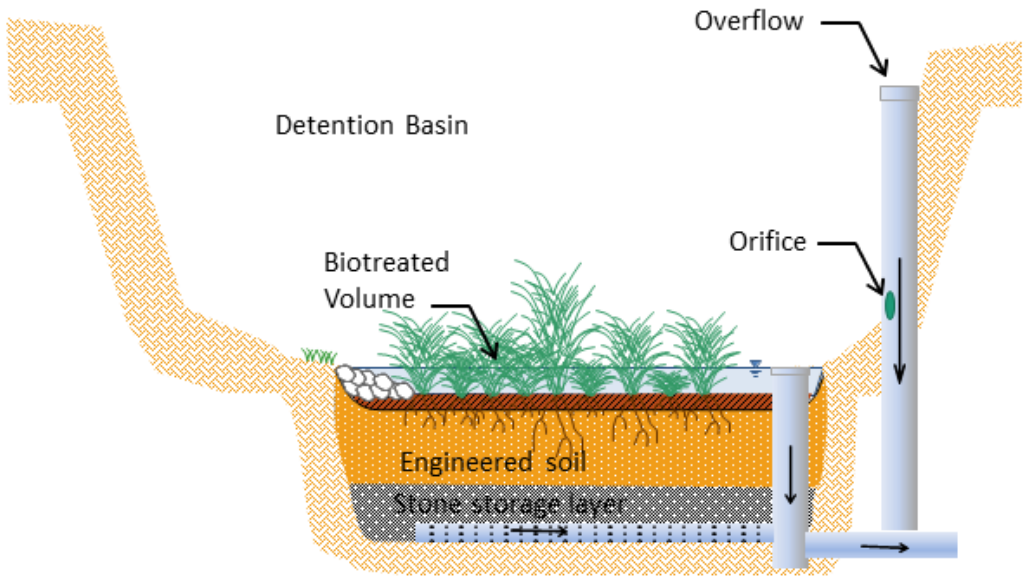
Integrated Design Approach

1) An SOHM model of the pre-development (naturally-occurring) and post-development condition of the site is developed.
2) A BMP is developed with the LID BMP in the bottom and a total BMP depth that can vary. An orifice for low flow is established from the LID BMP underdrains and a mid-height orifice is set above the LID storage volume.
3) The orifice sizes and total depth of the BMP are varied iteratively to arrive at a configuration that meets flow duration standards. The basin area could also be increased as part of these iterations to help limit the maximum depth.
4) Check the drawdown time of the LID surface storage, such that the water surface drains to at least 12 inches below the media surface within 24 hours following precipitation, assuming the LID compartment is full. If this cannot be met, then a greater portion of storage may need to be provided below the underdrain or this configuration may not be permissible.
5) Check that the sizing calculations for the LID BMP still conform, considering the slower drawdown time.

Applicability and Limitations

- A similar process could be used for any type of LID BMP to retain or biofilter the required LID volume to meet hydromodification requirements.
- Adding an orifice to the underdrains to meet a low flow threshold could greatly increase drawdown time. If there are increases in drawdown time, these must be reflected in LID sizing calculations and design checks to ensure nuisance conditions will not result.
- The option of upsizing an LID BMP to serve hydromodification purposes may result in a higher peak flow into the system, which should be accounted for in the inlet energy dissipation and scour protection.

Figure B-1: LID BMP with supplemental detention built into the BMP



Example 3: LID BMP Followed by Supplemental Detention/Retention in Series

Scenario (mostly the same as example 2)

- A 2-acre project will be 90 percent impervious.
- Infiltration is partially feasible at the project site and the project proposes to use bioretention with elevated underdrains to meet LID standards.
- It is known that the site will not allow LID footprint to be expanded or the use of a combination basin. Therefore, flow duration will need to be provided separately.

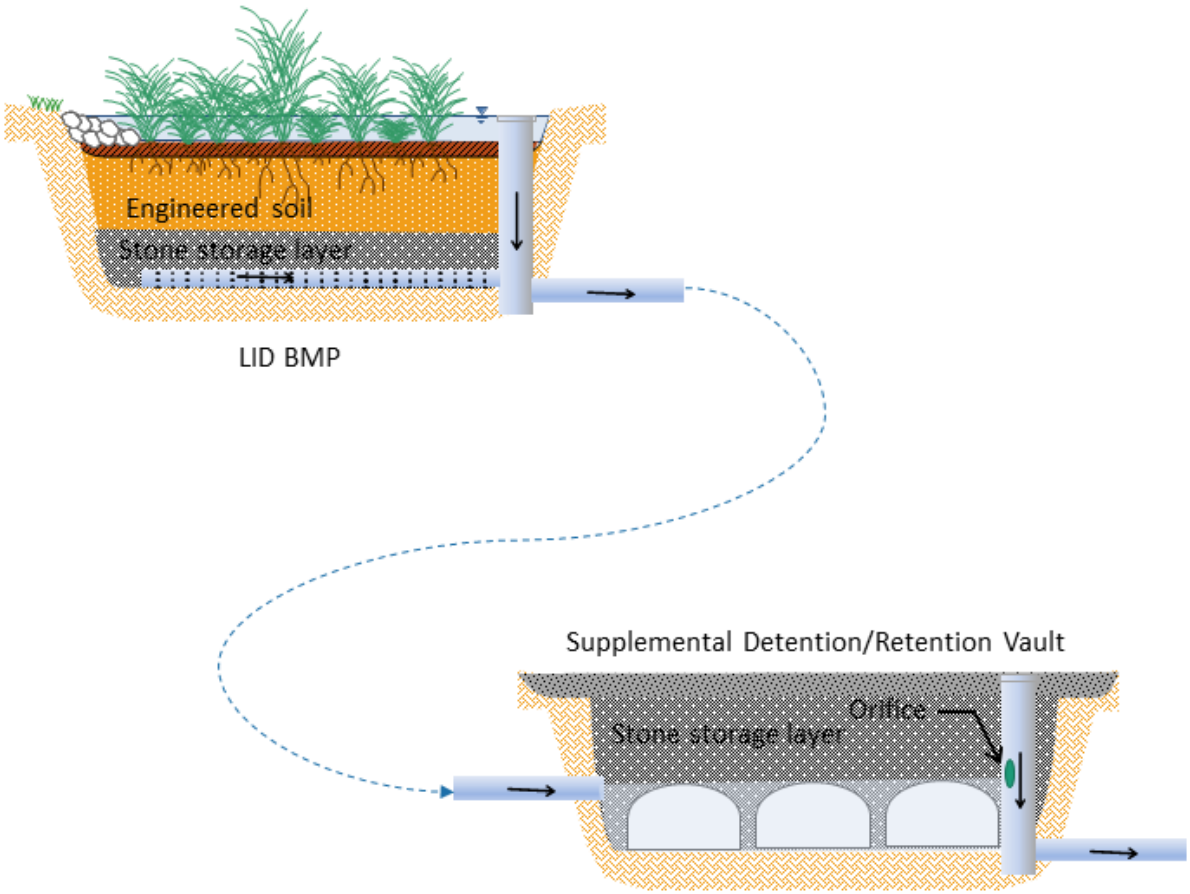
Summary of LID Calculations and Results (mostly the same as example 2)

- Based on LID sizing calculations in Section E.3, the required BMP footprint is 2,350 sq-ft. The BMP is designed with an 18-inch gravel storage layer below the underdrains of the system.
- The estimated infiltration rate is 0.15 inches per hour, which will drain the 18 inches of stone (7.2-inch effective water depth) in 48 hours.
- As a standalone system, this would comply with LID requirements

Integrated Design Approach

1) An SOHM model of the pre-development (naturally-occurring) and post-development condition of the site is developed.
2) The flow duration system (basin, tank, or chamber) is modeled in SOHM to determine the required volume to meet flow duration criteria on a standalone basis.
3) If location of the flow duration system is suitable for partial infiltration, the system should be soft-bottomed and infiltration should be accounted for.
4) If the system provides at least as much infiltration footprint as would have been provided in distributed LID BMPs (about 3% of impervious area of the site), then it is possible that more compact distributed LID BMPs could be used within the site, and goals to achieve incidental volume reduction could be satisfied via the losses in the flow duration system.
5) If flow-based biofiltration is used, then it must be sized for the flowrate required to provide 80 percent long term capture efficiency multiplied by a factor of 1.5.

Figure B-2: LID BMP followed by supplemental detention/retention in series



Applicability and Limitations

- This configuration could be tailored to fit most applications.
- There is no need to check for conflicts because the systems are largely separate.
- The operation of the flow duration control system requires that large storm flows enter the system, which are larger than the design of LID facilities. Therefore, even water that bypasses LID facilities should still flow to the flow duration control system.
- Both the LID BMP and hydromodification BMP should be selected based on infiltration feasibility to result in a combined system that maximized volume reduction.
- Upstream LID BMPs should generally provide adequate pretreatment for downstream infiltration/detention systems.
- This could be particularly useful if a centralized location has better feasibility for infiltration than the conditions below distributed LID BMPs.

APPENDIX C. GROUNDWATER-RELATED INFILTRATION FEASIBILITY CRITERIA

Infiltration BMPs shall not be used where they would adversely affect groundwater quality or where depth to groundwater would limit long term reliable infiltration rates. The purpose of this section is to provide guidelines for allowable use of infiltration BMPs to protect groundwater quality and ensure physical feasibility relative to groundwater and groundwater-related geotechnical considerations. This section considers:

- Depth to groundwater and mounding potential,
- Presence of groundwater plumes,
- Wellhead protection and septic systems,
- Contamination risks from land use activities in the area tributary to the BMP,
- Consultation with applicable groundwater agencies, and
- Technical requirements for conducting site specific studies.

C.1 Intended Use

The criteria contained in this appendix are intended to be used as part of the overall infiltration feasibility screening process. If one feasibility criterion renders infiltration infeasible, it is not necessary to also consider all of the other criteria contained in this section. However, before infiltration BMPs are approved for use on a project, each of these groundwater quality-related criteria must be evaluated and documented. The contents of this section can be used together with Worksheet 1 to determine the overall infiltration feasibility category for a DMA. Worksheet 2 can be used to document the feasibility of infiltration from a groundwater perspective. Whenever a project proposes to utilize full infiltration BMPs, the project proponent should invite the local groundwater agency to consult. This is particularly recommended if:

- The BMP uses a pipe or conveyance to direct flow to a subsurface system (dry well, vault, infiltration trench, etc.)
- The BMP is comprised of surface infiltration with a cumulative tributary area that exceeds 5,000 square feet
- The BMP is proposed to be located over known soil or groundwater contamination

A template and cover letter for inviting the groundwater agency to consult are included in this appendix along with additional guidance.

C.2 Depth to Groundwater and Mounding Potential

Minimum separation between the infiltrating surface (bottom of infiltration facility) and seasonally high mounded groundwater shall be observed in the design of infiltration BMPs, depending on BMP type.

- If the depth to unmounded seasonally high groundwater is greater than 15 feet, the depth to groundwater does not constrain infiltration
- If separation to unmounded seasonally high groundwater is greater than 10-feet and the infiltration area is less than 2,000 sq-ft, the depth to groundwater does not constrain infiltration.
- The separation between the infiltrating surface and the seasonally high mounded groundwater table shall not be less than 5 feet for all BMP types employing infiltration.
- The separation between the infiltrating surface and the seasonally high mounded groundwater table shall not be at less than 5 feet for the following BMP types:
    - Rain gardens and dispersion trenches (small, residential applications)
    - Bioretention and planters
    - Permeable pavement
    - Similar BMPs infiltrating over an extensive surface area and providing robust pretreatment or embedded treatment processes.
- Separation to mounded seasonally high groundwater shall be at least 10 feet for infiltration devices that inject water below the subsurface and surface infiltration BMPs with tributary area and land use activities that are considered to pose a more significant risk to groundwater quality. BMPs for which the 10-foot separation applies include[1]:
    - Subsurface infiltration galleries or vaults
    - Surface infiltration basins
    - Infiltration trenches
    - Other functionally similar devices or BMPs.

C.2.1 Approved Methods for Determining the Depth to Seasonally High Groundwater

The seasonally high groundwater table is defined as the depth to the highest level of the saturated groundwater zone. It is quantified as the average of measured annual minima (i.e., the shallowest recorded measurements in each water year, defined as October 1 through September 30 are averaged) for all years on record.

[1] Drywells are considered Class V Injection Wells. These have special requirements and are not considered in this Appendix. See Appendix I for guidance and requirements for Class V Injection Wells.

C.2.1.1 Site Specific Determination of Seasonally High Groundwater Elevation

The depth to seasonally high groundwater is ideally determined from long-term groundwater level data near the project. If groundwater level data are not available or are inadequate, the seasonal high groundwater depth can be estimated by redoximorphic analytical methods combined with temporary groundwater monitoring for at least one month between November 1 and April 1 at the proposed Project site. In this approach, a professional geologist assesses soil-mottling characteristics of soil cores to determine the depth at which soil features display reductive conditions which indicate the seasonal height of groundwater. This is coupled with observed groundwater level and variability over one month during the wet season of to prepare a professional opinion about seasonally high groundwater table.

Unless criteria are met to use mapped groundwater elevations, each project should utilize site-specific methods to assess groundwater elevations.

C.2.1.2 Conditions for Use of Mapped Groundwater Elevations

There are two primary source of mapped groundwater elevation contours:

- Appendix N includes an exhibit of groundwater contours below ground surface.
- Seismic Hazard Evaluation Open-File Reports prepared by the California Geological Survey describe the highest recorded groundwater level. These files can be found at the following link: http://www.conservation.ca.gov/cgs/shzp/pages/index.aspx. Data are found under "Regulatory Maps" as an exhibit near the end of the "Seismic Hazard Zone Report" for the 7.5-minute quadrangle of interest.

Both sources are based on depth below existing ground surface, therefore changes in site grade and depth of the BMP invert below surrounding grade need to be considered in interpreting these maps.

For sites where the groundwater elevation based on the map in Appendix N is less than 5 feet below the proposed BMP invert, this may be used as a basis for not considering infiltration BMPs. However, the project proponent does have the discretion to conduct site-specific investigation to support the feasibility of infiltration, if desired.

For sites where the mapped groundwater elevation is greater than 15 feet below the proposed invert of stormwater infiltration BMP, the mapped groundwater elevation and may be used as part of demonstrating that infiltration is feasible. Corroboration with site-specific data is encouraged, but is not required.

C.2.2 Methods for Evaluation of Groundwater Mounding Potential

Stormwater infiltration and recharge to the underlying groundwater table will, in most cases, create a groundwater mound beneath the infiltration facility. The height and shape of the

mound depends on the infiltration system design, the recharge rate, and the hydrogeologic conditions at the site, especially the horizontal hydraulic conductivity and the saturated thickness. Groundwater mounding beneath infiltration facilities also depends on the precipitation patterns, which affects the applied recharge rates and underlying soil moisture conditions. Maximum mounding potential is likely to occur in response to cumulative precipitation over relatively short periods, for example, a series of intense winter storms over a one to two-week period.

Methods for quantifying groundwater mounding potential range from detailed modeling studies to simple conservative estimation techniques. The methods employed by the project proponent will be subject to the acceptance of the reviewing agency.

Mounding Evaluation with Modeling Studies: A rigorous evaluation of mounding potential requires detailed site characterization and detailed modeling that accounts for the transient nature of stormwater infiltration and the site-specific hydrogeological conditions. For example, Carlton (2010)[2] used MODFLOW, an industry standard groundwater flow model, to evaluate groundwater mounding potential from infiltration facilities in hypothetical 1-acre and 10-acre developments. Modeling studies to evaluate groundwater mounding potential are applicable for design studies of large regional facilities. Detailed modeling analyses are typically not feasible for evaluation of on-site facilities in small development projects or dispersed small-scale facilities in larger projects.

Mounding Estimates Based on Simplified Groundwater Equations: Estimates of maximum mounding potential can be developed from analytical solutions to groundwater equations, called the Hantush equations. These equations incorporate a number of simplifying assumptions about the hydrogeology of the site including assumptions of uniform horizontal hydraulic conductivity and vertical infiltration rates. Solution of the Hantush equations can be accomplished with a simple Excel spreadsheet tool developed by the USGS (Carlton, 2010) available at online at **http://pubs.usgs.gov/sir/2010/5102/**.

This tool is simple to use but requires inputs about the saturated zone hydraulic conductivity, the thickness of the saturated zone, and estimates of the specific yield, which is related to the effective porosity. The tool also requires inputs about the infiltration conditions, including the dimensions of the infiltration facility, the uniform infiltration rate and the period application that will result in the maximum mounding height. Use of the USGS groundwater mounding tool is applicable and recommended for planning or design level analysis where there is the

[2] Carleton, G.B., 2010, Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins: U.S. Geological Survey Scientific Investigations Report 2010–5102, 64 p. http://pubs.usgs.gov/sir/2010/5102/

sufficient information of the surface conditions of the site and use of detailed modeling is not warranted.

Where information is not available, the following assumptions are recommended for using this tool to evaluating the potential for mounding under small-scale localized BMPs. Site-specific data and professional judgment should always be used in conducting groundwater mounding analyses.

- Recharge rate should be set to the design infiltration rate of the stormwater BMP, assuming that the BMP operates at its design infiltration rate throughout the critical period for groundwater mounding.
- The horizontal hydraulic conductivity should be set to 5 to 10 times the observed infiltration rate of the soil (Appendix D) to account for typical anisotropy of natural soils (ratio of horizontal to vertical hydraulic conductivity). Note the observed infiltration rate will generally be greater than or equal to 2 times the design infiltration rate (Appendix D).
- The period of simulation should be set to 10 days. Applying the design infiltration rate continuously over 10 days generally results in 3-5 times the DCV infiltrated over this period considering typical BMP drawdown times.
- The specific yield should be set to 0.2.
- The saturated zone thickness should be set to 20 feet.

An example using the USGS tool is included in **Example C.1** below.

Example C.1: Application of USGS Groundwater Mounding Tool Using a Hypothetical Range of Infiltration Scenarios

Given:

- Observed soil infiltration rate: 0.2 to 4 inches per hour
- Design infiltration rate: 0.1 to 2 inches per hour (Factor of Safety = 2.0)
- Horizontal Hydraulic Conductivity: 2 to 40 inches per hour (Anisotropy: 10:1 (H:V) applied to measured infiltration rate)
- Facility footprint: 500 to 4,000 sq-ft
- *System aspect ratio*: 1:1 (square) and 5:1
- Period of simulation: 10 days (total infiltrated depth =24 to 480 inches)
- Saturated zone thickness: 20 feet
- Specific yield: 0.2

Required:

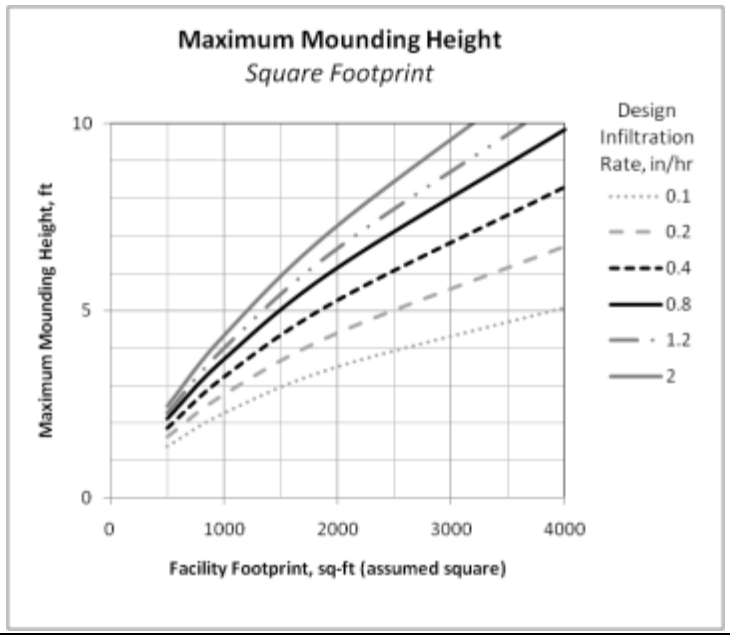
- Compute maximum mounding heights using USGS tool

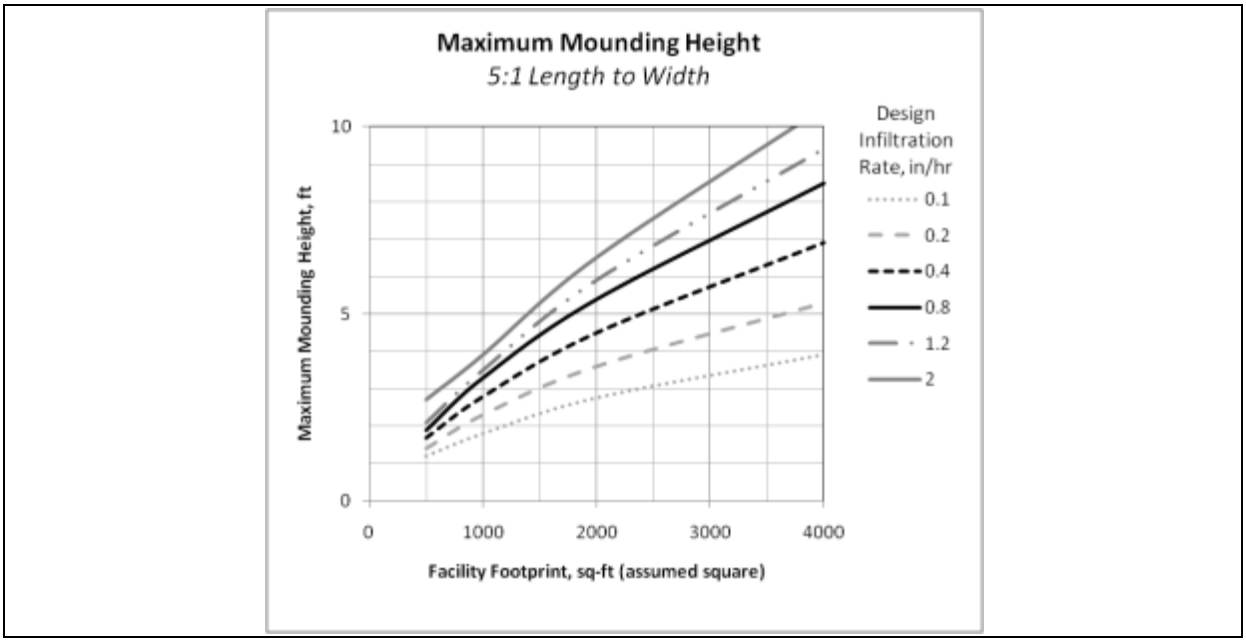
Solution:

Maximum mounding heights calculated with the USGS tool are given in Figure C-1. While these results reflect a relatively conservative case, they indicate that system size and design infiltration rate both influence the potential for mounding. In addition, a linear geometry reduces the magnitude of mounding somewhat compared to a square geometry with the same footprint.

Figure C-1: Example Calculations of Maximum Mounding Height by Facility Configuration from USGS Calculator (Carlton, 2010)

(For illustration purposes only based on input assumptions above; inputs shall be based on professional judgment)





C.3 Groundwater Plumes

Infiltration shall not be allowed in the vicinity of mapped or potential groundwater plumes, except where infiltration would not adversely impact groundwater conditions as determined via a site-specific or watershed study applicable to the site. In the absence of a site specific study, the following criteria apply:

- Infiltration is prohibited within *plume protection boundaries* identified by Orange County Water District (OCWD), or equivalent boundaries identified by applicable groundwater agencies, unless a site specific study demonstrates that infiltration would not adversely impact groundwater conditions.
- Infiltration is prohibited in identified natural pollutant source areas (e.g., selenium), unless a site specific study demonstrates that infiltration would not adversely impact groundwater conditions,
- Infiltration is prohibited within 250 feet of contaminated sites, such as sites found in the Geotracker or EviroStor databases (**http://geotracker.swrcb.ca.gov/**, **http://www.envirostor.dtsc.ca.gov/public/**), unless a site specific study demonstrates that infiltration would not adversely impact groundwater conditions. The study must include a review of the magnitude and type of the original contaminants and byproducts shall be used to assess the level of risk posed by infiltration in the vicinity of closed sites. This criterion applies to active contaminated sites or closed sites that have significant remaining potential for pollutant mobilization as a result of stormwater infiltration.

- A site-specific investigation shall always be performed to assess the feasibility of stormwater infiltration when the project proposes to redevelop a previously-contaminated site (e.g., Brownfields or otherwise contaminated).

As locations, boundaries, and number of contamination sites is subject to change, it is the responsibility of applicants to use the most up-to-date maps available from the permittees and applicable groundwater management agencies. Requirements for conducting site-specific studies vary with project size and are identified in Section **C.7**.

Basis for 250-foot Setback

The 250-foot separation distance from contaminated sites is based on the following considerations:

- In general terms, the degree of subsurface contamination typically decreases in the horizontal direction away from a contaminated site (although there can be site-specific conditions where this is not the case);
- As the distance between a contaminated site and a potential engineered infiltration system increases, the risk decreases that the engineered infiltration system will infiltrate water into subsurface contamination or otherwise negatively affect contamination originating from the contaminated site;
- By precluding engineered infiltration systems within 250 feet of a contaminated site, the risk decreases that infiltration would be increased through an area of the subsurface containing non-aqueous phase liquid contamination or areas with groundwater containing very high levels of contamination;
- A survey of sites contaminated with petroleum-related products estimated horizontal benzene plume lengths (California Leaking Underground Fuel Tank (LUFT) Historical Case Analysis, UCRL-AR-122207, prepared by Lawrence Livermore National Laboratory, 1995). Based on a 10 part per billion concentration threshold, the survey estimated that 90 percent of the sites had benzene plume lengths of 261 feet or less. Some contaminants may have longer or shorter plume lengths than benzene and the amount of data on plume lengths is increasing as additional data are collected. Additional data and analysis may warrant reconsideration of this issue in the future.

C.4 Guidelines for BMP Selection by Tributary Land Use Activities

Table C-1 provides criteria for selection of BMPs to address the potential for contamination of groundwater from tributary land use activities. Infiltration BMPs shall be selected and applied as recommended by **Table C-1**.

To prevent contamination from materials used in the construction of the infiltration BMP itself, soil media, construction materials, and construction practices should be appropriately selected to ensure that hazardous chemicals or groundwater pollutants of concern are not inadvertently leached to the underlying groundwater.

Figure C-2: North Orange County Groundwater Basin Protection Boundary and Plume Protection Boundaries (See Appendix N.2 for high resolution exhibit)[3]

[Placeholder for future addition after adoption of the 5th Term NOC MS4 Permit]

[3] An equivalent exhibit has not been prepared for South Orange County; the absence of a figure is not intended to imply that groundwater contamination does not exist in South Orange County

Table C-1: Recommendations/Requirements for BMP Selection to Minimize Groundwater Quality Impacts

Tributary Area Risk Category	Narrative Description of Category	Example Land Use Activities	BMP Selection Requirements
Low Runoff Contamination Potential	BMP receives runoff from a mix of land covers that are expected to have relatively clean runoff; significant spills in tributary area are unlikely.	• Rooftops with roofing material and downspouts free of copper and zinc • Patios, sidewalks, and other pedestrian areas • Mixed residential land uses with applicable source controls • Institutional land uses with applicable source controls • Driveways and minor streets	• Any infiltration BMP type may be used • Pretreatment for sediment is strongly recommended, as applicable, to mitigate clogging
Moderate Runoff Contamination Potential	BMP receives runoff from a mix of land covers, more than 10 percent of which have the potential to generate stormwater pollutants at levels that could potentially contaminate groundwater; there is potential for minor spills in the tributary area.	• Roadways greater than 5,000 ADT but less than 25,000 ADT • Commercial and institutional parking lots • Commercial land uses • Light industrial that does not include usage of chemicals that are mobile in stormwater and groundwater • Trash storage areas	• Any infiltration BMP type may be used • Pretreatment shall be used • The type of pretreatment shall be selected to address potential groundwater contaminants potentially found in stormwater runoff.
High Runoff Contamination Potential	BMP receives runoff from a mix of land covers, more than 10 percent of which have significant unavoidable potential to generate stormwater pollutants in quantities that could be detrimental to groundwater quality; and/or there is significant potential for major spills that could drain to BMPs.	• Roads greater than 25,000 ADT • Heavy and light industrial pollutant source areas, including areas with exposed industrial activity and high use industrial truck traffic, and any areas that cannot be isolated these areas. Does not include lower risk source sources areas within industrial zones (e.g., roofs, offices, and parking areas) that are hydrologically isolated from industrial pollutant source areas • Automotive repair shops • Car washes • Fleet storage areas • Nurseries, agriculture, and heavily managed landscape areas with extensive use of fertilizer • Fueling stations (infiltration prohibited under all conditions) • Motorized fleet vehicle storage	• Infiltration is prohibited unless advanced pretreatment and spill isolation can be feasibly used and enhanced monitoring and inspection are implemented. • Large projects[4] must evaluate feasibility of advanced pretreatment and spill isolation. • Small projects[4] may consider infiltration to be infeasible with narrative discussion.

[4] See Table C.2 for definition of "Large" and "Small" projects.

C.5 Well Head Protection and Septic Systems

To ensure protection of groundwater quality, the following criteria shall be met:

- Stormwater shall not be infiltrated within 100 feet horizontally of a water supply well, non-potable well, or spring.
- Stormwater shall not be infiltrated within 100 feet horizontally of a septic tank drain field.

Because data regarding the location of supply wells, springs, and septic systems is not generally available to the public, the project proponent is strongly encouraged to consult with the local review agency early in the WQMP preparation process to determine whether these conditions apply to all or part of the project site.

C.6 Stormwater Runoff Pollutants

Stormwater BMPs shall be selected to minimize the introduction of contaminants into groundwater via infiltration of stormwater runoff. The potential for groundwater contamination from pollutants found in stormwater runoff is a function of the land use activities that are present in the tributary area to the BMP. Table C.1 provides requirements for selection of BMPs and pretreatment devices based on the level of risk posed by land use activities.

C.7 Technical Requirements for Site Specific Study of Infiltration Impacts on Groundwater Quality

C.7.1 Project Size Applicability

Regardless of project size, any project proposing to use infiltration BMPs within a *plume protection boundary* or within 250 ft of a contaminated site shall conduct a site-specific study prior to using these BMPs to demonstrate that infiltration will not have adverse impacts on groundwater quality.

For small projects, a site-specific study is not required unless the project proponent chooses to use infiltration, in which case a site-specific study shall be prepared. If the proponent does not choose to use infiltration, the presence of one of the above-referenced conditions (including: shallow groundwater depth or mounding potential, presence of groundwater plumes, proximity to wellheads or septic systems, risks from land use activities, or other site-specific feasibility concerns) is sufficient to demonstrate infeasibility of infiltration BMPs.

For large projects, a site-specific study is required to determine if infiltration is feasible and would not adversely impact groundwater quality in the vicinity of plume(s) and/or contaminated sites, or adversely affect groundwater drinking supplies.

Large projects and small projects are defined in **Table C-2**.

Table C-2: Definition of Project Size Categories

	Residential	Commercial, Institutional	Industrial
Small Projects	Less than 10 acres and less than 30 DU	Less than 5 acres and less than 50,000 SF	Less than 2 acre and less than 20,000 SF
Large Projects	Greater than 10 acres or greater than 30 DU	Greater than 5 acres or greater than 50,000 SF	Greater than 2 acre or greater than 20,000 SF

C.7.2 Information and Documentation Required in Site-Specific Study

If a project proponent proposes to use infiltration BMPs within a *plume protection boundary* or within 250 ft of a contaminated site, the project proponent shall provide a written report to demonstrate that infiltration does not pose an adverse risk to groundwater. The written report should be prepared by a state-certified professional and provided to OCWD for review and comment. The report shall document that the following conditions are met:

1. Lateral and vertical extent of soil or groundwater contamination is defined at the site and is defined for off-site areas if contamination has migrated to the boundary of the site.
2. Groundwater conditions are defined based on site specific data (e.g., subsurface soil characteristics, depth to groundwater, groundwater flow direction, rate of groundwater movement).
3. Ongoing monitoring of soil or groundwater contamination is occurring and will continue to occur, as necessary.
4. A state-certified professional evaluates soil and groundwater data and evaluates whether proposed stormwater infiltration could cause adverse impacts to groundwater quality; an adverse impact to groundwater quality could include changing the movement of groundwater contamination, causing additional amounts of contamination in the unsaturated zone to migrate into the saturated zone, or negatively impacting an existing remediation system.
5. The applicable regulatory agency is identified and has continuing authority to require additional investigation or cleanup work if stormwater infiltration causes an adverse impact on groundwater quality.

In summary, infiltration shall not be allowed for sites where there is substantial evidence of an adverse risk to groundwater quality.

C.8 Groundwater-Related Feasibility Criteria Worksheet

Worksheet 2: Summary of Groundwater-related Feasibility Criteria

1	Is project large or small? (as defined by **Table C-2**) circle one	Large		Small
2	What is the tributary area to the BMP?	A		acres
3	What type of BMP is proposed?			
4	What is the infiltrating surface area of the proposed BMP?	A_{BMP}		sq-ft
5	What land use activities are present in the tributary area (list all)			
6	What land use-based risk category is applicable?	L	M	H
7	If M or H, what pretreatment and source isolation BMPs have been considered and are proposed (describe all):			
8	What minimum separation to mounded seasonally high groundwater applies to the proposed BMP? See Section **C.2** (circle one)	5 ft		10 ft
9	Provide rationale for selection of applicable minimum separation to seasonally high mounded groundwater:			
10	What is the separation from the infiltrating surface to seasonally high groundwater?			ft
11	What is the separation from the infiltrating surface to mounded seasonally high groundwater?			ft

Worksheet 2: Summary of Groundwater-related Feasibility Criteria

12	Describe assumptions and methods used for mounding analysis:	
13	Is the site within a plume protection boundary?	Y N N/A
14	Is the site within a selenium source area or other natural plume area?	Y N N/A
15	Is the site within 250 feet of a contaminated site?	Y N N/A
16	If site-specific study has been prepared, provide citation and briefly summarize relevant findings:	
17	Is the site within 100 feet of a water supply well, spring, or septic system?	Y N N/A
18	Is infiltration feasible on the site relative to groundwater-related criteria?	Y N
Provide rationale for feasibility determination:		

Note: if a single criterion or group of criteria would render infiltration infeasible, it is not necessary to evaluate every question in this worksheet.

C.9 Consultation with Applicable Groundwater Management Agencies

C.9.1 Consultation Recommendations

Consultation with the applicable groundwater management agency should be conducted early in the WQMP development process to the extent necessary to ensure that groundwater quality is protected. Consultation with the applicable groundwater management agency is especially encouraged if:

- The BMP uses a pipe or conveyance to direct flow to a subsurface system (dry well, vault, infiltration trench, etc.)
- The BMP is comprised of surface infiltration with a cumulative tributary area that exceeds 5,000 square feet
- The BMP is proposed to be located over known soil or groundwater contamination

This section presents a description of the consultation process, guidance for the process, and a template and cover letter that can be used by project proponents to facilitate consultation.

C.9.2 Applicable Groundwater Agencies

The primary groundwater management agency covering most of South Orange County is the San Juan Basin Authority. Maps of their jurisdictions of groundwater management agencies can be obtained from the California Department of Water Resources website: http://www.water.ca.gov/groundwater/boundaries.cfm

C.9.3 Guidelines for Process and Timing of Groundwater Agency Consultation

As part of preparation and/or review of the Conceptual/Preliminary WQMP, the Permittee responsible for review should provide an opportunity for groundwater agency consultation. The project applicant should support this review by providing the necessary information about the project.

The consultation process is intended to be an opportunity for the applicable groundwater management agency to identify any project-specific issues that should be considered. It is not intended to replace the infiltration feasibility criteria contained in this TGD. Consultation should only be initiated if all feasibility factors described in this TGD have been evaluated and it is determined by the project applicant and Permittee reviewer that it is potentially feasible to use full infiltration BMPs.

In order to facilitate meaningful input from the groundwater management agency, the following information should be included, as applicable, with the invitation to consult and should be the responsibility of the project applicant to prepare:

- A brief description of the project including land uses and pollutants expected to be generated
- A vicinity map and neighborhood map identifying the project location and areas in which infiltration BMPs are being considered
- Conceptual Infiltration Feasibility Findings
    - Worksheet 1 with attachments, as needed to provide additional details
    - Worksheet 2 with data sources, as needed to provide additional details
- Summary of the conceptual design of proposed infiltration BMPs including:
    - BMP type
    - BMP size (including depth, area, and volume)
    - Preliminary design info (media and gravel depths and infiltration rates, storage depths, overflow depths, footprint, etc.)
    - Pretreatment provided

The information needed for consultation is primarily prepared by the project applicant, but should be submitted by the Permittee with a cover letter. The cover letter should summarize the Permittee's tentative findings about infiltration feasibility and BMP selection. A template cover letter is included in Section C.9.4.

Timing for consultation is at the discretion of the project applicant and project reviewer. The goal should be to obtain input at a time when it can be meaningfully incorporated into conceptual BMP plans such that project plans avoid or mitigate potential groundwater quality issues. This process could be initiated prior to formal submittal of a Conceptual/Preliminary WQMP or in parallel with Permittee review of the Conceptual/Preliminary WQMP.

Groundwater management agencies may not desire to consult or have no comments. In this case, they may or may not respond. A period of two weeks should be provided for an expression of intent to consult, and a period of one month from date of the original invitation should be provided for receipt of comments.

C.9.4 Cover Letter and Template for Inviting Groundwater Management Agencies to Consult

The contents of this section can be used as a template for the invitation to the groundwater management agency to consult. Use of this language or format is not required, but is meant to provide consistency and streamline this process. Placeholders for project-specific inputs are included in square brackets. Guidance is included in parentheses.

[Jurisdiction Letterhead]

[Applicable Groundwater Management Agency, contact person, and address; email address if sent electronically]

Subject: Invitation to Consult on Stormwater Infiltration Proposal
[Project/Site Name]
Project/Site Street Address]
[Reviewing Jurisdiction Name]

To whom it may concern:

[Jurisdiction] is currently reviewing a preliminary project proposal for the subject site that includes stormwater infiltration. In the interest of protecting groundwater quality from potential impacts from stormwater infiltration, we are inviting you to consult on this proposal.

Instructions for Consultation

If [groundwater management agency] is interested in consulting on the proposed use of stormwater infiltration by this project, please reply in writing within 10 business days to indicate your intent to consult. If a letter of intent is received, then written input received within 30 calendar days of this letter will be considered in our review of the project. If responses are not received within the stated timeframes, we will assume that [groundwater management agency] finds the proposed use of stormwater infiltration to be acceptable or does not desire to consult on the project. [insert any specific instructions for communication].

Information to Support Consultation

The following information is attached to this letter to facilitate consultation on this project: (include any that apply; edit as appropriate)

A brief description of the project including land uses and pollutants expected to be generated

A vicinity map and neighborhood map identifying the project location and areas in which infiltration BMPs are being considered

Conceptual infiltration feasibility findings

- *Worksheet 1 with attachments, as needed to provide additional details*
- *Worksheet 2 with data sources, as needed to provide additional details*

Summary of the conceptual design of proposed infiltration BMPs including (to the extent known):

- *BMP type*
- *BMP size (including depth, area, and volume)*
- *Preliminary design info (media and gravel depths and infiltration rates, storage depths, overflow depths, footprint, etc.)*
- *Pretreatment provided]*

Preliminary Findings by [Jurisdiction]

[Jurisdiction] has reviewed the preliminary information described above. Our review has determined that the proposed use of stormwater infiltration is consistent with the criteria identified in the Orange County Technical Guidance Document and the applicable MS4 Permit. We have also determined that a good faith effort was made to investigate potential limits to stormwater infiltration.

[Insert any specific commentary or rationale that is deemed necessary to support this position]

[Jurisdiction] invites your input on this proposal, including identification of any additional data or factors that should be considered in our review.

[Insert any specific topics or questions that are of interest for groundwater agency input.]

Respectfully Submitted,

[Reviewing jurisdiction representative, title, and contact information]

APPENDIX D. GUIDELINES FOR INFILTRATION RATE EVALUATION

D.1 Introduction and General Guidelines

Estimation of reliable infiltration rates has an important role in various phases of project development. The purposes of this appendix are to:

- Explain the roles of infiltration testing at each project phase
- Provide guidance for selection and application of different infiltration testing or estimation methods
- Provide guidance for calculation and selection of an appropriate factor of safety specific for infiltration rates

D.1.1 Roles of Infiltration Testing

The role of soil characterization and infiltration testing differs with the size of the project, the soil types at the site, site groundwater and other characteristics, and the phase of project development. Some projects may not require any infiltration testing of any sort while others may require detailed testing in multiple phases. Table D-1 summarizes the purpose of infiltration testing or estimation efforts at each phase of the project.

Table D-1. Role of Infiltration Testing

Project Phase	Key Questions/Burden of Proof	General Assessment Strategies
Site and BMP Planning Phase	• Where within the project area is infiltration potentially feasible? • What volume reduction approaches are potentially suitable for my project? • Is additional testing needed to support design? (needed for infiltration BMPs only)	• Use existing data and maps to the extent possible • Use less expensive testing methods, where needed, to allow a broader area to be investigated more rapidly • Reach tentative conclusions that are subject to confirmation/refinement at the design phase
BMP Design Phase	• What infiltration rates should be used to design infiltration facilities? • What factor of safety should be applied? • Do design infiltration rates support full infiltration? • If full infiltration will be used, is additional testing needed during construction?	• Use more rigorous testing methods at specific BMP locations • Support or modify preliminary feasibility findings • Estimate design infiltration rates with appropriate factors of safety

Project Phase	Key Questions/Burden of Proof	General Assessment Strategies
Construction Phase (if needed)	• What is the actual as-constructed infiltration rate? • Is this consistent with design assumptions? • Does a contingency option need to be activated to ensure reliable performance?	• Conduct drawdown testing of the full scale facility, or infiltration testing at the final grade following heavy earthwork.

Several factors are important to note in planning and executing infiltration testing:

- Other feasibility criteria may limit infiltration feasibility, such as groundwater contamination and geotechnical considerations. If one of these factors controls feasibility, then infiltration testing may not be needed to support BMP selection. However, an understanding of how quickly water would move into and through soil often has underlying significance in addressing other questions of feasibility; therefore, some form of estimate of soil infiltration rate if often required to support general geotechnical evaluation.
- **Biotreatment BMPs with partial infiltration do not require design phase or construction phase testing.** These systems should take credit for a reasonable estimated infiltration rate, but their operation does not depend on a certain minimum infiltration rate.
- Testing for BMP planning and BMP design do not necessarily need to be separate. If testing conducted as part of BMP planning is adequately rigorous to support BMP design, then these phases can be combined.
- The BMP planning phase and design phase do not necessarily correspond to the Conceptual/Preliminary WQMP phase and Final Project WQMP phase, respectively. For some projects, it may be necessary or desirable to conduct planning and design phase testing prior to Conceptual/Preliminary WQMP submittal. In others cases, design phase testing could be deferred until the Final Project WQMP.
- Construction phase testing is strongly encouraged in cases where full infiltration will be used. It is especially important where it is not possible to conduct a rigorous test at the proposed elevation of infiltration during design, and/or where there will be significant earthwork and potential compaction that could impact infiltration rates. This is a key element in ensuring that infiltration BMPs are constructed as designed and should be strongly considered as part of the post-construction BMP verification process prior to permit closeout.
- While this appendix presents guidance on appropriate approaches at each phase, each project has specific considerations. It is ultimately at the discretion of the reviewing agency and project geotechnical professional to select and apply methods that are suitable to address the applicable questions based on site-specific factors.

- Finally, the need to fully consider infiltration as a first priority BMP must not be mistaken as an allowance to use infiltration without adequate justification and assurance. An initial indication of infiltration feasibility must be confirmed with appropriate design phase testing if full infiltration BMPs will be used. If this cannot be confirmed, then the BMP selection must be revised.

D.1.2 Project Size Categories for Determining Acceptable Methods

For the purpose of determining acceptable infiltration rate testing or estimation methods, Table D-2 describes the criteria for defining a project as "Small" or "Large." These definitions are considered to be guidelines; they are not intended to reduce the requirement to conduct an evaluation of infiltration feasibility that is based on substantial evidence.

Table D-2: Definition of Project Size Categories

	Residential	Commercial, Institutional	Industrial
Small Projects	Less than 10 acres and less than 30 DU	Less than 5 acres and less than 50,000 SF	Less than 2 acre and less than 20,000 SF
Large Projects	Greater than 10 acres or greater than 30 DU	Greater than 5 acres or greater than 50,000 SF	Greater than 2 acre or greater than 20,000 SF

D.1.3 Selection of Methods for Infiltration Rate Testing or Estimation

In general, simpler and more efficient methods of infiltration rate investigation are appropriate for planning level evaluation of infiltration feasibility and identification of potential BMP sites. However, some of these methods do not provided adequate confidence and resolution to support design of full infiltration systems or confirmation of as-constructed condition. Factors that should be considered in selection of an infiltration testing or estimation method include:

- How uniform are soils with depth? Some tests can be biased when there is high variability at different depths in the soil strata.
- How uniform are soils with location? Where soils are variable, a greater number of simpler tests may be warranted.
- What is the proposed grading plan relative to proposed BMP invert elevations? Will BMPs be located well below existing grade? Near existing grade? In some cases, a borehole-type method may be the only option until grading has occurred.
- What is the geometry of the proposed BMP? Some infiltration testing methods can be more reliably translated to specific BMP geometries than others. For example, results from borehole-type tests can translate more directly to the design flowrate of dry wells and infiltration trenches than other types of BMPs.

Table D-3 provides guidance on methods appropriate for each purpose. This list is not intended to be exhaustive. A geotechnical engineer may use other methods that are appropriate for the application, subject to the approval of the reviewing agency.

Table D-3: Suitability and Limitations of Infiltration Rate Investigation Methods for Different Phases of Project

Infiltration Rate Investigation Method	Used for Infiltration Feasibility Categorization and Site Identification	Used for Determination of Design Infiltration Rate for Full Infiltration BMPs	Key Limitations
Regional Maps and Available Data (Section D.2.1)	Yes, for small projects (Table D-3) that have mapped D soils; regional maps must be confirmed through use of available data	No	Maps are known to lack resolution to support definitive conclusions at a site scale. Therefore, maps are only used to identify Type D soils (indicating clear infeasibility) and must be confirmed with available site data. They have no reliable purpose for design-level investigation.
Simple Open Pit Test (Section D.2.2)	Yes	No. This test should be conducted as a design-level open pit test to estimate design infiltration rate (see below).	Measurement precision and small scale limit applicability for use in design development.
Borehole Methods (Section D.3. Well Permeameter Method Borehole Percolation Test Procedure Constant Head Well Permeameter, including commercial methods such as the Guelph Permeameter Method (multiple vendors) and Aardvark Permeameter (Soil moisture)	Yes, if conversion to infiltration rate is used	May be used for areas of proposed cut where other design-phase tests are not possible. These methods should be confirmed by a direct measurement at the finish grade following excavation using an acceptable method. Additionally, boring logs and soil layering over the testing interval and at least 15 feet below the proposed BMP should be carefully considered in interpreting tests.	Borehole-type tests can be strongly biased by horizontal flow into more permeable layers of soils within the testing interval. For example, a gravel lens within finer grained material. This type of test is most applicable for dry wells or infiltration trenches, as the majority of flow is horizontal in these BMPs. It may not be possible to reliably convert results to an estimate of vertical infiltration rate below a broader footprint BMP such as a bioretention area, infiltration basin, or infiltration gallery where the majority of flow is vertical. Confidence can be improved by measuring within each distinct layer of soil and inspecting boring logs to determine likely limiting layers. However, it is not possible to mitigate major uncertainty in actual full-scale infiltration rate.
Open Pit Methods Open Pit Falling Head	Yes	Yes, if appropriate geometric corrections for infiltration into side walls is used.	While these tests primarily measure vertical infiltration rate, some infiltration into side wall occurs during the test. Sidewall infiltration is typically a greater portion of total flow in tests than

Infiltration Rate Investigation Method	Used for Infiltration Feasibility Categorization and Site Identification	Used for Determination of Design Infiltration Rate for Full Infiltration BMPs	Key Limitations
Open Pit Constant Head		Should be done at the elevation of the proposed BMP. Interpretation should be accompanied by a boring log showing soil layering up to at least 15 feet below the proposed BMP.	in full-scale BMP geometry. Therefore, correction is needed. Confidence improves with increasing size of test; however, this also requires more excavation and water. These tests primarily measure the near-surface infiltration rate. They do not account for the potential effect of a limiting horizons further below the BMP and potential mounding of water at this layer. Therefore, they should be accompanied by interpretation of boring logs
<u>Infiltrometer Methods</u> Single Ring Infiltrometer Test Double Ring Infiltrometer Test Dual Head Infiltrometer (Decagon Devices)	Yes	Yes. Should be done at the elevation of the proposed BMP. Interpretation should be accompanied by a boring log showing soil layering up to at least 15 feet below the proposed BMP.	These tests provide a reliable estimate of the vertical infiltration rate into surficial soil layers at relatively low head (slightly conservative). These tests do not account for the potential effect of a limiting horizons further below the BMP and potential mounding of water at this layer. Therefore, they should be accompanied by interpretation of boring logs

D.1.4 Conversion of Field Measurements to Estimate Infiltration Rates for Feasibility or Design

In selecting and applying tests, it is important that it is understood what attribute of the soil the test is measuring and how this can be converted to a value that is meaningful for infiltration feasibility screening and design.

D.1.4.1 Infiltration Rate, Percolation Rate, and Hydraulic Conductivity

A common misunderstanding is that the "percolation rate" obtained from a percolation test is equivalent to the "infiltration rate" obtained from tests such as a single or double ring infiltrometer test which is equivalent to the "saturated hydraulic conductivity." These concepts are interrelated, but the terms have different meanings.

Saturated hydraulic conductivity (Ksat) is an intrinsic property of a specific soil sample under a given degree of compaction, with a given soil structure, in a given direction. It is a coefficient in Darcy's equation (Darcy 1856) that characterizes the flux of water that will occur through the soil under a given head (energy) gradient. Saturated hydraulic conductivity tested in a lab can be used as an indicator of infiltration rate, but it has limited direct value in determining the actual in situ infiltration rate of site soils. Tests that measure in-situ saturated hydraulic conductivity are primarily measuring infiltration or percolation rate and adjusting to a gradient of 1. This is reasonably similar to infiltration rate or percolation rate and is sometimes used interchangeably.

Infiltration rate is the rate of flux of water into the surface of the soil. Infiltration rate is a function of a number of factors including the soil grain size, layering of soil, density/compaction, macropores, depth of ponding on the soil surface, moisture content of the surface layer of the soil, and the rate at which water moves away from the surface once it is in the subsurface (i.e., the percolation rate). These factors control how quickly water can move into the soil. Infiltration rate tends to be higher at the start of an infiltration event as the soil wets, then declines to a steady state as the surface and near surface soils becomes saturated. Saturated infiltration rate is used for design of BMPs. There are two conceptual type of saturated infiltration rates:

- A **point infiltration rate** is the rate at which water will enter soil at a specific point and horizon, usually measured under saturated conditions. Most infiltration tests measure a point infiltration rate.
- The **full scale infiltration rate** is the rate at which water will enter soil reliably from the actual proposed BMP under extended saturation conditions. The full scale infiltration cannot typically be measured directly prior to construction. It must be estimated from point infiltration rates and accounting for whether

subsurface limitations could reduce the actual rate of infiltration at full scale and under sequential storm events.

Percolation rate is the rate at which water moves through soil under a given set of boundary conditions. Similar to infiltration rate, percolation rate measured in a test can be converted units of length per time (i.e., inches per hour). If the percolation rate is slower than the infiltration rate, then the percolation rate will tend to limit the infiltration rate after steady state conditions have been reached. In this case, it is reasonable to equate infiltration rate with percolation rate.

However, percolation rate can be much different than infiltration rate when the direction of percolation that is measured in a test is different than the direction of infiltration from the proposed BMP type. **Anisotropy** refers to preferential flow direction in soils. Most soils have a higher permeability in the horizontal direction than the vertical direction, commonly 5 to 10 times higher. Therefore, tests that primarily measure horizontal percolation rate (e.g., borehole tests) need to be carefully interpreted if they will be used to estimate the vertical hydraulic conductivity of soils.

D.1.4.2 Infiltration Rates Used in Infiltration Screening and Design

This TGD refers to three usages of infiltration rates. These infiltration rates are defined in Table D-4 with guidance on what factors should be considered in establishing each rate.

Table D-4. Definition of Infiltration Rates Used in Screening and Design

Infiltration Rate	Appropriate Factors to Consider	Factor of Safety
Observed Infiltration Rate (K_{obs})	• This value should be the best estimate of saturated infiltration rate in the vertical direction at potential BMP locations based on field testing and information known about potential BMP types (except where dry wells are proposed, in which case horizontal infiltration rate is most applicable). • Include adjustment from test measurements to estimate vertical infiltration (such as conversion from water level fall in borehole to 1-D infiltration rate) • Select representative value from the range of observations; not necessarily worst case • Adjustments for effects of water temperature on infiltration rate • Effects of groundwater limiting horizon on full scale infiltration rate. However, in most cases, where groundwater separation distances are observed and limiting horizons are tested, there should be no need to convert account for the limiting effects of groundwater mounding in K_{obs}.	**None**

Infiltration Rate	Appropriate Factors to Consider	Factor of Safety
Feasibility Screening Infiltration Rate (K_{screen})	• K_{screen} is only intended to be used to determine if infiltration should be considered further. It is not to be used in design. • A minimum factor of safety 2.0 is applied to K_{obs} to account for a nominal level of unavoidable uncertainty and potential for long term clogging. • This factor of safety assumes a very rigorous investigation would be done to support full scale design of an infiltration BMP and a robust pretreatment approach would be used if infiltration BMPs are selected.	**2.0**
Design Infiltration Rate (K_{design})	• This is intended to be the infiltration rate that can be reliably assured over long term operation of an infiltration BMP. • Consider additional factors in Section D.4 to determine the appropriate factor of safety to apply to K_{obs} to determine the reliable long term K_{design}. • Consider results of any additional testing or exploration that is conducted to support design. • Consider specific BMP geometry in interpreting testing results. For example, if some amount of infiltration will occur through sidewalls, account for this in the infiltration rate used in design.	**Per Section D.4.** **At least 2.0.**

D.1.5 Effects of Temperature on Infiltration Rates

The rate of infiltration of water through soil is strongly affected by the viscosity of the water, which is affected by the temperature of the water. Therefore, warmer water infiltrates much faster than colder water, all other things being equal.

If possible, testing should be conducted at a temperature that approximates the typical runoff temperatures for the site during the wet season (~60 degrees F). If this is not possible, then the results of infiltration tests must be adjusted to account for the difference between the temperature of the water used for testing and the typical temperature of runoff that the BMP will receive. Table D-5 provides adjustment factors.

Table D-5. Correction Factors for Temperature of Test Water

Temperature of Test Water, F	Correction Factor (Multiply by Raw Observation)
60 or less	1.00
70	0.90
80	0.77
90	0.69
100	0.61

D.1.6 Inherent Limits of Infiltration Testing

There are a number of inherent limits in the degree to which infiltration testing can assure as-built and long-term design conditions. The investigation and reporting of infiltration rates should acknowledge these limitations to help provide realistic guidance to project designers about the level of confidence in findings and the need for additional testing and/or contingency plans.

D.1.6.1 Scaling from Point Measurements to Full-Scale and Long-Term Performance

There are several challenges in scaling short-term, point observations of infiltration rate to long-term, full scale performance.

1. Testing procedures are all approximations, with simplifications in the measurement geometry and scale compared to full scale BMPs. Correction factors are similarly simplified. Testing and interpretation methods often rely on assumptions about uniform soil properties, isotropic behavior (i.e., same in all directions), which are typically not entirely true.
2. Point measurements do not involve enough water or long enough testing periods to directly test the long term infiltration capacity of the surface plus subsurface soil. These factors need to be estimated from soil and groundwater information.
3. Earthwork and associated compaction of the site can greatly change soil structure and associated infiltration rates. Compaction can reduce infiltration rates by an order of magnitude (10x), even in relatively sandy soils.
4. Over time, the surface of infiltration facilities can become plugged as sedimentary particles accumulate at the infiltration surface. Plant action can help avoid or reduce this. But the balance between these two factors is poorly characterized.

Prior to full scale construction and operation, it is appropriate to consider infiltration measurements to be "informed estimates" at best. But these measurements do not provide assurance of actual future conditions. For these reasons, it is expected that relatively large factors of safety are needed to support an infiltration design, unless the design also include a contingency plan for how the BMP will be modified if actual infiltration is less than planned. Additionally, construction phase testing is encouraged to confirm infiltration rate.

D.1.6.2 Infiltration in Future Fill Conditions

If the bottom of a BMP (infiltration surface) will be located in fill that has not yet been placed, it is not possible to test infiltration rates for the future compacted fill. There is no reliable basis for estimating the infiltration of future standard fill material. Where fill depths are not excessive below the invert of the BMP, the use of a granular permeable fill meeting project-specific requirements could allow infiltration in these conditions, provided that underlying soils also support infiltration. The design infiltration rate of the permeable fill materials should be at least

two times higher than the underlying soils to ensure that this horizon does not limit infiltration. In any case, testing should be conducted following placement to ensure that specifications for permeable fill material were met.

D.1.7 Guidelines for Scoping and Reporting of Infiltration Investigations

D.1.7.1 Planning Phase Investigation

Tests should seek to characterize the infiltration rates at the likely elevation of the infiltration BMPs, but it is recognized that design-level BMP elevations may not be known at this time.

Spacing of tests should be determined based on the variability of conditions. This can be informed by other information about the soils and geology within the projects, such as previous geotechnical investigations. In sites with uniform conditions, a minimum of three tests per site is recommended, coupled with review of other information to interpolate or extrapolate from test results. For larger or more varied sites, additional tests may be needed. Testing locations should be focused where other soils and geologic data suggests that infiltration is most likely to be feasible. The density of testing does not need to be uniform throughout the site.

As described in Section 2.3 of the TGD, the goal of this investigation should be to prepare a map of the site that overlays infiltration rate ranges with other constraints to identify potentially suitable areas for infiltration. The following ranges of K_{screen} ($K_{obs}/2$) are suggested to guide decision making:

- Areas K_{screen} of > 2 inch per hour (most favorable for infiltration)
- Areas with K_{screen} of 0.3 to 2 inches per hour (good possibility for infiltration, but a backup plan is likely needed.)
- Areas with K_{screen} of 0.05 to 0.3 inches per hour (most suitable for biotreatment with partial infiltration designs)
- Areas with K_{screen} < 0.05 inches per hour (negligible infiltration potential)

A map is not necessarily applicable for small sites where conditions are reasonably consistent across the site.

As part of the planning/screening phase, review of NRCS soils maps and available information may be conducted by the project design professional. Simple open pit testing may also be conducted by the project design professional. These forms of testing do not require a report separate from the WQMP.

Other types of tests must be conducted by a licensed professional geotechnical engineer or registered geologist. These types of testing require reporting.

Reporting should include:

- Description of methods
- Identification of other data source uses
- Geologic setting
- Testing locations
- Testing results
- Interpretation of findings
- Graphical identification of ranges of infiltration rate (if applicable)

D.1.7.2 Design-Phase Investigation

Design phase testing must be conducted or overseen by a qualified professional, either a Professional Engineer (PE) or Registered Geologist (RG) licensed in the State of California.

Design phase testing should be conducted at the location of each infiltration BMP that is proposed.

The elevation of the tests should correspond to the facility elevation, plus 1 to 2 feet to account for soil amendments or decompacted zones under the infiltration system. If a confining layer, or soil with a greater percentage of fines, is observed during the subsurface investigation to be within 6 feet of the bottom of the planned infiltration system, the testing should be conducted within that confining layer.

The boring logs should continue to at least 15 feet below the invert of the proposed BMP. Borings should be conducted at each test location.

The recommended number of infiltration tests depends up on the footprint size and the soil variability. The following guidance is provided to estimate the number of tests per BMP.

- Three infiltration tests should be conducted for every Full Infiltration BMP, conducted within the proposed BMP footprint or within 20 feet of the perimeter in representative soil formations.
- For Full Infiltration BMPs with footprints larger than 10,000 square feet, conduct one additional test for every 10,000 square feet of BMP footprint area after the first 10,000 square feet
  For example, if a large BMP had an infiltration area of 30,000 square feet, 5 tests should be conducted (3 for the first 10,000 square feet, 1 for the next 10,000, and 1 for the next 10,000)
- One test for every 100 lineal feet of infiltration facility.
- In general, no more than five valid tests are required per BMP of any footprint, unless more tests would be valuable or necessary (at the discretion of the qualified professional assessing the site, as well as the reviewing jurisdiction).

These recommendations may need to be reduced or increased at the discretion of the project professional and reviewing jurisdiction depending on the complexity and variability of the site.

Reporting should include:

- Name and qualifications of preparer
- Scope of investigation, including description of methods, identification of other data source uses
- Geologic setting
- Testing locations and depths
- Testing results
- Testing records and description of specific measurements
- Interpretation of findings, including consideration of limiting horizons or groundwater conditions that could limit full scale infiltration
- Confirmation or adjustment of preliminary infiltration screening – is it acceptable to utilize full infiltration BMPs?
- Recommended component of the overall factor of safety that is appropriate to account for variability or uncertainty in testing.

Reporting for planning phase and design phase testing does not need to be contained in separate reports, however the combined reporting must justify how the BMP locations were selected for detailed testing.

D.2 Guidance on Application and Interpretation of Methods

This section provides guidance on application and interpretation of selected infiltration testing or estimation methods. Methods should be selected based on the guidance provided in Section D.1.3.

D.2.1 Use of Regional Maps and "Available Data"

This section describes a method that satisfies the requirements for infiltration screening of small projects as defined by Table D-2. This method uses regionally mapped data coupled with all applicable data available through other site investigations to determine the infiltration rate for the purposes of infiltration feasibility screening and categorization.

Via this method, areas of a project identified as having Hydrologic Soil Group D soils (See Appendix N) are considered infeasible for Full Infiltration BMPs. This determination may be supported without testing if available data do not contradict this determination.

"Available data" is defined as data collected by the project or otherwise available that provides information about soil types or infiltration rates. Applicable data is expected to be available as part of nearly all projects subject to New Development and Significant Redevelopment stormwater management requirements in Orange County. Data sources may include:

- Geotechnical investigations
- Due diligence site investigations
- Other CEQA investigations
- Investigations performed on adjacent sites with applicability to the project site

For projects permitted to utilize this method, additional infiltration testing data is not required to be obtained, however, infiltration testing data which is already available from previous studies must be used. If available data suggests that other soil types are present than the mapped soil types such that there is a reasonably chance that infiltration could be feasible, then a site-specific investigation with testing is needed.

The distinction between large and small projects is based on the lower spatial variability expected on smaller projects and the lower project value. In these cases, the expense associated with infiltration testing of HSG D soils to attempt to identify localized exceptions to this mapped and supported determination is considered to be an unreasonable economic burden.

D.2.2 Simple Open Pit Infiltration Test

The Simple Open Pit Infiltration Test is a simple, site-specific method which can be used to provide a preliminary estimate of infiltration rate for the planning level/screening level investigations. This approach is similar to the Open Pit Falling Head Test (D.3.1), but is less rigorous and does not need to be conducted by a licensed professional.

1. Excavate a test hole to the elevation of the likely bottom of proposed infiltration facilities or into the lowest permeability layer believed be present in the top 5 feet. The test hole can be excavated with small excavation equipment or by hand using a shovel, auger, or post hole digger. The hole should be a minimum of 2 feet in diameter or square and should be sufficient to allow for observation of the water surface level in the bottom of the hole. Remove loose material, as much as possible from the bottom of the hole but avoid compaction of the bottom surface. If a layer hard enough to prevent further excavation is encountered during excavation, or if noticeable moisture/water is encountered in the soil, stop and measure this depth. Proceed with the test at this depth.
2. Scarify the side walls and bottom with a rake or similar equipment to loosen soil and alleviate any "smearing" that is noted
3. Fill the hole with water to a height of about 18 inches from the bottom of the hole, and record the exact time. Check the water level at regular intervals (every minute for fast-draining soils to every 10 minutes for slower-draining soils) for a minimum of 3 hours or until at least 6 inches of water have infiltrated. Record the distance the water has dropped from a stable fixed reference point such as the top edge of the hole. A temporary staff gage driven in to the bottom of the hole is also recommended.
4. The infiltration rate is calculated by dividing the change in water elevation time (inches) by the duration of the test (hours).

5. Repeat this process two more times, for a total of three rounds of testing. These tests should be performed as close together as possible to accurately portray the soil's ability to infiltrate at different levels of saturation. The third test provides the best measure of the saturated infiltration rate.
6. For each test location, record all three testing results with the date, duration, drop in water height, and conversion into inches per hour.
7. Make adjustments for water temperature used in the test, if necessary.

Due to infiltration into sidewalls and lack of pre-saturation, this test is likely to produce results that are higher than other more rigorous tests.

Source: City of Portland, 2014, Stormwater Management Manual

D.2.3 Borehole Methods

[Placeholder for development of guidance to support preferred methods. Identification of Preferred methods are pending research with local geotechnical engineering firms. The tentative recommendation from geotechnical firms is to provide detailed guidance to support the "Constant Head Well Permeameter" method, with the intent of standardizing testing details and interpretation based on this method. There was strong recommendation that this test should only be used for screening purpose or for design level investigation of dry wells or infiltration trenches, as it primarily measures horizontal infiltration. If used for other types of systems that rely on vertical infiltration, it should be confirmed with an infiltrometer or PIT test at the proposed grade after excavation has occurred.]

D.2.4 Open Pit Methods

[Placeholder for development of guidance to support preferred methods. Identification of Preferred methods are pending research with local geotechnical engineering firms. The tentative recommendation from geotechnical firms is to provide detailed guidance to support the "Small Scale PIT Test", with the intent of standardizing testing approaches based on this method. This method should be the preferred method for BMP types that operate primarily on vertical infiltration.]

D.2.5 Infiltrometer Methods

[Placeholder for development of guidance to support preferred methods. Identification of Preferred methods are pending research with local geotechnical engineering firms. The tentative recommendation from geotechnical firms is to refer to the ASTM standard for double ring infiltrometer, as there is not a major differentiation between this method and a single ring infiltrometer.]

D.3 Computing the Design Factor of Safety for the Design Infiltration Rate

Given the known potential for infiltration BMPs to fail over time, an appropriate factor of safety applied to infiltration testing results must be mandatory. The infiltration rate will decline between maintenance cycles as the BMP surface becomes occluded and particulates accumulate in the infiltrative layer. Monitoring of actual facility performance has shown that the full-scale infiltration rate is often lower than the rate measured during design. It is important that adequate conservatism is incorporated in the selection of design infiltration rates to ensure LID goals are met and to avoid potential threats and costs associated with failing BMPs. The design infiltration rate discussed here is the infiltration rate of the underlying soil, below the elevation to which soil amendments would be provided. It is not the infiltration rate of the soil amendment.

The design factor of safety that should be applied to observed infiltration rates is a function of:

- Suitability of underlying soils for infiltration
- The infiltration system design, including how resilient the design is to uncertain conditions

These factors are discussed in the following sections.

As discussed in Section D.1.2, the *feasibility screening infiltration rate* (K_{screen}) calculated for the purpose of infiltration feasibility categorization shall be based on a feasibility factor of safety of 2.0 applied to the rates obtained from the infiltration test results. No adjustments from this value are permitted. The design factor of safety used to compute the *design infiltration rate* shall not be less than 2.0, but may be higher at the discretion of the design engineer and acceptance of the plan reviewer, per the considerations described in the following sections.

It is recognized that there are competing objectives in the selection of both the infiltration feasibility factor safety and the design factor of safety. A low feasibility factor of safety allows a broader range of systems to be considered "feasible" in marginal conditions. There is also an economic incentive to select a lower design factor of safety to yield smaller BMP designs. However, there are both economic and environmental incentives for the use of an appropriate factor of safety for both the feasibility factor of safety and the design factor of safety to prevent premature failure and substandard performance. The use of an artificially low factor of safety is shortsighted in that it does not consider the long term operability and success of the system.

The best way to balance these competing factors is through a commitment to thorough site investigation, use of effective pretreatment controls, good construction practices, the commitment to restore the infiltration rates of soils that are damaged by prior uses or construction practices, including a contingency plan in BMP designs, and the commitment to

effective maintenance practices. However, these commitments do not mitigate the need to apply a factor of safety to account for uncertainty and long term deterioration that cannot be technically mitigated. Therefore, a design factor of safety of no less than 2.0 shall be applied to the observed infiltration rate to compute the design infiltration rate for sizing BMPs; a typical design factor of safety should typically be higher. The remainder of this section discusses factors affecting the selection of a design factor of safety.

D.3.1 Site Suitability Considerations

Suitability assessment related considerations include (**Table D-3**):

- Soil assessment methods – the site assessment extent (e.g., number of borings, test pits, etc.) and the measurement method used to estimate the infiltration rate (e.g. open pit falling head procedure with a pit much smaller than the proposed BMP).
- Predominant soil texture/percent fines – soil texture and the percent of fines can greatly influence the potential for clogging.
- Site soil variability – site with spatially heterogeneous soils (vertically or horizontally) as determined from site investigations are more difficult to estimate average properties for resulting in a higher level of uncertainty associated with initial estimates.
- Depth to seasonal high groundwater/impervious layer – groundwater mounding may become an issue during excessively wet conditions where shallow aquifers or shallow clay lenses are present.

Table D-6: Suitability Assessment Related Considerations for Infiltration Facility Safety Factors

Consideration	High Concern	Medium Concern	Low Concern
Assessment methods (see explanation below)	Use of borehole methods to estimate vertical infiltration rate (not recommended, but may be necessary) Less than 2 tests per BMP	At least 2 tests per BMP Use of borehole tests for dry wells or infiltration trenches Use of infiltrometer or small scale PIT methods for vertical infiltration BMPs	Extensive infiltration testing, such as PIT testing or infiltrometer testing at 3+ locations per BMP, or Commitment to construction phase testing and design adaptation if necessary
Texture Class	Silty and clayey soils with significant fines	Finder sandy soils, with some loam content	Clean, granular soils (sands)
Site soil variability	Highly variable soils indicated from site assessment or limited soil borings collected during site assessment	Soil borings/test pits indicate moderately homogeneous soils	Multiple soil borings/test pits indicate relatively homogeneous soils
Depth to groundwater/ impervious layer	Groundwater conditions or movement not well understood	Seasonal high GW at least 5-10 ft below facility bottom	Seasonal high GW at least 10 ft below facility bottom

D.3.2 Design Related Considerations

Design related considerations include (**Table D-4**):

- Size of area tributary to facility – all things being equal, risk factors related to infiltration facilities increase with an increase in the tributary area served (See Section D.2.6). Therefore, facilities serving larger tributary areas should use more restrictive adjustment factors.
- Level of pretreatment/expected influent sediment loads – credit should be given for good pretreatment by allowing less restrictive factors to account for the reduced probability of clogging from high sediment loading (See Section D.2.6). Also, facilities designed to capture runoff from relatively clean surfaces such as rooftops are likely to see low sediment loads and therefore should be allowed to apply less restrictive safety factors.

- Redundancy – facilities that consist of multiple subsystems operating in parallel such that parts of the system remains functional when other parts fail and/or bypass should be rewarded for the built-in redundancy with less restrictive correction and safety factors. For example, if a contingency plan is in place, such that a full infiltration BMP could be converted to a biofiltration BMP with partial infiltration, this could justify a lower factor of safety.
- Compaction during construction – proper construction oversight is needed during construction to ensure that the bottoms of infiltration facility are not overly compacted. Facilities that do not commit to proper construction practices and oversight should have to use more restrictive correction and safety factors.

Table D-7: Design Related Considerations for Infiltration Facility Safety Factors

Consideration	High Concern	Medium Concern	Low Concern
Tributary area size	Greater than 10 acres.	Greater than 2 acres but less than 10 acres.	2 acres or less.
Level of pretreatment/ expected influent sediment loads	Pretreatment from gross solids removal devices only, such as hydrodynamic separators, racks and screens AND tributary area includes landscaped areas, steep slopes, high traffic areas, or any other areas expected to produce high sediment, trash, or debris loads.	Good pretreatment with BMPs that mitigate coarse sediments such as vegetated swales AND influent sediment loads from the tributary area are expected to be relatively low (e.g., low traffic, mild slopes, disconnected impervious areas, etc.).	Excellent pretreatment with BMPs that mitigate fine sediments such as bioretention or media filtration or sedimentation OR Facility only treats runoff from relatively clean surfaces, such as rooftops.
Redundancy of treatment	No redundancy in BMP treatment train; no reasonable ability to adapt design if infiltration rates less than planned	There is a reasonable option for the BMP be converted to a biofiltration BMP with partial infiltration as a contingency plan, but this is not detailed in the WQMP. It would be a separate effort to fix this system if failure occurred.	A clear contingency plan is described in the WQMP, and adaptation to a biofiltration BMP with partial infiltration is relatively simple.
Compaction during construction	Construction of facility on a compacted site or elevated probability of unintended/ indirect compaction. (this scenario is strongly discouraged)	Low ground pressure equipment will be used for excavation and/or there is a medium probability of unintended/ indirect compaction.	Equipment is strictly prohibited from infiltration areas during construction and low probability of unintended/ indirect compaction.

D.3.3 Determining Design Factor of Safety

A design factor of safety shall be used. To assist in selecting the appropriate design infiltration rate, the measured short term infiltration rate should be adjusted using a weighted average of several safety factors using the worksheet shown in Worksheet 3 below. The design infiltration rate would be determined as follows:

1. For each consideration shown in **Table D-3** and **Table D-4** above, determine whether the consideration is a high, medium, or low concern.
2. For all high concerns, assign a factor value of 3, for medium concerns, assign a factor value of 2, and for low concerns assign a factor value of 1.
3. Multiply each of the factors by the corresponding weight to get a product.
4. Sum the products within each factor category to obtain a safety factor for each.
5. Multiply the two safety factors together to get the final combined safety factor. If the combined safety factor is less than 2, then 2 shall be used as the safety factor.
6. Divide the measured short term infiltration rate by the combined safety factor to obtain the adjusted design infiltration rate for use in sizing the infiltration facility.

The design infiltration rate shall be used to size BMPs and to evaluate their expected long term performance. This rate shall not be less than 2, but may be higher at the discretion of the design engineer.

Worksheet 3: Factor of Safety and Design Infiltration Rate and Worksheet

Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25		
		Predominant soil texture	0.25		
		Site soil variability	0.25		
		Depth to groundwater / impervious layer	0.25		
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			
B	Design	Tributary area size	0.25		
		Level of pretreatment/ expected sediment loads	0.25		
		Redundancy/contingency plan	0.25		
		Compaction during construction	0.25		
		Design Safety Factor, $S_B = \Sigma p$			
Combined Safety Factor, $S_{Total} = S_A \times S_B$					
Observed Infiltration Rate, inch/hr, K_{obs} (corrected for test-specific bias)					
Design Infiltration Rate, in/hr, $K_{design} = K_{obs} / S_{Total}$					
Supporting Data					
Briefly describe infiltration test and provide reference to test forms:					

Note: The minimum combined adjustment factor shall not be less than 2.0 and the maximum combined adjustment factor shall not exceed 9.0.

D.4 Additional Considerations for Infiltration Rates

D.4.1 Waiver of Infiltration Testing Requirements

In addition to the conditions described in Section D.1.1 where DMAs would not require infiltration testing (DMAs with obstacles to infiltration or DMAs in small projects with confirmed D-type soils), infiltration testing would also not be required for the following BMP types and site conditions:

- **Hydrologic source controls** (See HSC-1 through HSC-7 in Appendix G): Testing requirements are waived for most soil types, and most HSCs can be accommodated with all soil types. Soil amendments are required to use HSC-1 through HSC-3 where site soils are hydrologic soil group C or D. If soils cannot be amended and are type D soils, then some practices, such as Localized On-Lot Infiltration (HSC-1) or Self-Retaining Areas (HSC-7) should not be used unless infiltration testing is conducted to verify performance.
- **Porous pavement designed to be self-retaining** (See INF-5 in Appendix G): Testing requirements for this BMP are waived for A, B, and C soil types if soil type and general drainage conditions are confirmed with site-specific information. This waiver does not apply to porous pavement that accepts run-on from a tributary area larger than 50 percent of its area.

D.4.2 Maximum Infiltration Rates

In some cases, an infiltration test may show that an area has very high infiltration rates, such as 20 to 100 inches/hour or more in very coarse, sandy soils. While these may be excellent areas for infiltration, if stormwater moves too rapidly through the subsurface, it may not have time to be treated by the soil prior to reaching groundwater and could contaminate groundwater aquifers. In order to account for this, the project should utilize pretreatment and amended media which is selected based on the POCs where very high infiltration rates may threaten local groundwater supplies. This will help to ensure that the runoff is treated prior to contact with groundwater aquifers. Note that it is contact time with the soil that is required for treatment of the water, so using an orifice or other control to meter flows onto the rapidly draining soil is not an appropriate way to slow the infiltration rate. Groundwater contamination is of elevated concern if:

- Observed infiltration rates are greater than 20 inches per hour, or
- Organic content is less than 1 percent

Acceptable options include:

- Provide enhanced pretreatment with a biofiltration or treatment control BMP, and/or

- Amend at least 1 foot of the underlying soil with a certified compost meeting the criteria in the MISC-1 or MISC-2 fact sheets.

The sizing methods for Full Infiltration BMPs are based largely on drawdown time, so with very high infiltration rates, very short drawdown times may be used, leading to very small footprints for Full Infiltration BMPs. While the calculation may show that a very small footprint may infiltrate a large volume due to the high infiltration rate, there is still a potential for the media to clog, especially with a small footprint relative to the tributary area. Therefore, as part of the sizing methods, a check on the footprint size relative to the clogging risk is required (See Appendix E.3). In general, the design infiltration rate should be limited to no more than 5 inches per hour.

D.5 References

ASTM D 3385-94, 2003. "Standard Test Method for Infiltration Rate of Soils Field Using Double-Ring Infiltrometer." American Society for Testing Materials, Conshohocken, PA. 10 Jun, 2003.

Caltrans, 2003. "Infiltration Basin Site Selection". Study Volume I. California Department of Transportation. Report No. CTSW-RT-03-025.

City of Portland, 2010. *Appendix F.2: Infiltration Testing.* Portland Stormwater Management Manual, Revised 2014

County of Los Angeles, 2014, Guidelines for Design, Investigation, and Reporting Low Impact Development Stormwater Infiltration. GS200-1.

County of Riverside, 2011, Low Impact Development BMP Design Handbook, Appendix A: Infiltration Testing.

United States Department of the Interior, Bureau of Reclamation (USBR), 1990, "Procedure for Performing Field Permeability Testing by the Well Permeameter Method (USBR 7300-89)," in Earth Manual, Part 2, A Water Resources Technical Publication, 3rd ed., Bureau of Reclamation, Denver, Colo.

APPENDIX E. HYDROLOGIC CALCULATIONS AND SIZING METHODS FOR LID AND TREATMENT CONTROL BMPS

E.1 Introduction

The purpose of this appendix is to provide detailed methodologies for sizing BMPs to meet LID and/or treatment control criteria. Each methodology is made up of a series of calculations. This appendix is divided into:

- Section E.2: Calculations in support of sizing methods. Calculations are not standalone sizing methods, and they may be common to multiple sizing methods.
- Section E.3: Sizing methodologies made up of several calculations. Methodologies are specific to BMP types.
- Section E.4: Other sizing resources and guidelines.

The project proponent should refer to this appendix according to the general framework for development of a Project WQMP (Section 2). While this appendix discusses feasibility, it is not the basis for BMP selection. This appendix assumes that the initial site and watershed assessments (Section 2.3), the site design and drainage plan incorporating site design and source control BMPs (Section 2.4), determination of the infiltration feasibility category for each DMA (Section 2.5.1), and selection of the appropriate LID BMP type (2.5.2) have all been previously completed, including Worksheets 1, 2, and 3 (Groundwater infeasibility, infiltration feasibility categorization, and design infiltration rate).

Based on the BMP type proposed, the project proponent should use the summary table in Section E.3 to determine the applicable sizing method.

E.2 Calculations

This section contains individual calculations that are used as part of the BMP sizing methodologies in Section E.3. **The calculations in this sections are all only components of the sizing methodologies and are not intended to be used as standalone methods to size BMPs.** Table E-1 contains a summary of all calculations included in this section along with the subsection they are discussed in.

Table E-1: Calculations used in BMP Sizing Methodologies

Calculation	Typical Uses in the Methodologies in Section E.3	Subsection
Calculating the Effective Storage Depth and Capture Efficiency of HSCs	Used to adjust the design storm size or percent capture when sizing structural BMPs	E.2.1
Converting Between Storm Depth (d) and Runoff Volume (V)	Used in several volume-based BMP sizing methods.	E.2.2
Calculating Time of Concentration	Used in sizing flow-based BMPs	E.2.3
Converting Between Storm Intensity (i) and Flow Rate (Q)	Used in several flow-based BMP sizing methods	E.2.4
Calculating drawdown time of infiltration BMPs	Used in sizing methods for volume-based infiltration BMPs	E.2.5
Calculating provided storage volume in BMPs	Used as part of determining that BMP designs provide the required volume	E.2.6

E.2.1 Calculating the Effective Retention Depth and/or Capture Efficiency of HSCs

The effect of HSCs is accounted for in hydrologic calculations for sizing downstream structural BMPs as either an adjustment to the design storm depth or as a percentage of the long-term capture rate. The adjustment used is specific to the BMP sizing methodology. Adjustments are dependent on the type and magnitude of HSCs employed for the DMA. The process for accounting for HSCs includes:

1. Calculating the effective storm retention depth for each HSC in a DMA and the area to which each applies
2. Calculating the area-weighted effective storm retention depth over a whole DMA using all of the HSCs (including the area not affected by any HSCs) and applying this to the design storm depth
3. If the method used for sizing a structural BMP uses a long-term capture efficiency instead of a design storm depth, then the effective depth of the HSCs must be converted to an equivalent long term capture efficiency to calculate the effect on the size of the downstream structural BMP.

Different HSCs affect the capture depth in different ways. See the HSC Fact Sheets in Appendix G for guidance on calculating the effective capture depth of each HSC type. HSC-7: self-retaining areas do not apply to impervious area, so they are not used to adjust the design storm

depth. They are instead used to subtract pervious areas from the total area of a DMA which decreases the total area, raises the imperviousness, and typically decreases runoff volumes and minimum required footprints.

This section provides the steps for calculating the overall effect of HSCs over a whole DMA (E.2.1.1) based on HSC-specific effective depths and effective areas (See Appendix G.1), and a method for calculating the equivalent long term average capture efficiency achieved by the HSCs (E.2.1.2).

E.2.1.1 Calculating the area-weighted effective storm retention depth for a DMA and applying to the design storm depth

A DMA may have multiple HSCs implemented within it, all applied to different areas. There are also likely to be portions of the impervious area within a DMA to which no HSCs are available to be applied. In order to determine the overall effect of any number of HSCs applied over any number of portions of a DMA, it is necessary to compute an area-weighted average of the individual effects of the HSCs on a DMA. This is done using the equation below:

$$d_{HSC\ total} = (\sum(d_{HSCi} \times IA_i)) / IA_{total} \qquad \text{Equation E.1}$$

Where:

$d_{HSC\ total}$ = combined effective storm retention depth of HSCs in DMA (inches)
d_{HSCi} = effect of individual HSC_i per criteria in the relevant fact sheet (Appendix G.1) (inches)
IA_i = impervious area tributary to individual HSC_i as explained in the relevant fact sheet (Appendix G.1); areas cannot be counted twice if more than one HSC captures runoff from the same impervious area (e.g., street trees covering a roof top that is disconnected).
IA_{total} = total impervious area in drainage area

Worksheet 4 is provided below to aid in this calculation. An example calculation using Worksheet 4 is also provided below in Example E.1. The combined effective storm retention depth for the HSCs in the DMA ($d_{HSC\ total}$) is used to adjust the design storm depth for a DMA. So, for example, if the design storm depth for the site is 1.05 inches, and the combined effective storm retention depth for the HSCs provided on a DMA is 0.14 inches, then the adjusted design storm depth used to size the structural BMPs would be (1.05-0.14=0.91 inches). This leads to reduced required volumes in the structural LID BMPs for the DMA.

Worksheet 4: Hydrologic Source Control Calculation Form

Drainage area ID _____

Total drainage area _____ acres

Total drainage area Impervious Area (IA_{total}) _____ acres

HSC ID	HSC Type/ Description/ Reference BMP Fact Sheet	Effect of individual HSC_i per criteria in **relevant fact sheet (Appendix G.1)** (d_{HSCi})[1]	Impervious Area Tributary to HSC_i (IA_i)	$d_i \times IA_i$
	Box 1:		$\sum d_i \times IA_i =$	
	Box 2:		$IA_{total} =$	
	[Box 1]/[Box 2]:		$d_{HSC\ total} =$	
			Percent Capture Provided by HSCs (Table E.2)	

1 – None of the values in this column may be larger than the design storm depth for the project

Example E.1: Hydrologic Source Control Calculation Form (Worksheet 4)

Drainage area ID	A		
Total drainage area	2.1 acres		
Total drainage area Impervious Area (IA_{total})	1.3 acres		
HSC Type/ Description/ Reference Section	Effect of individual HSC_i per criteria in **Section E.2.1.1)** (d_{HSCi})	Impervious Area Tributary to HSC_i (IA_i)	$d_i \times IA_i$
Downspout Dispersion, 1:2 ratio (0.5) of rooftop to pervious area for 0.38 acres	0.25"	0.38	0.095
Street Trees, perennial canopy over 0.25 acres of impervious area	0.05"	0.25	0.0125
Downspout Infiltration, 10-15 cu-ft storage per 1000 sf of roof for 0.21 acres	0.15"	0.21	0.032
Residential Rain Barrels, four 55 gallon barrels per 1000 sf of roof (4*55*50%=110 gal/1000 sf) for 0.2 acres	0.18"	0.2	0.036
Box 1:		$\sum d_i \times IA_i =$	0.175
Box 2:		$IA_{total} =$	1.3
[Box 1]/[Box 2]:		$d_{HSC\ total} =$	0.135
		Percent Capture Provided by HSCs (Table E.2)	26%

E.2.1.2 Calculation of the Long-Term Average Capture Efficiency for HSCs

For sizing methodologies based on a long-term capture efficiency of 80%, it is necessary to convert the effective storm retention depth of HSCs calculated in Section E.2.1.1 to a long-term capture efficiency. Table E-2 provides the conversions from the combined effective storm retention depth (d_{HSC}) to a long-term capture efficiency in both lowland and mountainous areas of Orange County.

Table E-2: Fraction of Average Long Term Runoff Reduced (Capture Efficiency) by HSCs

Combined HSC Adjustment to Design Capture Storm Depth (d_{hsc})	Capture Efficiency Achieved Lowland Regions (<1,000 ft)	Capture Efficiency Achieved Mountainous Regions (>1,000 ft)
<0.05	0	0%
0.05”	8%	7%
0.1”	20%	16%
0.2”	37%	31%
0.3”	48%	42%
0.4”	57%	50%
0.5”	64%	57%
0.6”	70%	63%
0.7”	75%	68%
0.8”	80%	72%
0.9”	80%	76%
1.0”	80%	80%

E.2.2 Converting Between Capture Depth and Capture Volume

Volume-based BMP sizes are often represented in one of two ways:

- **Design storm depth**: the depth of precipitation falling on the area contributing to a BMP that the BMP is designed to capture without overflowing
- **Design Capture Volume (DCV):** the volume of runoff that the BMP can retain without overflowing

In several of the BMP sizing methodologies in Section E.3, it is necessary to convert one of these quantities to the other. The volume of runoff produced from a storm event of a given depth is primarily a function of the total tributary area receiving precipitation, and the imperviousness of that area. The equation to convert the storm depth into the runoff volume is:

$$V = C \times d \times A \times 43560\ sf/ac \times 1/12\ in/ft \qquad \text{Equation E.2}$$

Where:

V = runoff volume during the design storm event, cu-ft

C = runoff coefficient = $(0.75 \times imp + 0.15)$

imp = impervious fraction of drainage area (ranges from 0 to 1)

d = storm depth (inches)

A = tributary area (acres)

Note that this example is a calculation to be used as referenced from the methods in Section E.3 and is not a stand-alone method for sizing LID BMPs.

The tributary area includes all of the area that drains to the BMP (including any run-on from off-site areas), except for any pervious areas that are self-retaining (See BMP Fact sheet for HSC-7: Self-Retaining Areas). Self-retaining areas do not receive runoff from impervious areas, so they are not accounted for in HSC adjustments to the design storm depth. However, they are pervious areas that are graded and/or amended so that they do not produce any runoff during the design storm event. They are accounted for by removing the self-retaining pervious area from the total contributing area of the DMA.

An example of this calculation is provided in **Example E.2**. **Note that this example is a calculation to be used as referenced from the methods in Section E.3 and is not a stand-alone method for sizing LID BMPs.**

Example E.2: Convert storm depth into a runoff volume accounting for self-retaining areas

Given:

- A DMA consists of a 1 acre building roof with 2 acres or pervious landscaping and 0.5 acres of connected impervious road/driveway area. 0.75 acre of the landscaping has received soil amendments so that it is fully self-retaining and receives no run-on from impervious areas. The whole drainage area is to drain to a single BMP.
- The storm depth from Figure N-1 is 0.85 inches.

Required:

- Calculate the runoff volume resulting from the storm depth

Result:

1) Calculate the total area contributing to the BMP: A = 1 acre impervious rooftop + 2 acres pervious landscaping +0.5 acre impervious area - 0.75 acres self-retaining area = 2.75 acres
2) Calculate the imperviousness = impervious area/total area: IA= (1 acre rooftop + 0.5 acre impervious area) / 2.75 total acres = 0.545
3) Calculate the runoff coefficient (c): C = (0.75 * 0.545 +0.15) = 0.559
4) From Equation E.2: $V = C \times d \times A \times 43560$ sf/ac $\times$ 1/12 in/ft
5) d = 0.85 inches
6) V = 0.559 × 0.85 in × 2.75 ac × 43560 sf/ac × 1/12 in/ft = **4,740 cu-ft**

In some BMP sizing methodologies, it may be necessary to "back-calculate" the storm depth based on the runoff volume and a description of the DMA. The design storm depth can be calculated by rearranging Equation E.4 above:

$$d = V \times 12\ in/ft/[C \times A \times 43560\ sf/ac] \qquad \text{Equation E.3}$$

Example E.3 illustrates how a given volume of stormwater would be translated to an equivalent storm depth.

Example E.3: Back-computing storm depth from runoff volume

Given:
• A DMA consists of a 1 acre building roof surrounded by 0.25 acres of landscaping (80 percent composite imperviousness)
• An LID BMP with 1,200 cu-ft of storage is provided
Required:
• What is the equivalent storm depth corresponding to this BMP volume?
Result:
1) From Equation E.3: d = V × 12 in/ft/[C × A × 43560 sf/ac]
2) V = 1,200 cu-ft (given)
3) C = (0.75×0.8 + 0.15) = 0.75
4) A = 1.25 ac
5) d = 1,200 cu-ft × 12 in/ft / [0.75 × 1.25 ac × 43560 sf/ac] = **0.35 inches**

E.2.3 Calculating the Time of Concentration

The time of concentration is used in flow-based LID BMP sizing methodologies. The time of concentration for sizing flow-based LID BMPs is calculated individually for each DMA.

The time of concentration is the time required for the entire DMA to begin contributing runoff to the BMP. It is, therefore, the travel time of the longest flow path on the DMA to the BMP. Whether computed by hand or by a modeling tool, the time of concentration should be calculated using one of the following methods:

- Method from Section D of the Orange County Hydrology Manual
- Method from Chapter 3 of the TR-55 Manual.

These methods are summarized below. In most cases, a modeling tool will be used to calculate the time of concentration. The WinTR-55 model provides an acceptable model-calculated method of calculated Tc through its Time of Concentration Details window.

The time of concentration for use in other models, such as WMS-Orange County and HEC-HMS, should be supported by hand calculations of the time of concentration per the criteria below.

The inputs provided to the models to compute Tc should be per guidance contained in the Orange County Hydrology Manual or the TR-55 Manual and should be submitted with the Project WQMP documentation.

E.2.3.1 Orange County Hydrology Manual Methods

The Orange County Hydrology Manual method entails computing the initial time of concentration of a subarea of a limited length, based on a nomograph, and summing it with the travel time(s) to the outlet of the DMA through downstream conveyances.

The time of concentration is a function of the length of the flow, the slope, the surface roughness, and the geometry of the flow path. An adaptation of the Orange County Hydrology Manual method for computing the time of concentration is outlined in the steps below:

1. Using CAD, GIS, a grading plan, or similar design drawings of the proposed development, locate the point in the DMA that is farthest from the outlet and calculate the length of overland flow that would occur until it entered some kind of stormwater

collection system (curb and gutter, swale, storm drain, channel, etc.). The maximum length of this path is 330 feet[5].

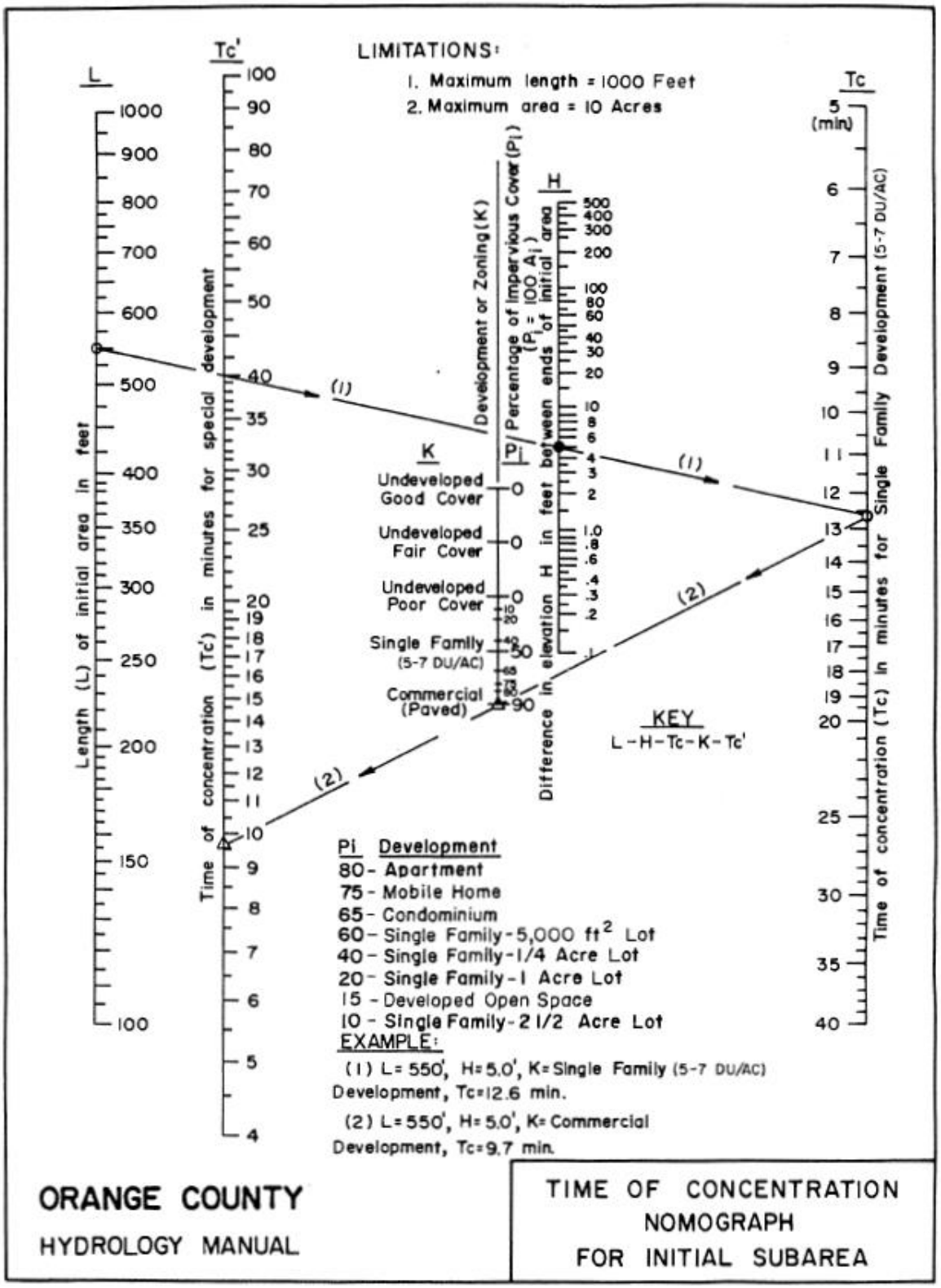
   a. Several potential points in the DMA may need to be tested to obtain the longest time of concentration due to the combination of length of flow, slope, roughness, and subsequent travel time. Typically, the farthest location from the outlet of the DMA (the proposed BMP) will be a reasonable estimate for the longest travel time.

2. Determine the change in elevation between the beginning and end of the overland flow path.
3. Record the dominant land use type for the subarea contributing flow to the overland flow path
4. Use the nomograph in Figure E-1 to compute the initial time of concentration.
5. Use the design drawings of the stormwater conveyance system, or each portion of the conveyance system for long flow paths, to determine the length, slope, cross section geometry, and Manning's roughness factor for each portion of the collection system between the overland flow portion and the outlet of the DMA (into the proposed BMP)
6. Use the information from Step 5 to estimate the velocity in each portion of the stormwater conveyance(s), or use Manning's formula to compute the velocity using an estimate of the hydraulic radius
7. Divide the length of each portion of the conveyance by the velocity to obtain the travel time
8. Sum the initial time of concentration obtained from Step (4) with the travel time(s) obtained in Step (8) to compute the time of concentration for the DMA.

In most situations, the initial time of concentration of the overland flow is much larger than the time of travel in the conveyance system to the BMP and is the most sensitive factor. BMPs can typically be sized based on the overland flow time of travel only.

[5] While Figure E-1 states that 1000 feet is allowable, a 1996 addendum to the hydrology manual limits this length to 330 feet.

Figure E-1: Nomograph for computing initial time of concentration (Orange County Hydrology Manual, 1986)



E.2.3.2 TR-55 Manual Methods

The TR-55 method for computing the time of concentration involves computing travel times for sheet flow, shallow concentrated flow, and channel flow for a given flow path and summing them to obtain the time of concentration. Sheet flow is flow over plane surfaces, typically occurring at the most remote parts of the DMA. The length of sheet flow is typically less than 100 feet. Shallow concentrated flow is more concentrated than sheet flow, but not as concentrated as channelized flow. Channelized flow is flow in conveyance systems such as curb and gutter, storm drain networks, etc.

A method for computing the time of concentration for a DMA adapted from the TR-55 Manual is included below. This method is most simple to implement within the WinTR-55 software. Hand calculation steps are also provided below.

1. Using CAD, GIS, a grading plan, or similar design drawings of the proposed development, locate the point in the DMA that is farthest from the outlet and calculate the length of overland flow that would occur until it entered some kind of stormwater collection system (curb and gutter, swale, storm drain, channel, etc.).
    a. Several potential points in the DMA may need to be tested to obtain the longest time of concentration due to the combination of length of flow, slope, roughness, and subsequent travel time. Typically, the farthest location from the outlet of the DMA (the proposed BMP) will be a reasonable estimate for the longest travel time.
2. If the length computed in Step (1) is greater than 100 feet, the first 100 feet can be considered sheet flow and the remaining length can be considered shallow concentrated flow.
3. Using the grading plan, drainage plans, or similar, compute the slope of the sheet flow and shallow concentrated flow portions of the flow path.
4. Determine the 2-year, 24-hour storm event depth in inches. This is 2.05 inches for locations below an elevation of 2000 feet and 3.81 inches for locations above an elevation of 2000 feet.
5. Use Table 3-1 of the TR-55 manual (included as Figure E-2 below) to estimate the Manning's roughness coefficient for the sheet flow portion of the flow path.
6. Calculate (or allow the TR-55 model to calculate) the travel time for the sheet flow portion of the flow path using the equation below:

$$T_t = \frac{0.007(nL)^{0.8}}{P^{0.5}S^{0.4}}$$ Equation **E.4**

Where:

T_t = travel time of the sheet flow portion of the flow path (hours)

n = Manning's roughness coefficient

L = flow length of the sheet flow portion of the flow path (ft)

P = 2-year, 24-hour rainfall (inches)

s = slope of hydraulic grade line (land slope ft/ft)

7. Calculate (or allow the TR-55 model to calculate) the travel time of the shallow concentrated flow portion of the flow path by dividing the length of the shallow concentrated flow path by the average velocity obtained from Figure E-3 below.
8. Use the design drawings of the collection system, or each portion of the collection system for long flow paths, to determine the length, slope, cross section geometry, and Manning's roughness factor for each portion of the collection system between the overland flow portion and the outlet of the DMA (into the proposed BMP). Note that the Manning's roughness coefficient for the conveyance system should not be estimated using Figure E-2 because those are tailored for sheet flow, only.
9. Use the information from Step 8 to estimate the velocity in each portion of the stormwater conveyance(s), or use Manning's formula to compute the velocity using an estimate of the hydraulic radius
10. Divide the length of each portion of the conveyance by the velocity to obtain the travel time for the conveyance
11. Sum the travel time for the sheet flow, shallow concentrated flow, and channelized flow for each portion of the flow path to obtain the time of concentration for the DMA

In most situations, the sheet flow and shallow concentrated flow dominates the time of concentration and is the most sensitive factor. BMPs can typically be sized based on the overland flow time of travel only.

Figure E-2: Roughness coefficients (Manning's n) for sheet flow (TR-55 Manual)

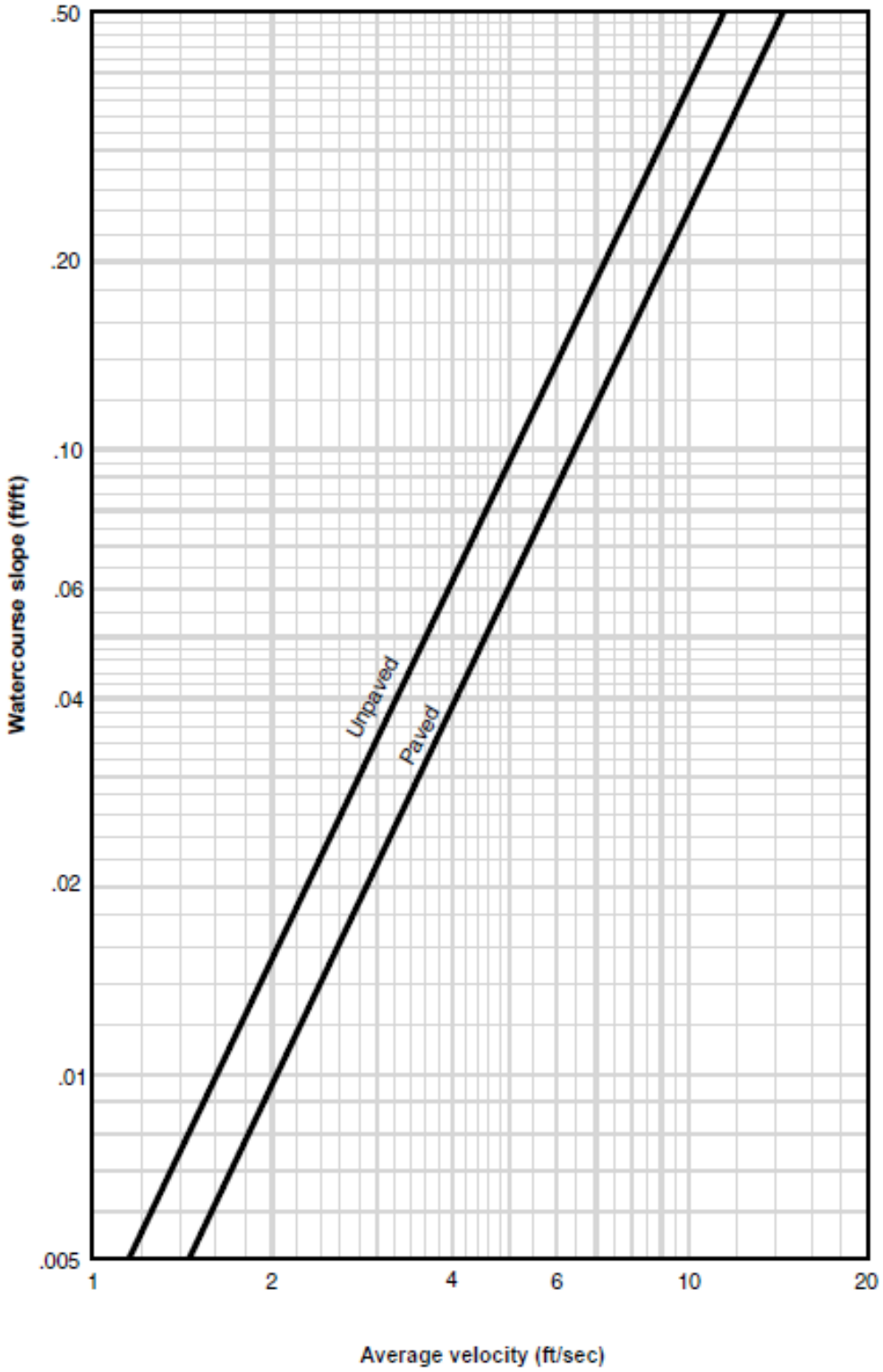
Surface description	n [1/]
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses [2/]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods:[3/]	
Light underbrush	0.40
Dense underbrush	0.80

1 The n values are a composite of information compiled by Engman (1986).

2 Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.

3 When selecting n , consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

Figure E-3: Average Velocities for Estimating Travel Time for Shallow Concentrated Flow (TR-55 Manual)



E.2.4 Converting Between Storm Intensity and Runoff Flow Rate

Flow-based BMP sizes can be represented in one of two ways:

- **Design storm intensity**: the rainfall rate (inches/hour) falling on the area contributing to a BMP that the BMP is designed to capture without overflowing
- **Design Flow Rate:** the flow rate (cubic feet per second) of runoff that the BMP can capture without overflowing

In the flow-based BMP sizing methodologies in Section E.3, it is necessary to convert one of these quantities to the other. Under uniform rainfall intensity, the flow rate of runoff produced from a given rainfall intensity is primarily a function of the total tributary area receiving precipitation, and the imperviousness of that area. The equation to convert the rainfall intensity to the runoff flow rate is:

$$Q = c \times i \times A \qquad \text{Equation E.5}$$

Where:

Q = runoff flowrate, cfs
c = runoff coefficient = $(0.75 \times imp + 0.15)$
imp = impervious fraction of drainage area (ranges from 0 to 1)
i = rainfall intensity (inches/hour)
A = tributary area (acres)

This is a calculation method. It is not a standalone sizing method. Flow-based BMP sizing methods must be used to determine the appropriate intensity (*i*) to use in this calculation to meet sizing criteria.

Note that, as long as the units used in the definitions above are used, no unit conversion is necessary. This is because the conversion from square feet to acres (43,560 sq ft/acre) is approximately equal to the conversion to inches to feet and seconds to hours (43,200 in*seconds/ft*hour).

The tributary area includes all of the area that drains to the BMP (including any run-on from off-site areas), except for any pervious areas that are self-retaining (See BMP Fact sheet for HSC-7: Self-Retaining Areas). Self-retaining areas are accounted for by removing the area from the contributing area.

An example of this calculation is provided in Example E.4.

Example E.4: Convert storm intensity into a runoff flow rate accounting for self-retaining areas

Given:

- A DMA consists of a 1 acre building roof with 2 acres or pervious landscaping and 0.5 acres of connected impervious road/driveway area. 0.75 acre of the landscaping has received soil amendments so that it is fully self-retaining and receives no run-on from impervious areas. The whole drainage area is to drain to a single BMP.
- The rainfall intensity is 0.23 inches/hour. (this is a hypothetical example; it would be determined via one of the sizing methods)

Required:

- Calculate the runoff flow rate resulting from the storm intensity

Result:

1) Calculate the total area contributing to the BMP: A = 1 acre impervious rooftop + 2 acres pervious landscaping +0.5 acre impervious area - 0.75 acres self-retaining area = 2.75 acres
2) Calculate the imperviousness = impervious area/total area: IA= (1 acre rooftop + 0.5 acre impervious area) / 2.75 total acres = 0.545
3) Calculate the runoff coefficient (c): C = (0.75 * 0.545 +0.15) = 0.559
4) From Equation E.5: Q = C × i × A
5) i = 0.23 inches/hour
6) Q = 0.559 × 0.23 × 2.75 ac= **0.35 cfs**

In some instances, it may be necessary to "back-calculate" the storm intensity from a runoff volume and a description of the DMA. This could be the case where a BMP exists with a known treatment flow rate, but it is not known what fraction of the design intensity it fulfills. The rainfall intensity of a given flow rate can be calculated by rearranging Equation E.5 above:

$$i = Q / (c \times A)$$ Equation **E.6**

E.2.5 Calculating Drawdown Time of Infiltration BMPs

Drawdown time is the time it takes to drain a BMP from brim full after inflow to the BMP has stopped. The drawdown time of infiltration BMPs or storage compartments within BMPs is a common calculation needed to support BMP sizing methods. There are two primary ways of calculating drawdown time:

Method 1: Simple Vertical Infiltration. For simple BMPs that have primarily vertical infiltration (i.e., the plan view footprint is much larger than side walls), the drawdown time can be estimated as the effective depth of the BMP divided by the design infiltration rate. The effective depth is the storage depth expressed as the effective water depth. The depth of porous layers is converted to an effective depth by multiplying by the freely drained porosity. Freely drained porosity of 0.2 for amended media and 0.4 for washed drain rock gravel are reasonable assumption.

$$Drawdown\ time = D_{effective}/K_{design} \qquad \text{Equation E.7}$$

Where,

$$D_{effective} = D_{ponding} + D_{media} * 0.2 + D_{gravel} * 0.4 \qquad \text{Equation E.8}$$

Where $D_{ponding}$, D_{media}, and D_{gravel} refer to the total depth of these layers before converting for porosity. Alternative porosity values can be used, with supporting documentation.

Method 2: Vertical plus Sidewall Infiltration. This method accounts for the specific geometry of the BMP including the sidewall area and plan view area. The average infiltration discharge rate (as cu-ft/hr) is calculated based on the wetted infiltration area when the BMP is half full multiplied by the design infiltration rate. The full BMP volume is then divided by the infiltration discharge rate to determine the drawdown time.

$$Drawdown\ time\ (hours) = V_{design}/Q_{infiltration} \qquad \text{Equation E.9}$$

Where,

V_{design} is the total water quality design volume of the BMP (cu-ft)

$Q_{infiltration}$ (cu-ft/hr)= K_{design} (in/hr) * wetted surface area when BMP is half full (sq-ft) * 1 ft/12 inches

E.2.6 Calculating Provided Volume in BMPs

Determining the volume provided in a BMP is a typical calculation needed as part of showing that BMPs are in compliance. There are two primary methods that are acceptable:

Method 1: Effective area/effective depth method. This method involves determining the effective depth of water stored in the BMP (see calculations in Section E.2.5) and multiplying it by the effective area. For systems with vertical walls, the effective area is simply the plan view area. For systems with side slopes, the effective area can be approximated as the plan view area inundated when the ponded depth is half full. This is the area of the contour at an elevation half way between the surface of the BMP and the overflow elevation. This method is generally acceptable for most BMPs.

Method 2: Area takeoff/trapezoidal method. For more complex BMP geometries, it may be necessary to perform area takeoffs at regular contour intervals within the BMP and apply trapezoidal geometry calculations. The effectively breaks the BMP into horizontal slices. Each horizontal "slice" would have a vertical thickness, an average surface area, and an effective porosity. The product of these values is the storage volume in the slice. The sum of all slices is the total storage volume.

In both methods, volume should only be tabulated below the overflow or bypass elevation of the BMP. Surcharge or freeboard storage should not be included in calculations

E.3 BMP Sizing Methodologies

This section contains the methodologies to be used to size structural LID BMPs and treatment control BMPs. The project proponent should determine the applicable infiltration feasibility category and BMP type based on guidance in Chapter 2 and 4, then use Table E-3 below to select an appropriate sizing methodology. Alternative methods, including continuous simulation, may also be acceptable as long as the LID criteria are shown to be met.

Table E-3: BMP Sizing Methodologies

Infiltration Feasibility Category	BMP Application	Included BMPs	BMP Sizing Method Option Descriptions
Full Infiltration	Infiltration BMPs	• Infiltration Basin • Infiltration Trench • Bioretention with no Underdrain • Drywell (See Appendix I) • Permeable Pavement • Underground Infiltration	Simple DCV Method: Section E.3.1 **OR** Capture Efficiency via Nomograph Method: Section E.3.2
Biotreatment with Partial Infiltration / No Infiltration[6]	Volume-based Biofiltration BMPs	• Bioretention with Raised Underdrain	Biofiltration Routing Method: Section E.3.3, **OR** Biofiltration Static Volume Method: Section E.3.4
	Compact Biofiltration BMP	• Proprietary Biofiltration with Supplemental Retention	Flow Based Biofiltration + Volume Reduction (if applicable): Section E.3.5
Any	Harvest and Use BMPs	• Above-Ground Cisterns • Underground Detention	Capture Efficiency via Nomograph Method: Section E.3.6
Any	Flow-based Treatment Control BMPs	• Media Filters • Cartridge Media Filters • Vegetated Swales • Vegetated Filter Strips	Flow-based Capture Efficiency via Nomograph Method: Section E.3.7
	Volume-based Treatment Control BMPs	• Dry Detention Basins • Wet Detention Basins	Simple DCV Method: Section E.3.1

[6] The methods in this category can be applied to Biotreatment with Partial Infiltration condition or the Biotreatment with No Infiltration condition. The latter is supported in these methods by ignoring the infiltration and volume reduction components described in each method.

E.3.1 Simple DCV Method for Sizing of Infiltration BMPs and Volume-based Treatment Control BMPs

This method is used to determine the required volume of infiltration BMPs when a DMA is in the Full Infiltration Category. It can also be used to size volume-based treatment control BMPs. This is the simplest method, and may result in a BMP that achieves greater than 80 percent capture of long term runoff, and may, therefore, be somewhat oversized to meet minimum performance criteria. This would result where the DCV can draw down in less than 48 hours. If the size of the BMP that results from this method is impracticable because it is oversized, the capture efficiency via nomograph method for sizing infiltration BMPs is recommended (Section E.3.2).

E.3.1.1 Simple DCV Method Stepwise Instructions for Sizing Infiltration BMPs

The method includes the following calculations:

1. Determine the 85th percentile, 24-hour design storm event depth by locating the site on Figure N-1.
2. Reduce the design storm depth based on upstream HSCs in the DMA (See Section E.2.1). Also include the volume retained by any other upstream LID BMPs (e.g., a cistern). The volume that is drawn down within 48 hours after the end of rainfall can be counted as retained for these BMPs. The retained volume can be converted to a storm depth using the method in Section E.2.2. This storm depth can be subtracted from the design storm depth (in addition to the volume retained by HSCs).
3. Convert the remaining design storm depth to a runoff volume to compute the DCV for the BMP of interest (See Section E.2.2)
4. Design the BMP vertical profile (i.e., ponding, media, and gravel elements) and determine the effective depth of storage in the BMP. The effective depth of storage is the ponding depth plus the depth stored in gravel and soil pores. Typical void ratios are 0.4 for gravel and 0.2 for soil media.
5. Determine the BMP area needed to provide storage for the design volume. If the BMP has sloped sides, this needs to be accounted for in calculations. For simplicity, the BMP area can be measured at the mid-ponding depth of the BMP. This can then be multiplied by the effective storage depth in the vertical profile to estimate the volume. For more complex geometries, the storage volume should be determined using area and volume take-offs from the proposed topography.
6. Ensure the BMP will fully draw down within 48 hours.
    a. For systems that rely primarily on vertical infiltration, divide the effective storage depth (inches) by the infiltration rate (K_{design}) of the underlying soil (inches per hour) to calculate the drawdown time (hours).
    b. Where systems have both lateral and vertical infiltration (such as infiltration trenches), first calculate the total infiltration discharge rate (cu-ft per hour) based

on the wetted infiltration surface area when the system is half full. This can be calculated as the wetted infiltration surface area when the system is half full multiplied by the design infiltration rate, with appropriate unit conversions. Calculate the drawdown time by dividing the total storage volume (cu-ft) by the total estimated infiltration discharge rate when the system is half full (cu-ft/hr).

c. If drawdown time exceeds 48 hours, then reduce the effective depth of the BMP and expand the footprint to compensate until the drawdown time is less than 48 hours.

7. Check that the infiltrating surface area of the BMP meets the minimum surface area guidelines to avoid premature clogging (See Section E.4.1). If it does not, increase the infiltrating surface area or provide more robust pretreatment to support a smaller infiltrating surface area.

E.3.1.2 Example Using the Simple DCV Method for Sizing Infiltration BMPs

Example E.5: **Using the Simple DCV Method to Size a Full Infiltration BMP**

Given:

- Redevelopment project, 85th percentile, 24-hr storm depth = 0.85 inches (From Figure N-1)
- Drainage Area = 1.5 acres
- Imperviousness = 80%
- Effective retention depth of HSCs (d_{HSC}) = 0.2 inches (from Worksheet 4)
- No upstream cisterns or other retention BMPs
- Design infiltration rate of underlying soil = 0.5 in/hr (from Worksheet 3)
- ***Required:***
- Determine LID DCV by the Simple Method and check that this volume can be drawn down in less than or equal to 48 hours

Solution:

1. Design capture storm depth = 0.85 inches from Figure N-1.
2. Design capture storm depth, less HSCs = 0.85 inches – 0.2 inches = 0.65 inches
3. DCV = 1.5 ac × (0.75*0.8 + 0.15) × (0.65 inches) * 43,560 sf/ac × 1/12 in/ft = 2,650 cu-ft
4. Design a bioretention BMP profile based on fact sheet in Appendix G.1, select 12 inches of ponding and 24 inches of media, therefore the effective storage depth is 12 inches + 24 inches * 0.2 in/in = 16.8 inches = 1.4 ft.
5. Design the BMP with a footprint adequate to store the runoff volume: 2,650 cu-ft/1.4 ft = 1,890 sq-ft. This is the needed effective area. This should be measured at the mid-ponding depth of the BMP.

6. Calculate the drawdown time: For a simple BMP such as this, the drawdown can be calculated as the effective storage depth divided by the design infiltration rate: 16.8 inches/0.5 in/hr = 34 hours. This is less than 48 hours and is acceptable.

7) Check for potential clogging risk. For an urban mixed land use without open space, and a bioretention area without pretreatment, the target infiltrating surface area to avoid premature clogging is 2.8 percent of the total impervious area of the DMA (See table in Section E.4.1). As designed, the infiltrating surface area of the system at half ponding depth is 1,890 sq-ft / (1.5 ac * 80% imp * 43560 ft/ft) = 3.6% of the impervious tributary area. This exceeds the 2.8 percent target and is acceptable. No further calculations are needed.

E.3.1.3 Worksheet for Using the Simple Method to Size Full Infiltration BMPs

Worksheet 5: Simple Design Capture Volume Sizing Method for Full Infiltration BMPs

Part 1: Calculate the DCV				
1	Enter design capture storm depth from **Figure N-1**, *d* (inches)	d=		inches
2a	Enter the combined effect of provided HSCs, d_{HSC} (inches) (based on **Worksheet 4**) including any other upstream BMPs	d_{HSC}=		inches
2b	Calculate the remainder of the design capture storm depth, $d_{remainder} = d - d_{HSC}$	$d_{remainder}$=		inches
3a	Enter DMA area tributary to BMP(s), *A* (acres) excluding any self-retaining areas	A=		acres
3b	Enter DMA Imperviousness, imp (unitless) after removal of self-retaining areas	imp=		
3c	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=		
3d	Calculate runoff volume, *DCV = (C x $d_{remainder}$ x A x 43560 x (1/12)) (See Section E.2.2)*	DCV=		cu-ft
Part 2: Design BMP and Calculate Effective Storage Depth and Footprint				
4	Enter total effective storage depth (sum of values below)	$D_{total_effective}$		inches
4a	Ponding storage depth	D_{pond}		inches
4b	Media effective storage depth (depth * 0.2)	$D_{media_effective}$		inches
4c	Gravel effective storage (depth * 0.4)	$D_{gravel_effective}$		inches
5	Determine required effective footprint: A_{BMP} = DCV /(D_{Total} *12 inches/ft) If sides are sloped, measure A_{BMP} at the mid-ponding depth of the BMP.	A_{BMP}=		sq-ft
Part 3: Check Drawdown Time				
6a	Calculate design infiltration rate, $K_{design} = K_{observed} / S_{total}$ (See **Worksheet 3** and **Appendix D**)	K_{design}=		in/hr
6b	Calculate drawdown time ($D_{total_effective} / K_{design}$) (must be less than or equal to 48 hours).	$T_{drawdown}$=		hours
6c	If using Method 2 for drawdown (Section E.2.5) which accounts for sidewall infiltration, insert result and attach relevant calculations below.	$T_{drawdown}$=		hours
Part 4: *Check Minimum Infiltrating Surface Area for Premature Clogging*				
7a	Calculate BMP infiltrating surface area as percent of tributary impervious area ($A_{infiltrating}$/(A * imp * 43560 sq-ft/ac)			%
7b	Calculate minimum infiltrating surface area required for BMP to avoid premature clogging (Section E.4.1)			%

E.3.2 Capture Efficiency via Nomograph Method for Sizing Infiltration BMPs

This method is used to determine the required volume of infiltration BMPs when a DMA is in the Full Infiltration Category. The method has the ability to account of upstream HSCs and other types of upstream retention. The target using this method is to achieve 80 percent long-term average capture of runoff. This method is more complicated than the Simple Method (Section E.3.1) and is iterative by its nature, but it implicitly accounts for infiltration that occurs during a storm event in computing the retained volume. When the drawdown time is approximately 48 hours, both the Simple Method and the Capture Efficiency via Nomograph Method yield a similar required BMP volume. However, when the drawdown time is less than 48 hours, the Capture Efficiency via Nomograph Method can yield smaller required BMP sizes than the Simple Method. Additionally, when a drawdown time of 48 hours cannot be achieved, the Capture Efficiency via Nomograph Method can compute the capture efficiency corresponding to a longer drawdown time which can still meet LID criteria, whereas the Simple Method requires the drawdown time to be 48 hours or less.

This method is only suitable for Full Infiltration BMPs that have a drawdown rate that can be approximated as constant throughout the year or over the wet season. A BMP that relies in whole or part on irrigation to draw down the BMP should not use this method as irrigation demand varies throughout the year.

E.3.2.1 Capture Efficiency via Nomograph Method Stepwise Instructions for Sizing Full Infiltration BMPs

The method includes the following calculations:

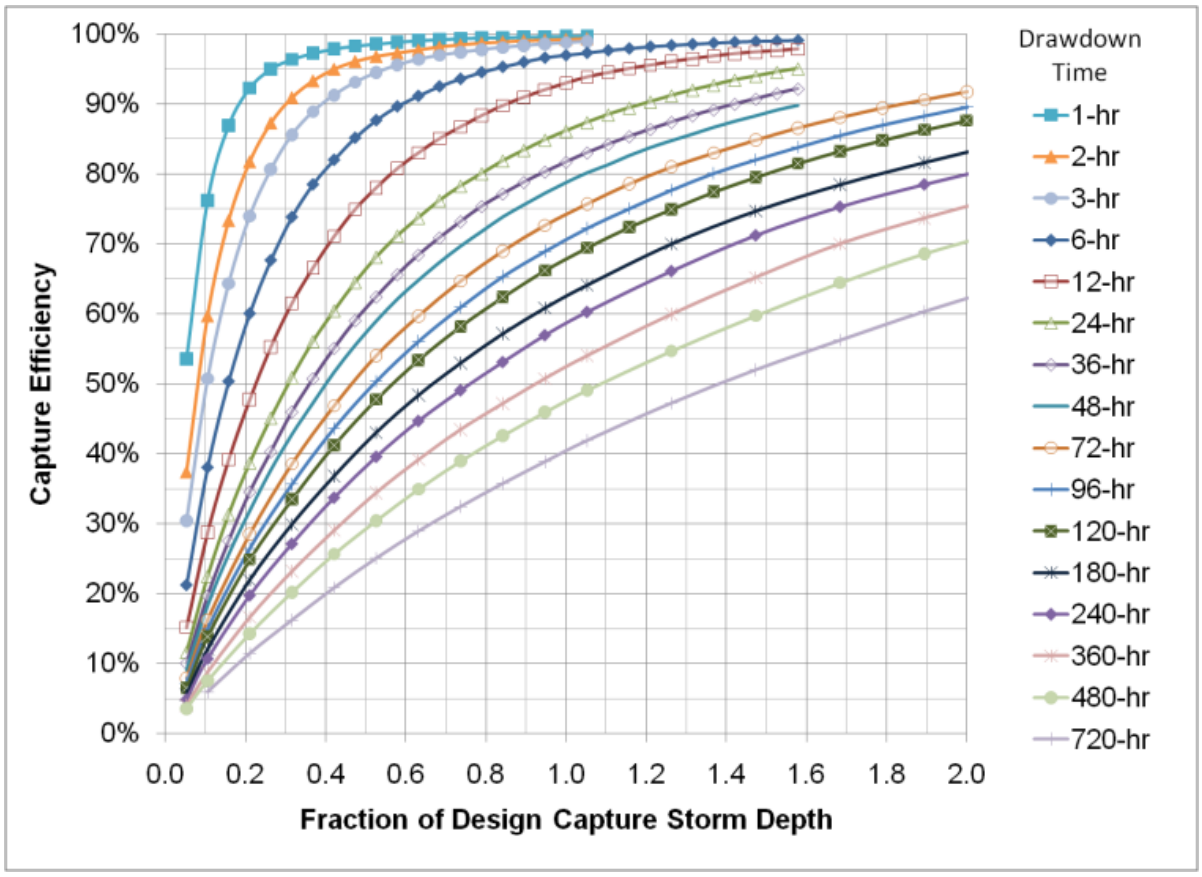
1. Design the BMP vertical profile (i.e., ponding, soil media, gravel depths) and determine the effective depth of storage in the BMP. The effective depth of storage is the ponding depth plus the depth stored in soil and gravel pores. Typical void ratios are 0.4 for gravel and 0.2 for soil media.
2. Calculate the drawdown time of the BMP (See Section E.2.5).
    a. For systems that rely primarily on vertical infiltration, divide the effective storage depth (inches) by the infiltration rate (K_{design}) of the underlying soil (inches per hour) to calculate the drawdown time (hours).
    b. Where systems have both lateral and vertical infiltration (such as infiltration trenches), first calculate the infiltration discharge rate (cu-ft per hour) based on the wetted infiltration surface area when the system is half full. Calculate the drawdown time by dividing the total storage volume (cu-ft) by the total estimated infiltration discharge rate when the system is half full (cu-ft/hr).
3. Locate the line corresponding to the estimated drawdown time in Figure E-4. Locate the point on the line that corresponds to 80% capture (y-axis) and record the corresponding value from the x-axis. This is the total fraction of the 85th percentile, 24-hour storm that

needs to be captured in order to achieve 80% capture at the selected drawdown time. This is referred to as X_1.

4. Determine the capture efficiency achieved by any upstream retention including HSCs (Section E.2.1) or Harvest and Use BMPs (Section E.3.6) and trace a horizontal line on Figure E-4 corresponding to the computed capture efficiency. Trace this line horizontally. This is referred to as Y_2.
5. Find where the line traced in step (4) intersects the line corresponding to the drawdown time of the BMP selected in step (2). Pivot down and read the value on the x-axis correspond to this location. This is the fraction of the equivalent design storm already captured by upstream HSCs or harvest and use BMPs. This is referred to as X_2. Note that if no upstream retention is provided in HSCs or harvest and use BMPs, X_2 will be 0.
6. Subtract X_2 from X_1 to determine the fraction of the design storm depth that must be provided in the Full Infiltration BMP to achieve 80% capture.
7. Determine the 85th percentile, 24-hour design storm event depth by locating the site on Figure N-1.
8. Multiply the results of step (6) by the 85th percentile design storm depth from step (7) to obtain the design storm depth for the BMP.
9. Convert the design storm depth from step (8) to the DCV (Section E.2.2). This is the required BMP retention volume.
10. Maintaining the same vertical design profile as determined in Step 1, size the footprint of the BMP to retain the required volume from Step 9.
11. Calculate the infiltrating surface area of the BMP, including bottom and walls, where applicable, and check that the wetted infiltrating surface area meets the minimum area requirements to avoid premature clogging (See Section E.4.1). If it does not, increase the BMP size so that the infiltrating surface area is at least this minimum, or provide more robust pretreatment to address clogging risk. The infiltrating surface should be based on the wetted area when the BMP is half full.

This method may require some iteration to determine a BMP profile and footprint that provide an optimal and compliant combination of storage volume and drawdown time. Iteration parameters could

Figure E-4. Capture Efficiency Nomograph for Constant Drawdown BMPs in Orange County



E.3.2.2 Example Using the Capture Efficiency via Nomograph Method to Size a Full Infiltration BMP

Example E.6: Computing Design Criteria to Achieve Target Capture Efficiency, Full Infiltration BMP

Given:

- 85th percentile, 24-hr storm depth = 0.85 inches
- Drainage Area = 1.5 acres
- Imperviousness = 80%
- Effect of provided HSCs (d_{HSC}) = 0.2 inches
- Initially assume BMP is an infiltration chamber, 30-inch total effective depth
- Design infiltration rate = 0.31 in/hr

Required:

- Determine volume required to achieve 80 percent capture

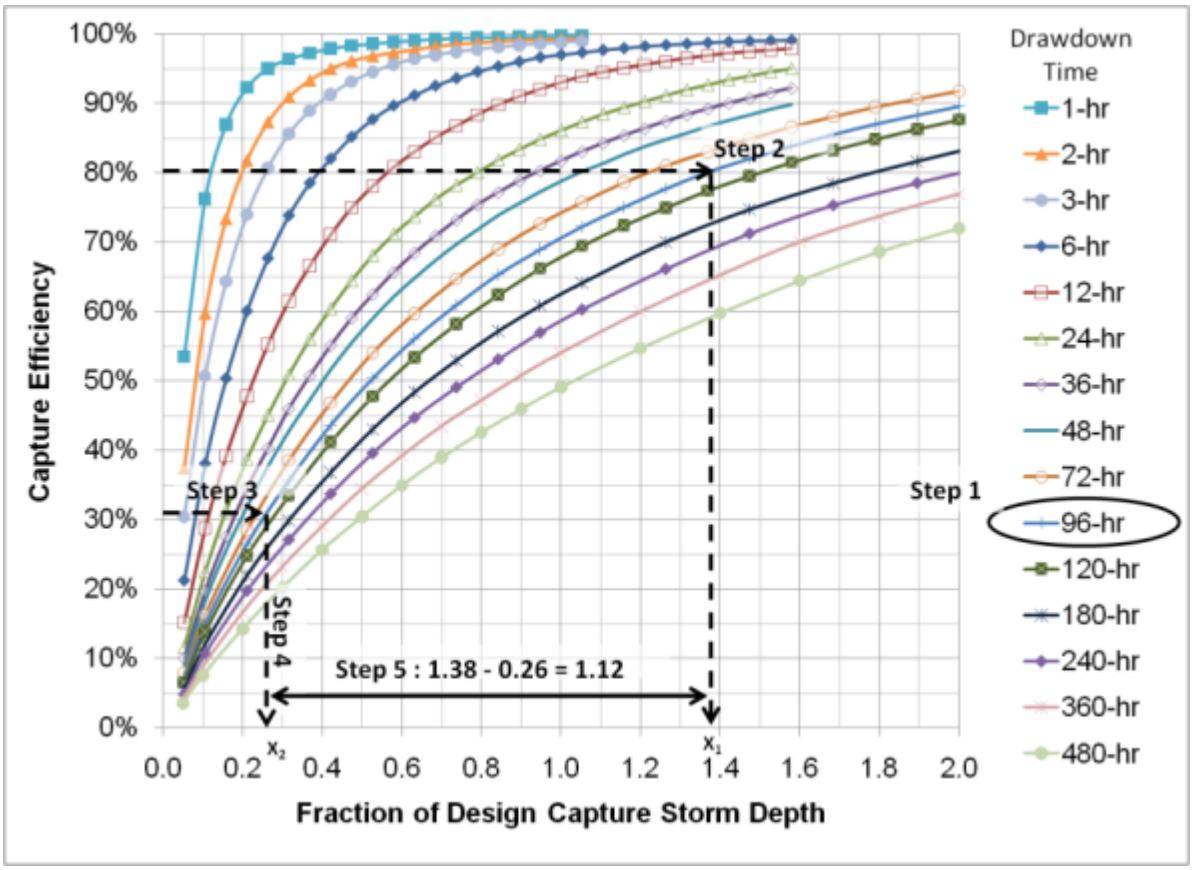
Solution:

1. BMP has total effective depth of 30 inches
2. The drawdown time can be calculated via a simple approach by dividing the effective storage depth by the design infiltration rate
   →30 in / 0.31 in/hr = 96 hour total drawdown
3. From Figure E-4: X_1 = 1.38 (point where 80% capture intersects with 96 hour drawdown)
4. Capture efficiency achieved by 0.2 inches of HSCs = 31% (From Section E.2.1)
5. From Figure E-4: X_2 = 0.26 (point where 31% capture intersects with 96 hour drawdown)
6. Fraction of 85th percentile, 24-hour storm depth required (X1 – X2) = (1.38 – 0.26) = 1.12
7. From Figure N-1, 85th percentile, 24-hour storm event is 0.85 inches
8. Required design storm depth = 0.85 inches * (1.12) = 0.95 inches
9. Required storage volume = 1.5 ac × 0.95 inches × (0.8×0.75 + 0.15) × 43560 sf/ac × 1/12 in/ft = 3,880 cu-ft
10. Assuming the original retention depth of 30 inches (2.5 feet), the required footprint to capture the DCV = 3,880 cu-ft/2.5 ft = 1,550 sq-ft.
11. Using the method in Section E.4.1, the default footprint to avoid premature clogging is 3% of the total impervious area of the. The wetted infiltrating surface area is 1,550 sq-ft (3.0 % of tributary impervious area). So the footprint provided just meets the minimum requirement for clogging to avoid premature clogging and no adjustment is necessary.

(see graphical operations on following page)

Graphical operations supporting solution:

***Graphical Operations Supporting* Example E.6**



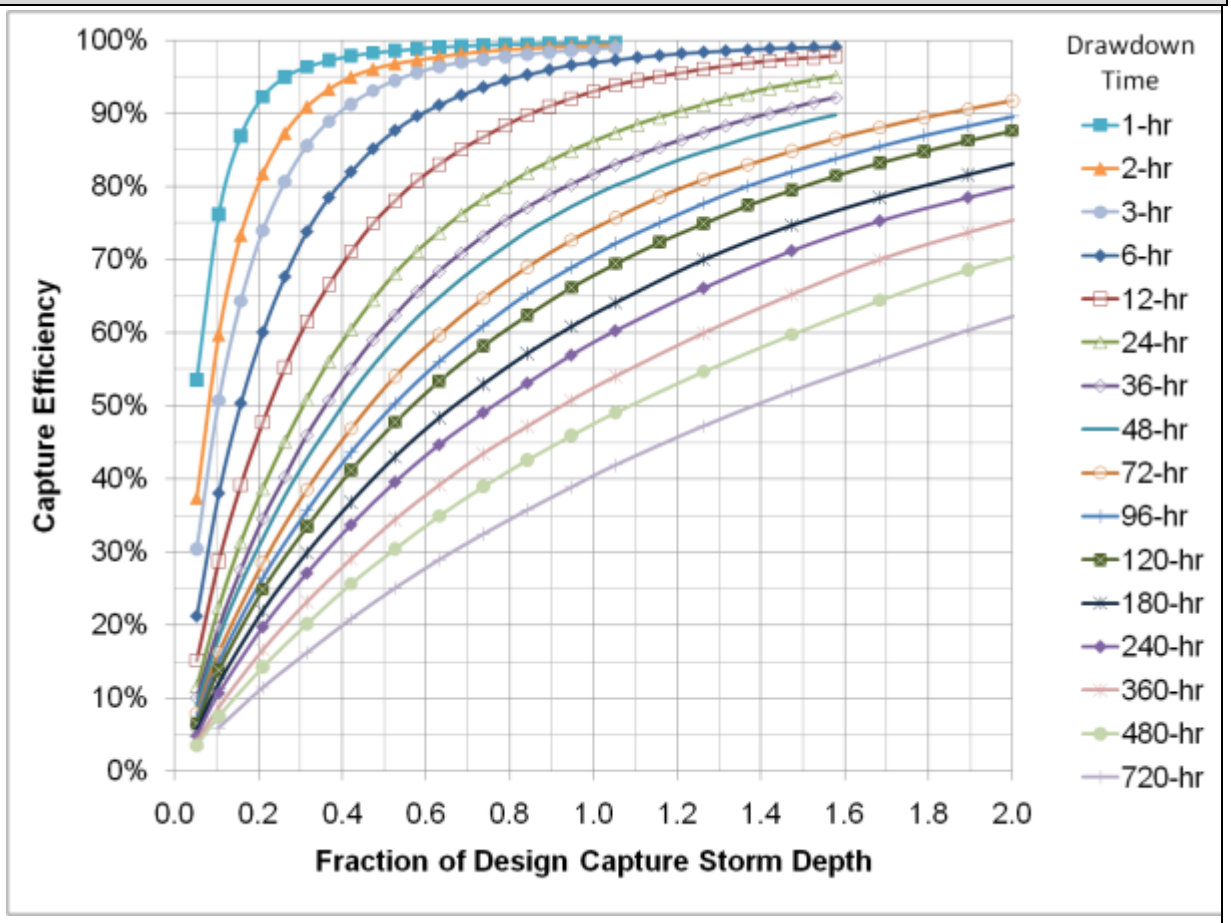
E.3.2.3 Worksheet for Using the Capture Efficiency via Nomograph Method to Size a Full Infiltration BMPs

Worksheet 8: Capture Efficiency Method for Full Infiltration, Constant Drawdown BMPs

Part 1: Calculate the design depth and drawdown time				
1	Enter total effective storage depth (sum of values below)	$D_{total_effective}$		inches
1a	Ponding storage depth	D_{pond}		inches
1b	Media effective storage depth (depth * 0.2)	$D_{media_effective}$		inches
1c	Gravel effective storage (depth * 0.4)	$D_{gravel_effective}$		inches
2a	Calculate design infiltration rate, $K_{design} = K_{observed} / S_{total}$ (See **Worksheet 3** and **Appendix D**)	K_{design}=		in/hr
2b	Calculate drawdown time ($D_{total_effective} / K_{design}$)	$T_{drawdown}$=		hours
2c	If using Method 2 for drawdown (Section E.2.5) which accounts for sidewall infiltration, insert result and attach relevant calculations below.	$T_{drawdown}$=		hours
Part 2: Determine the portion of the design storm for the BMP				
3	Using Figure E-4 or the figure within the worksheet below, determine the "fraction of design capture storm depth" at which the BMP drawdown time line intersects with 80% capture efficiency. Trace down to determine X_1	X_1=		
4	Enter capture efficiency corresponding to upstream HSCs and/or upstream Harvest and Use BMPs, Y_2.	Y_2 =		%
5	Using Figure E-4 or the figure within the worksheet below, determine the fraction of “design capture storm depth” at which the drawdown time of the BMP intersects with the equivalent of the upstream capture efficiency (Y_2). Trace down to determine X_2	X_2=		
6	Calculate the fraction of design capture storm depth that must be provided by the BMP, fraction = $X_1 – X_2$	fraction=		
7	Enter design capture storm depth from N-1, d (inches)	d=		inches
8	Calculate the storm depth to use in sizing calculations, $d_{fraction}$= fraction × d	$d_{fraction}$=		inches
Part 3 Calculate the DCV (Section E.2.2)				
9a	Enter DMA area tributary to BMP (s), *A* (acres) (not including any self-retaining areas)	A=		acres
9b	Enter DMA Imperviousness, *imp*	imp=		unitless
9c	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=		unitless

Worksheet 8: Capture Efficiency Method for Full Infiltration, Constant Drawdown BMPs

9d	Calculate the DCV= *(C x $d_{fraction}$ x A x 43560 x (1/12))*	DCV=		cu-ft
Part 3: Check footprint and drawdown times				
10	Footprint required to retain the DCV, DCV/$D_{effective}$ (A_{BMP} is measured at the mid ponding depth for systems with side slopes)	A_{BMP}		sq ft
11a	Infiltrating surface area required to avoid premature clogging (from Section E.4.1), as percent of tributary impervious area	$\%A_{min,clog}$		%
11b	Provided infiltrating surface area as a fraction of the tributary impervious surface (included wetted infiltrating area when BMP is half full)	$\%A_{infiltration_surface}$		%
Supporting Calculations				



Provide supporting graphical operations.

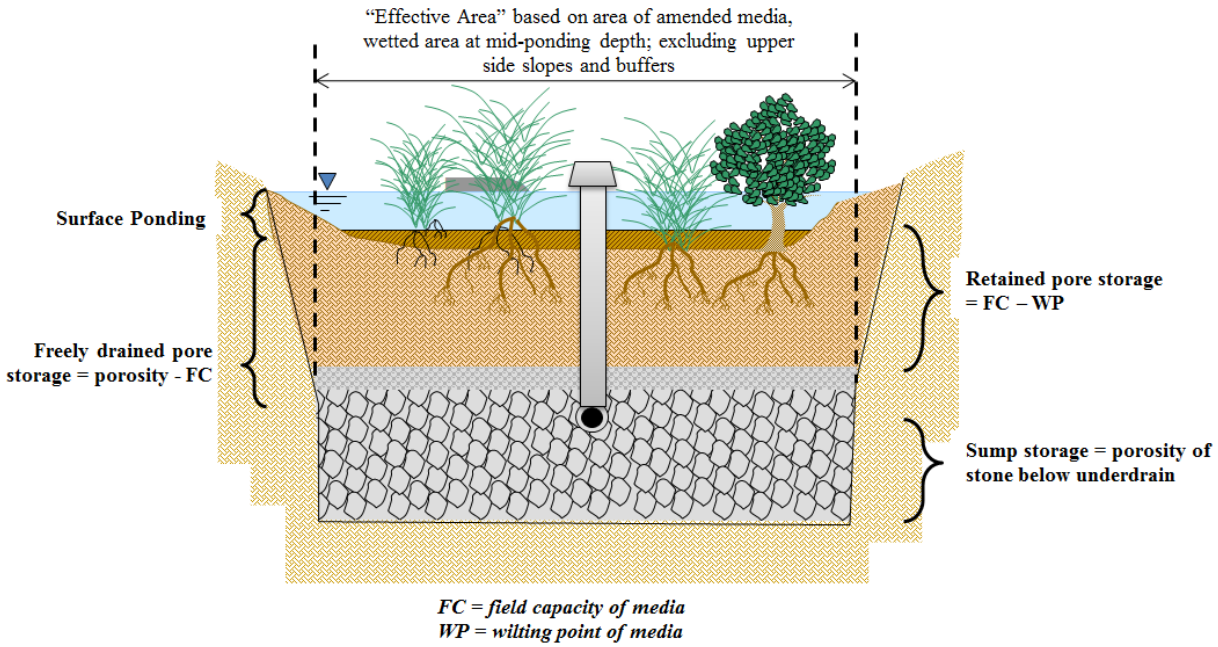
E.3.3 Biofiltration Routing Method for Sizing Volume-Based Biofiltration BMPs

This method can be used to design biofiltration BMPs. Sizing criteria (listed in Section 4.2.4 of the TGD) include:

- Biofilter at least 150% of the portion of the DCV not reliably retained,
- Maximize volume reduction (except in the No Infiltration Condition), and
- Avoid premature clogging.

This sizing method has been specifically tailored to a Bioretention BMP with underdrains (See BMP fact sheets in Appendix G and Figure E-5 below). In the Partial Infiltration condition, the retention volume must be maximized, and the discharge point of the underdrain is typically elevated such that water is first stored in a gravel layer for retention (Figure E-5) before biofiltered water begins to discharge. In the No Infiltration Condition, the internal water storage may still be desirable for pollutant control (water held below underdrain discharge elevation), but is not counted in sizing methods. This method assumes that the Bioretention BMP is in the Partial Infiltration condition and includes a retention sump. This method can be used to size a Bioretention BMP in the No Infiltration Condition by ignoring the volume provided in the infiltration sump.

Figure E-5: Bioretention volume compartments for sizing purposes



Either this method or the Biofiltration Static Volume Method (Section E.3.4) may be used for sizing biofiltration BMPs.

E.3.3.1 Biofiltration Routing Method Stepwise Instructions for Sizing Biofiltration BMPs

The method includes the following calculations:

1. Determine the 85th percentile, 24-hour design storm event depth by locating the site on Figure N-1
2. Reduce the design storm depth based on upstream HSCs in the DMA (See Section E.2.1) and the equivalent storm depth corresponding to water captured in any other upstream retention BMP.
3. Convert the remaining design storm depth to a runoff volume (See Section E.2.2)
4. Select a BMP effective footprint area by reviewing the limiting factors for biofiltration footprint:
    a. Minimum footprint to avoid premature clogging (Section E.4.1) (applies in all conditions)
    b. Footprint to achieve target incidental volume reduction (Section E.4.2) (partial infiltration conditions only)
    c. Prior iterations of this method may show that the actual footprint needs to exceed the footprints above to satisfy sizing calculations, in which case the higher footprint should be used.
    d. In absence of other information, start with a footprint equivalent to 3 percent of the tributary impervious area.
5. (Partial Infiltration category only) Determine the target effective depth of the gravel sump storage by dividing the design infiltration rate, K_{design}, of the underlying soil obtained using the factor of safety from Worksheet 3 (Appendix D) by 48 hours. If Kdesign is not known, assume 0.15 in/hr. A porosity of 0.4 can be used for washed drain rock. The depth of drain rock below the underdrain discharge elevation does not need to exceed 18 inches, but may be as large as the depth that would infiltrate in 48 hours based on a reliable design infiltration rate.
6. (Partial Infiltration category only) Calculate the volume retained in the gravel sump below the underdrain by multiplying the effective depth of the gravel from step (5) by the footprint from step (4).
7. Select an initial media depth (typically 24") using the BMP fact sheets and multiply by 0.1 to calculate the effective retention depth of the media. Multiply this depth by the footprint from step (4) to obtain the volume retained in the media (retention of runoff on the media grains and in pores that does not drain freely, but is instead evapotranspired).
8. Calculate the remaining portion of the DCV by subtracting the volume retained by the gravel sump from step (7) and the volume retained on the media from step (8) from the initial design volume from step (3).
9. Multiply the remaining DCV by 1.5 to obtain the volume that must be biofiltered (not retained) by the Bioretention BMP.

10. Select an initial profile above the underdrain including the soil media thickness selected in step (8), and surface ponding (typically 6"-12") based on guidance in the BMP fact sheet for Bioretention (Appendix G). Calculate the total effective biofiltration storage depth of the media and ponding assuming a void ratio of 0.2 for the media.

    $D_{biofilter_effective}$ = ponding depth + 0.2 * media depth

11. Calculate the volume biofiltered by the BMP during an allowable routing period accounting for the actual duration of real storms. Use a routing period, T_{rout}, of 5 hours[7] and an infiltration rate, K_{media} of 2.5 inches/hour for the media or justify other values.

    $$V_{treated} = (D_{biofilter_effective} + K_{media} * T_{rout}) * A_{BMP_EFF} * (1ft/12\ inches)$$ Equation **E.10**

    Where:

    $V_{treated}$ = the volume of runoff biofiltered, including stored plus routed volume (cubic feet)
    $D_{biofilter_effective}$ = the effective depth of biofiltration storage in the media and ponding area above the underdrain (inches) calculated in step (10)
    K_{media} = the infiltration rate of the soil media (in/hr) (2.5 in/hr, unless otherwise justified)
    T_{rout} = the routing period (5 hours, unless otherwise justified)
    A_{BMP_EFF} = the effective footprint of the BMP (sq ft) calculated in step (4)

12. Ensure the volume biofiltered in step (12) is greater than or equal to the required biofiltered volume calculated in step (9). If the volume from step (12) is less than the required from step (9) iteratively adjust footprint and/or profile and repeat steps (6) through (12) until the provided biofiltered volume ($V_{treated}$) equals or exceeds the required biofiltered volume ($V_{treat_required}$). Do not decrease the footprint below the minimum required for volume reduction and avoiding premature clogging calculated in step (4), and do not increase the gravel sump depth above the depth calculated in step (5) that will drain in 48 hours.

[7] Routing period of 5 hours is based on the 15th percentile storm duration for storms similar (within 10%) to the 85th percentile rainfall depth. Estimated based on inspection of continuous rainfall data from the Fullerton Dam, Santiago Dam, and Laguna Beach 2 rain gages between 1948 and 2008.

E.3.3.2 Example Using Biofiltration Routing Method for Sizing Biofiltration BMPs

Example E.7: Using Biofiltration Routing Method for Sizing Bioretention BMPs with Underdrains

Given:

- Redevelopment project, 85th percentile, 24-hr storm depth = 0.85 inches (From Figure N-1)
- Drainage Area = 1.5 acres
- Imperviousness = 80%
- Effective retention depth of HSCs (d_{HSC}) = 0.1 inches (from Worksheet 4)
- Design infiltration rate not measured, assume 0.15 in/hr
- Biofiltration BMP with raised underdrain discharge elevation in the Partial Infiltration category
- ***Required:***
- Size the Biofiltration BMP to meet LID sizing criteria

Solution:

1. Design capture storm depth = 0.85 inches from Figure N-1.
2. Design capture storm depth, less HSCs = 0.85 inches – 0.1 inches = 0.75 inches
3. Runoff volume = 1.5 ac × (0.75*0.8 + 0.15) × (0.75 inches) * 43,560 sf/ac × 1/12 in/ft = 3,060 cu-ft
4. Select the minimum footprint using guidance from Sections E.4.1 and E.4.2.
   Minimum footprint to avoid premature clogging: **2.1%** of impervious area (Section E.4.1 Urban mixed land use, no significant open space, vegetated surface BMP with forebay)

   Target footprint for volume reduction: **1.8%** of impervious area (Section E.4.2.)

   Select 2.5% : Effective footprint = 0.025 * 1.5 acres * (0.8) * (43,560 sq ft/acre) = 1,310 square feet (this selection was based on iterative approach, indicating that a size larger than the minimums is needed)
5. Target effective depth of storage in gravel = 0.15 in/hr * 48 hour drawdown time = 7.2 inches. (Actual gravel depth will be 7.2 inches/0.4 porosity =18 inches).
6. Calculate the volume retained in the gravel sump = effective gravel sump depth * footprint = 7.2 inches * 1,310 sq ft * (1 ft/12 inches) = 780 cubic feet retained in infiltration sump
7. Select 24 inches of media. Calculate the volume retained in the soil media = 0.1* 24 inches * (1 ft/12 inches) * 1,310 sq ft = 260 cubic feet
8. Remaining DCV = 3,060 cubic feet (from step 4) – 780 cubic feet (from step 7) - 260 cubic feet (from step 8)= 2,020 cubic feet
9. Volume to be biofiltered equals 1.5 x the remaining DCV = 1.5 * 2,010 = 3,030 cubic feet
10. Select profile of 12 inches surface storage plus the 24 inches of media previous selected.

$D_{biofilter_effective}$ = 0.2 (24 inches) + 12 inches = 16.8 inches

11. $V_{treated}$ = (16.8 inch + 2.5 in/hr * 5 hour)* 1,310 square feet * (1 ft/12 inches) = 3,200 cubic feet
12. 3,200 cubic feet treated (from step 11) > 3,030 cubic feet (from step 10). This BMP is adequate sized and could be downsized slightly, if desired.

E.3.3.3 Worksheet for Using Biofiltration Routing Method for Sizing Biofiltration BMPs

Worksheet 9: Biofiltration Routing Method for Sizing Bioretention BMPs with Underdrains

Part 1: Calculate Design Storm Volume				
1	Enter design capture storm depth from **Figure N-1**, *d* (inches)	d=		inches
2a	Enter the combined effect of provided HSCs, d_{HSC} (inches) (based on **Worksheet 4**)	d_{HSC}=		inches
2b	Calculate the remainder of the design capture storm depth, $d_{remainder} = d - d_{HSC}$	$d_{remainder}$=		inches
3a	Enter DMA area tributary to BMP(s), *A* (acres) excluding any self-retaining areas	A=		acres
3b	Enter DMA Imperviousness, imp (unitless) after removal of self-retaining areas	imp=		
3c	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=		
3d	Calculate runoff volume, *DCV = (C x $d_{remainder}$ x A x 43560 x (1/12)) (See Section E.2.2)*	DCV=		cu-ft
Part 2: Select Initial BMP Effective Footprint Area (can be iterative)				
4a	Calculate minimum area required for BMP to avoid premature clogging from Section E.4.1.(as percent of impervious tributary area)	$\%A_{min,clog}$=		%
4b	Calculate minimum area required for BMP to meet volume reduction requirements (Partial Infiltration category only) using Section E.4.2.	$\%A_{min,vol}$=		%
4c	Effective footprint of BMP as percent of tributary impervious area, must be equal to or greater than both $\%A_{min,clos}$ and $\%A_{min,vol}$ (as applicable)	$\%A_{BMP_EFF}$		%
4d	Effective footprint of BMP ($\%A_{BMP_EFF}$ * A * imp)	A_{BMP_EFF}		sq-ft
Part 3: Calculate Retention Volume in BMP				
5a	Determine gravel layer depth (18 inches or an alternative depth that will infiltrate within 48 hours)	D_{gravel}		inches
5b	Calculate effective retention storage depth of gravel layer D_{eff_gravel} = 0.4 porosity * D_{gravel} (Partial Infiltration Category only)	$D_{eff,gravel}$		inches

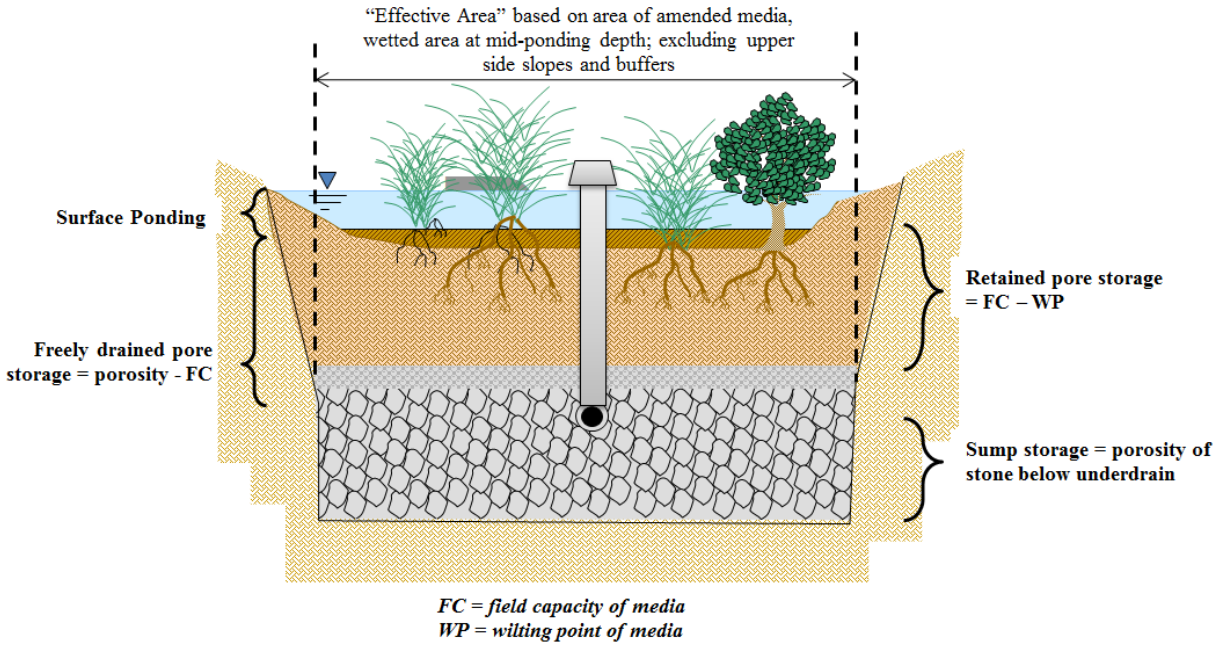
6	Calculate volume retained in gravel layer (Partial Infiltration Category only) $V_{gravel} = D_{eff,gravel} * A_{BMP_EFF} * (1 ft/12 inches)$	V_{gravel_retain}		cu-ft
7a	Media depth D_{media} (24 inches typical) See BMP fact sheet (Appendix G)	D_{media}		inches
8b	Calculate volume retained in soil media layer, $V_{media} = 0.1 * D_{media} * A_{BMP_EFF} * (1 ft/12 inches)$	V_{media_retain}		cu-ft
Part 4: Calculate Required and Provided Biofiltered Volume				
9	Calculate the remaining DCV by subtracting the retained volume in the gravel layer and media layer from the initial design volume, $DCV_{remain} = DCV - V_{gravel_retain} - V_{media_retain}$	DCV_{remain}		cu-ft
10	Calculate the required volume to be biofiltered by multiplying the remaining DCV by 1.5, $V_{treat_req} = 1.5 * DCV_{remain}$	V_{treat_req}		cu-ft
11a	Surface storage ponding depth (6-12 inches typical) See BMP fact sheet (Appendix G)	$D_{ponding}$		inches
11b	Calculate effective depth of the biofiltration storage above the underdrain, $D_{biofilter_effective} = D_{ponding} + 0.2 * D_{media}$	$D_{biofilter_effective}$		in
12a	Routing period (5 hours is default, proponent must justify any other value), T_{rout}	T_{rout}		hours
12b	Media infiltration rate (2.5 inches/hour default, proponent must justify any other value)	K_{media}		in/hr
12c	Calculate biofiltered volume, $V_{treated} = (D_{biofilter_effective} + K_{media} * T_{rout}) * A_{BMP_EFF} * (1 ft/12 in)$	$V_{treated}$		cu-ft
13	Verify that $V_{treated} > V_{treat_req}$. If it is not, must revise profile or footprint while conforming to criteria			

E.3.4 Biofiltration Static Volume Method for Sizing Volume-Based Biofiltration BMPs

This method is very similar to the Biofiltration Routing Method (Section E.3.3) with a few minor changes. This method can be used lieu of the method in Section E.3.3 to design biofiltration BMPs to meet the required sizing criteria.

This sizing method has been specifically tailored to a Bioretention BMP with underdrains (See BMP fact sheets in Appendix G and Figure E-6 below). In the Partial Infiltration condition, the retention volume must be maximized, and the discharge point of the underdrain is typically elevated such that water is first stored in a gravel layer for retention (Figure E-5) before biofiltered water begins to discharge. In the No Infiltration Condition, the internal water storage may still be desirable for pollutant control (water held below underdrain discharge elevation), but is not counted in sizing methods. This method assumes that the Bioretention BMP is in the Partial Infiltration condition and includes an infiltration sump. This method can be used to size a Bioretention BMP in the No Infiltration Condition by ignoring the volume provided in the infiltration sump.

Figure E-6: Bioretention with raised underdrain volume compartments for sizing purposes



E.3.4.1 Biofiltration Static Volume Method Stepwise Instructions for Sizing Biofiltration BMPs (For use in SOC only)

The method includes the following calculations:

1. Determine the 85th percentile, 24-hour design storm event depth by locating the site on Figure N-1
2. Reduce the design storm depth based on upstream HSCs in the DMA (See Section E.2.1) and the equivalent storm depth corresponding to water captured in any other upstream retention BMP.
3. Convert the remaining design storm depth to a runoff volume (See Section E.2.2)
4. Select a BMP effective footprint area by reviewing the limiting factors for biofiltration footprint:
    a. Minimum footprint to avoid premature clogging (Section E.4.1) (applies in all conditions)
    b. Footprint to achieve target incidental volume reduction (Section E.4.2) (partial infiltration conditions only)
    c. Prior iterations of this method may show that the actual footprint needs to exceed applicable minimums to satisfy sizing calculations, in which case the higher footprint should be used.
    d. In absence of other information, start with an effective BMP footprint equal to 3 percent of tributary impervious area.
5. (Partial Infiltration category only) Determine the target effective depth of the gravel sump storage by dividing the design infiltration rate, K_{design}, of the underlying soil obtained using the factor of safety from Worksheet 3 (Appendix D) by 48 hours. If Kdesign is not known, assume 0.15 in/hr. A porosity of 0.4 can be used for washed drain rock. The depth of drain rock below the underdrain discharge elevation does not need to exceed 18 inches, but may be as large as the depth that would infiltrate in 48 hours based on a reliable design infiltration rate.
6. (Partial Infiltration category only) Calculate the volume retained in the gravel sump below the underdrain by multiplying the effective depth of the gravel from step (5) by the footprint from step (4).
7. Select an initial media depth (typically 24") using the BMP fact sheets and multiply by 0.1 to calculate the effective retention depth of the media. Multiply this depth by the footprint from step (4) to obtain the volume retained in the media (retention of runoff on the media grains and in pores that does not freely drain, but is instead evapotranspired).
8. Calculate the remaining portion of the DCV by subtracting the volume retained by the gravel sump from step (7) and the volume retained on the media from step (8) from the initial design volume from step (3).
9. Multiply the remaining DCV by 0.75 to obtain the volume that must be held in static biofiltration storage by the Bioretention BMP ($V_{biofilter_storage_req}$).

10. Select an initial profile above the underdrain including the soil media thickness selected in step (8), and surface ponding (typically 6"-12") based on guidance in the BMP fact sheet for Bioretention (Appendix G). Calculate the total effective biofiltration storage depth of the media and ponding assuming a void ratio of 0.2 for the media.

    $D_{effective_biofilter}$ = 0.2 * media depth + ponding depth

11. Calculate the volume of the pores in the gravel, media, and surface storage above the underdrain.

    $V_{biofilter_storage} = D_{effective_biofilter} * A_{BMP_EFF} * (1ft/12\ inches)$ Equation **E.11**

    Where:

    $V_{biofilter_storage}$ = the biofilter volume of storage provided in the pores of the media and surface storage above the underdrain (cubic feet)
    $D_{effective_biofilter}$ = the effective depth of biofiltration storage in the media and ponding area (inches) calculate in step (11)
    A_{BMP_EFF} = the footprint of the BMP (sq ft) calculated in step (6)

12. Ensure the static biofiltration volume provided in step (11) is greater than or equal to the required static biofiltration volume calculated in step (9). If the volume from step (11) is less than the required from step (9) iteratively adjust footprint and/or profile and repeat steps (6) through (11) until it reaches this volume. Do not decrease the footprint below the minimum required for volume reduction and avoiding premature clogging calculated in step (4), and do not increase the gravel sump depth above depth that will drain in 48 hours as calculated in step (5).

E.3.4.2 Example Using Static Volume Method for Sizing Biofiltration BMPs

Example E.8: Static Volume Method for Sizing Biofiltration BMPs in SOC

Given:
• Redevelopment project, 85th percentile, 24-hr storm depth = 0.85 inches (From Figure N-1)
• Drainage Area = 1.5 acres
• Imperviousness = 80%
• Effective retention depth of HSCs (d_{HSC}) = 0.1 inches (from Worksheet 4)
• Design infiltration rate not measured, assume 0.15 in/hr
• Biofiltration BMP with raised underdrain discharge elevation in the Partial Infiltration category
• ***Required:***
• Size the Biofiltration BMP to meet LID sizing criteria

Solution:

1. Design capture storm depth = 0.85 inches from Figure N-1.
2. Design capture storm depth, less HSCs = 0.85 inches – 0.1 inches = 0.75 inches
3. Runoff volume = 1.5 ac × (0.75*0.8 + 0.15) × (0.75 inches) * 43,560 sf/ac × 1/12 in/ft = 3,060 cu-ft
4. Select the minimum footprint using either site-specific methods from Section E.4.1 and E.4.2. Minimum footprint to avoid premature clogging: **2.1%** of impervious area **(**Section E.4.1 Urban mixed land use, no significant open space, vegetated surface BMP with forebay)

   Target footprint for volume reduction: **1.8%** of impervious area (Section E.4.2)

   Select 2.5% : Effective footprint = 0.025 * 1.5 acres * (0.8) * (43,560 sq ft/acre) = 1,310 square feet (this selection was based on iterative approach, indicating that a size larger than the minimums is needed)
5. Target effective depth of gravel = 0.15 in/hr * 48 hour drawdown time = 7.2 inches. (Actual gravel depth will be 7.2 inches/0.4 porosity =18 inches).
6. Calculate the volume retained in the gravel sump = effective gravel sump depth * footprint = 7.2 inches * 1,310 sq ft * (1 ft/12 inches) = 780 cubic feet retained in infiltration sump
7. Select 24 inches of media. Calculate the volume retained in the soil media = 0.1* 24 inches * (1 ft/12 inches) * 1,310 sq ft = 260 cubic feet
8. Remaining DCV = 3,060 cubic feet (from step 4) – 780 cubic feet (from step 7) - 260 cubic feet (from step 8)= 2,020 cubic feet
9. Biofilter volume required to be provided in pores of media and surface ponding storage above the underdrain equals 0.75 x the DCV = 0.75 * 2,020 = 1,520 cubic feet = $V_{biofilter_storage_req}$
10. Select profile of 12 inches surface storage plus the 24 inches of media previous selected.

    $D_{effective_biofilter}$ = 0.2 (24 inches) + 12 inches = 16.8 inches
11. $V_{biofilter_storage}$ = 16.8 inches* 1,310 square feet * (1 ft/12 inches) = 1,830 cubic feet
12. 1,830 cubic feet > 1,520 cubic feet (size is acceptable; BMP footprint area or surface storage ponding depth could be reduced slightly to optimize design)

E.3.4.3 Worksheet for Using Static Volume Method for Sizing Biofiltration BMPs

Worksheet 10: Static Volume Method for Sizing Bioretention BMPs with Underdrains in SOC

Part 1: Calculate Design Storm Volume				
1	Enter design capture storm depth from **Figure N-1**, *d* (inches)	d=		inches
2a	Enter the combined effect of provided HSCs, d_{HSC} (inches) (based on **Worksheet 4**)	d_{HSC}=		inches
2b	Calculate the remainder of the design capture storm depth, $d_{remainder}$ = d - d_{HSC}	$d_{remainder}$=		inches
3a	Enter DMA area tributary to BMP(s), *A* (acres) excluding any self-retaining areas	A=		acres
3b	Enter DMA Imperviousness, imp (unitless) after removal of self-retaining areas	imp=		
3c	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=		
3d	Calculate runoff volume, *DCV = (C x $d_{remainder}$ x A x 43560 x (1/12)) (See Section E.2.2)*	DCV=		cu-ft
Part 2: Select Initial BMP Effective Footprint Area (can be iterative)				
4a	Calculate minimum area required for BMP to avoid premature clogging from Section E.4.1.(as percent of impervious tributary area)	$\%A_{min,clog}$=		%
4b	Calculate minimum area required for BMP to meet volume reduction requirements (Partial Infiltration category only) using Section E.4.2	$\%A_{min,vol}$=		%
4c	Effective footprint of BMP as percent of tributary impervious area, must be equal to or greater than both $\%A_{min,clos}$ and $\%A_{min,vol}$ (as applicable)	$\%A_{BMP_EFF}$		%
4d	Effective footprint of BMP ($\%A_{BMP_EFF}$ * A * imp)	A_{BMP_EFF}		sq-ft
Part 3: Calculate Retention Volume in BMP				
5a	Determine gravel layer depth (18 inches or an alternative depth that will infiltrate within 48 hours)	D_{gravel}		inches
5b	Calculate effective retention storage depth of gravel layer $D_{eff,gravel}$ = 0.4 porosity * D_{gravel} (Partial Infiltration Category only)	$D_{eff,gravel}$		inches
6	Calculate volume retained in gravel layer (Partial Infiltration Category only) V_{gravel} = $D_{eff,gravel}$ * A_{BMP_EFF} * (1 ft/12 inches)	V_{gravel_retain}		cu-ft
7a	Media depth D_{media} (24 inches typical) See BMP fact sheet (Appendix G)	D_{media}		inches
8b	Calculate volume retained in soil media layer, V_{media} =0.1*D_{media}*A_{BMP_EFF} * (1 ft/12 inches)	V_{media_retain}		cu-ft
Part 4: Calculate Required and Provided Biofiltered Volume				
9	Calculate the remaining DCV by subtracting the retained volume in the gravel layer and media layer from the initial design volume, DCV_{remain}= DCV-V_{gravel}-V_{media}	DCV_{remain}		cu-ft

9	Calculate the required static biofiltration volume to be provided in the pores of the media and surface ponded storage above the underdrain, $V_{biofilter_storage_req} = 0.75 * DCV_{remain}$	$V_{biofilter_storage_req}$		cu-ft
10a	Surface storage ponding depth (6-12 inches typical) See BMP fact sheet (Appendix G)	$D_{ponding}$		inches
10b	Calculate effective depth of the biofiltration storage above the underdrain, $D_{effective_biotreat} = 0.2 * D_{media} + D_{ponding}$	$D_{effective_biotreat}$		in
11	Calculate static biofiltration storage volume provided in pores of media, and surface ponded storage above the underdrain $V_{biofilter_storage} = (D_{effective_biotreat}) * A_{BMP_EFF} * (1\ ft/12\ in)$	$V_{biofilter_storage}$		cu-ft
12	Verify that $V_{biofilter_storage} > V_{biofilter_storage_req}$. If it is not, must revise profile or footprint.			

E.3.5 Flow-Based Compact Biofiltration Sizing Method

This sizing method is used to size compact, flow-based biofiltration BMPs. At this time, this method applies only to proprietary BMPs deemed acceptable per Appendix J.

In DMAs that are categorized as "Biotreatment with Partial Infiltration" the use of a compact BMP may need to be supplemented with volume reduction features. This method includes steps to account for supplemental volume reduction features. In DMAs that are categorized as "Biotreatment with No Infiltration" supplemental volume reduction features are not needed and those elements of the sizing method are not relevant.

E.3.5.1 Stepwise Instructions for Sizing Compact Biofiltration BMPs

The method includes the following calculations:

1. Calculate the time of concentration for the DMA (See Section E.2.3)
2. Locate the line corresponding to the time of concentration (T_c) in Figure E-7Figure E-7. Locate the point on the line that corresponds to 80% capture (y-axis) and record the corresponding value from the x-axis. This is the design intensity required in order to achieve 80% capture (I_1).
3. Determine the capture efficiency achieved by any upstream HSCs (Section E.2.1) or harvest and use BMPs (Section E.3.6). Trace a horizontal line Figure E-7 corresponding to the capture efficiency achieved by the upstream HSC or harvest and use BMPs.
4. Find where the line traced in step (3) intersects the line corresponding to the time of concentration of the BMP selected in step (1) and read down to the x-axis. This is the equivalent flow rate captured by upstream HSCs or harvest and use BMPs. This is referred to as I_2. Note that if no upstream retention is provided in HSCs or harvest and use BMPs, I_2 will be 0.
5. Subtract I_2 from I_1 to determine the design intensity for flow-based BMPs that would achieve 80 percent long term capture.
6. Convert this intensity to a flow rate (See Section E.2.4).
7. Multiply the flow rate from Step (6) by 150% to obtain the required design flow rate of the compact flow-based biofiltration BMP.

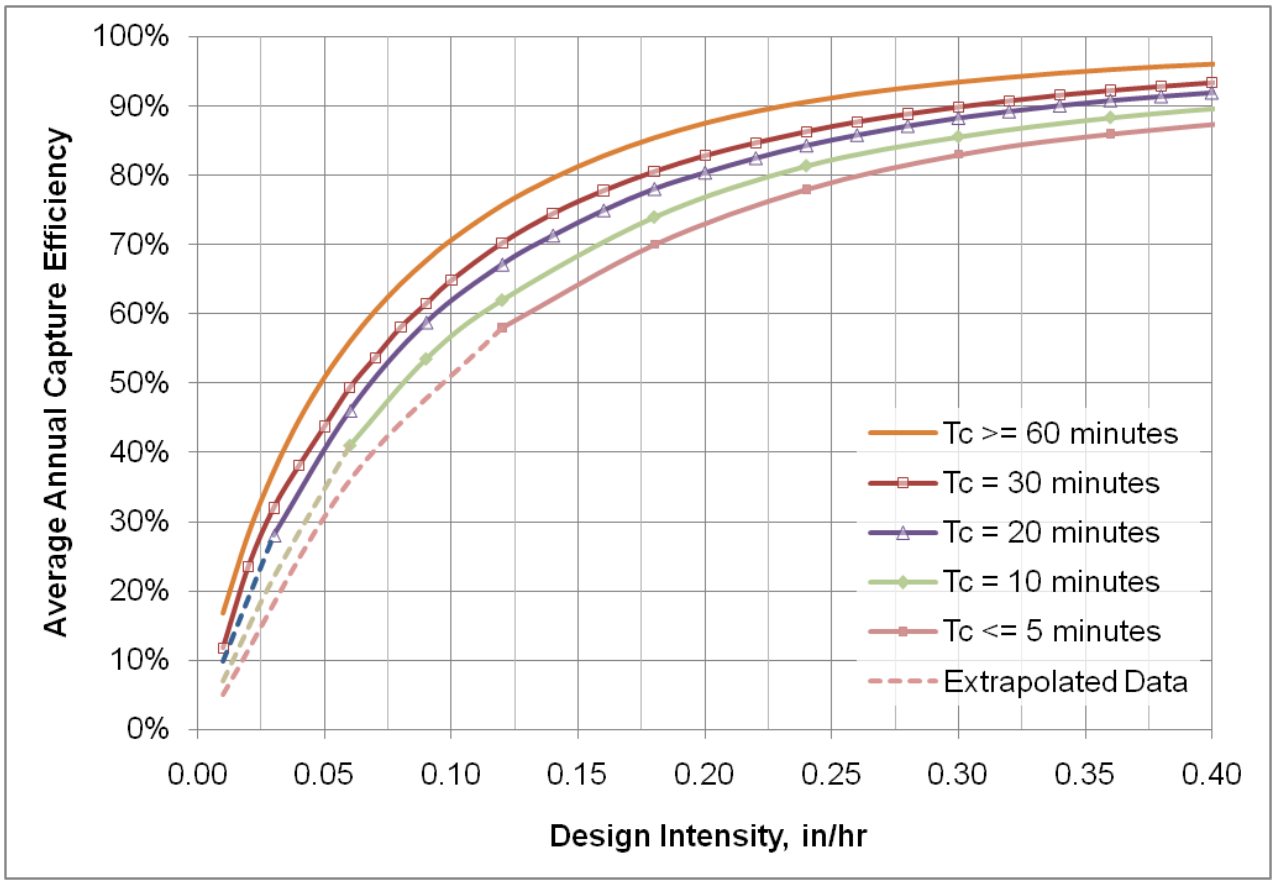
For BMPs in a DMA categorized a "biotreatment with no infiltration" stop here. For BMPs in a DMA categorized as "biotreatment with partial infiltration" proceed.

8. Select and describe HSCs, upstream BMPs, and/or downstream BMPs that are provided to result in volume reduction. This could include any HSC from Appendix G, cisterns or permeable pavement upstream of the BMP, or shallow infiltration galleries or trenches downstream of the BMP.
9. Demonstrate that one of the following options is met:

Option 1 for Supplemental Retention: Demonstrate that HSCs, upstream BMPs, and downstream BMPs collectively achieve at least 40 percent average annual runoff volume for the DMA. This can be demonstrated using the nomograph capture efficiency method in Section E.3.2, but setting the target for 40 percent rather than 80 percent.

Option 2 for Supplemental Retention: Demonstrate that the effective footprint for infiltration provided by HSCs, upstream BMPs, and downstream BMPs, as applicable, is equivalent to a conventional biofiltration BMP. The footprint to achieve partial volume reduction goals is determined via Section E.4.2.

Figure E-7. Capture Efficiency Nomograph for Flow-based Biotreatment BMPs in Orange County



E.3.5.2 Guidance on Sizing Compact Biofiltration with Upstream Detention

There are some design scenarios where an upstream cistern or tank could be used to detain and slow the flow entering a compact biofiltration BMP. This design approach can be used to extend the time of concentration of the catchment up to a maximum of 60 minutes. It cannot be used to

significantly extend the duration of flow through the compact biofilter. The following guidance applies to this configuration:

- Detention outlet should be sized such that the maximum discharge rate is equal to or less than the design capacity of the biofilter when the detention storage is full

- An adjustment to the time of concentration used in biofilter sizing can be calculated as:

  Tc increase = Volume of detention (cu-ft) / [Design flowrate of biofilter (cfs) * 3600 sec/hr]

  In no case can the total Tc used in sizing calculations exceed 60 minutes.

- The tank should be demonstrated to drain within 6 hours following the end of precipitation. It is unacceptable to use compact biofilters downstream of extended detention or flow duration control basins that drain over a longer time period due to potential issues with extended saturation and elevated loading per footprint area of the biofilter.

Proprietary compact biofiltration BMPs have not typically be tested for certification purposes under extended drawdown and heavier loading as would result from additional credits for detention. This adjustment to a maximum of a 60 minute time of concentration is the limit to which detention effects can be considered at this time.

E.3.5.3 Example Using the Method for Sizing Compact Biofiltration BMPs

Example E.9: Sizing to Achieve Target Average Annual Capture Efficiency, Flow-based Biotreatment BMPs

Given:

- Partial Infiltration condition
- Drainage Area = 1 acre
- Imperviousness = 90%
- The BMP is located in an area with an 85th percentile, 24-hour storm of 0.8 inches.
- HSCs upstream provide 15% volume reduction (See Section E.2.1)
- A compact biofiltration BMP is used that meets the acceptance criteria in Appendix J
- An shallow infiltration gallery will be provided downstream of the BMP to provide supplemental volume reduction
- The assumed infiltration rate is 0.15 inches per hour based on initial feasibility screening efforts; detailed design-level analyses are not required

Required:

- Determine compact biofiltration design flowrate and size supplemental infiltration gallery

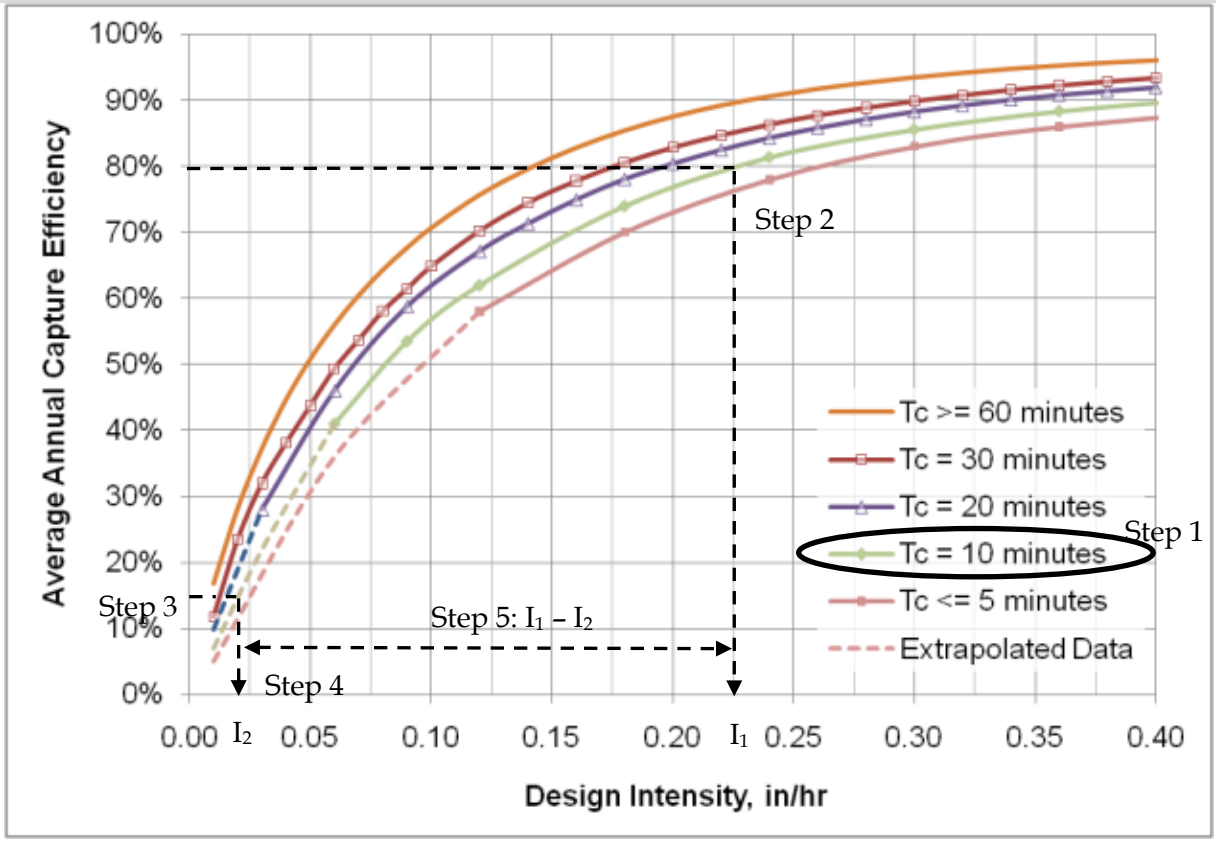
Solution:

1. Computed time of concentration, T_c = 10 minutes (This would be calculated per methods in Section E.2.3)
2. From Figure E-7: I_1 = 0.23 in/hr
3. Capture efficiency achieved in upstream HSCs is 15% (This would be calculated per methods in Section E.2.1)
4. From Figure E-7: I_2 = 0.02 in/hr
5. $I_1 – I_2$ = design intensity = 0.21 in/hr
6. Q = [(0.90 ×0.75+0.15) × 0.21 in/hr × 1 ac]= 0.17 cfs
7. Q_{design} = 0.17cfs x 150% = **0.26 cfs**
8. Upstream HSCs achieve 15% volume reduction (<40%), so additional supplemental infiltration is needed if determined to be feasible. A shallow infiltration gallery with a depth of 18 inches of stone will be used. Water from underdrains of the compact biofilter will be routed to this gallery to infiltrate. The degree of infiltration is comparable to a biofiltration BMP with elevated underdrains.
9. The demonstration of adequacy will be made based on providing an equivalent footprint for infiltration compared to a conventional biofiltration BMP. See The footprint to achieve partial volume reduction goals is determined via E.4.2. Per this section the combined footprint of upstream and downstream BMPs needs to be 1.7 percent of the tributary impervious area.

   90% * 1 ac * 1.7% * 43560 sq-ft/ac = 670 sq-ft infiltration area required.

   Provide a shallow infiltration gallery with a footprint of at least 670 sq-ft. Provide an overflow pipe at 18 inches above the bottom of the gallery. Alternatively, more aggressive use of upstream BMPs, such as permeable pavement, could provide the needed footprint for infiltration without a downstream infiltration gallery, and could also reduce the required size of the compact biofilter.

Graphical operations supporting solution:



E.3.5.4 Worksheet for Using the Flow-Based Compact Biofiltration with Supplemental Retention Method for Sizing Compact Biofiltration BMPs

Worksheet 13: Flow-Based Compact Biofiltration with Supplemental Retention Method

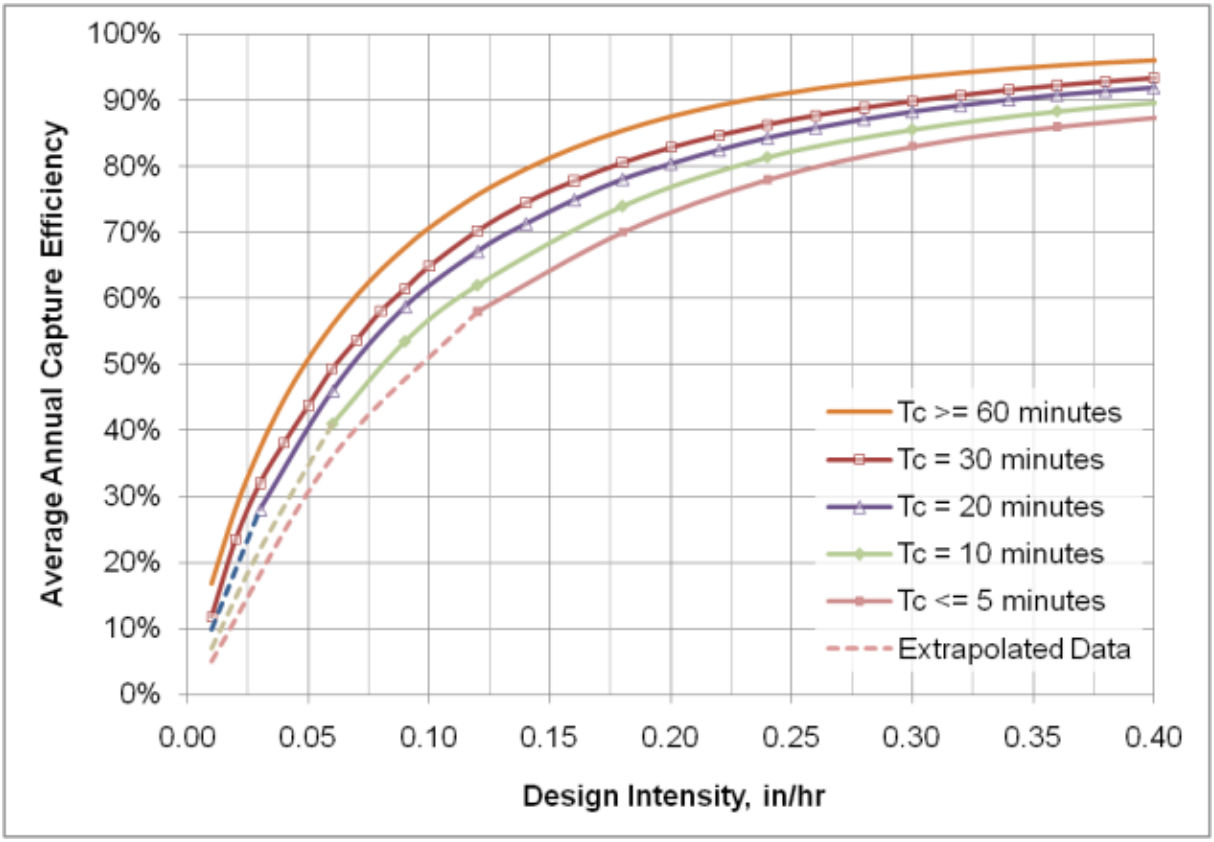
Part 1: Determine the design storm intensity of the compact biofiltration BMP				
1	Enter the time of concentration, T_c (min) (See E.2.3**)** (account for upstream detention by increasing Tc to a maximum 60 minutes per Section E.3.5.2 if detention is provided)	T_c=		min
2	Using Figure E-7 or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=		in/hr
3	Enter capture efficiency corresponding to upstream HSCs and/or upstream BMPs, Y_2. Attach associated calculations.	Y_2 =		%
4	Using Figure E-7, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=		in/hr
5	Determine the design intensity that must be provided by BMP to achieve 80 percent capture, $I_{design}= I_1-I_2$	$I_{design_80\%}$ =		in/hr
Part 2: Calculate the design flowrate of the compact biofiltration BMP (Section E.2.6)				
6a	Enter DMA area tributary to BMP (s), *A* (acres)	A=		acres
6b	Enter DMA Imperviousness, imp (unitless)	imp=		
6c	Calculate runoff coefficient, *c= (0.75 x imp) + 0.15*	c=		
6d	Calculate flowrate to achieve 80 percent capture, $Q_{80\%}$= *(c x* I_{design} *x A)*	$Q_{80\%}$=		cfs
7	Calculate design flowrate, $Q_{design}= Q_{80\%}$ *x 150%*	Q_{design}=		cfs
Part 3: Demonstrate that Supplemental Retention BMPs Conform to Volume Reduction Targets (Only DMAs Categorized as "Biotreatment with Partial Infiltration")				
8	Describe system, including features to maximize volume reduction (if applicable):			
9	Summarize calculations to demonstrate that volume reduction targets are met, where feasible and applicable.			

Worksheet 13: Flow-Based Compact Biofiltration with Supplemental Retention Method

Supporting Calculations

Provide time of concentration assumptions:

Graphical Operations



Provide supporting graphical operations in figure above.

E.3.6 Capture Efficiency via Nomograph Method for Harvest and Use BMPs

Harvest and Use BMPs capture and store rainwater for later use as irrigation, toilet flushing, and other demands. Because these BMPs rely on demand for the harvested water rather than infiltration, their drawdown is typically much slower. The drawdown time is calculated based on the size of the cistern and the magnitude of the indoor and outdoor demands. Appendix F contains methods for computing both indoor and outdoor harvested water demand. Outdoor demands are typically seasonal while indoor demands are more constant. Because outdoor demand is more common for harvested rainwater in Orange County, this method focuses only on determining the capture efficiency of a Harvest and Use BMP configuration with a seasonally varying use rate (irrigation demand). The capture efficiency of a Harvest and Use BMP configuration used for constant indoor demand can be calculated using a similar method, except that a constant drawdown nomograph (Figure E-4) is used instead of the EIATA-based nomograph (Figure E-8), with the drawdown time based on the indoor demand rather than outdoor demand. For Harvest and Use BMP systems with both seasonally varying outdoor demand and constant indoor demand, continuous simulation modeling will be required to determine the capture efficiency.

Harvest and Use BMPs cannot typically achieve 80% capture of long term runoff in Orange County because their drawdown time is typically much longer than other LID BMPs. Typically, this method will be used as a component of other LID BMP sizing methodologies to calculate the capture efficiency of upstream Harvest and Use BMPs, so that the required size of downstream LID BMPs is reduced.

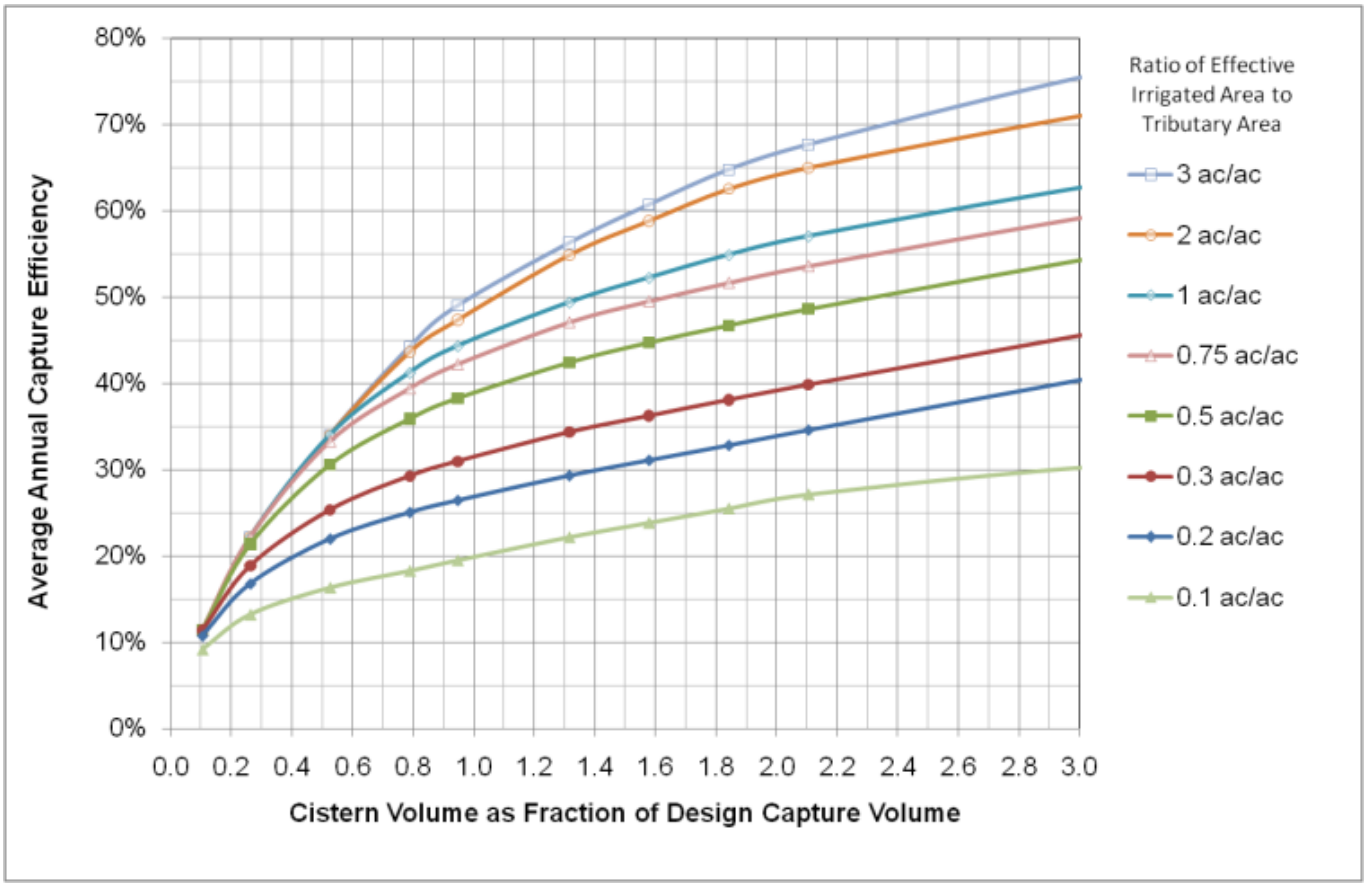
E.3.6.1 Stepwise Instructions for Capture Efficiency via Nomograph Method for Harvest and Use BMPs

The method includes the following calculations:

1. Estimate the effective irrigation area ratio of the system (EIATA) (See Appendix F). This is calculated as the amount of irrigated area divided by the amount of impervious area tributary to the cistern.
2. Determine the capture efficiency achieved by any upstream HSCs (Section E.2.1). Trace a horizontal line corresponding to this capture efficiency on Figure E-8. Locate where this line intersects the line corresponding to the EIATA computed in Step (1).
3. Pivot and read down to the horizontal axis. This is X_1. Note that if no HSCs are provided, X_1 will be 0.
4. Determine the 85th percentile, 24-hour design storm event depth by locating the site on Figure N-1.
5. Convert the design storm depth from Step (4) into a design capture volume (E.2.2).
6. Calculate the storage volume of the BMP (the volume of the cistern, tank, vault, etc.)

7. Divide the storage volume from Step (6) by the DCV from Step (5) to obtain the storage volume as a fraction of the DCV.
8. Add the result of Step (7) to X_1 from Step (3). This is X_2.
9. Draw a vertical line from X_2 to intersect with the line corresponding to the EIATA. Pivot and read to the vertical axis. This is the cumulative capture efficiency achieved by the Harvest and Use BMP and any upstream HSCs.

Figure E-8: Capture Efficiency Nomograph for Harvest and Use Systems with Irrigation Demand in Orange County



E.3.6.2 Example Using the Capture Efficiency via Nomograph Method for Sizing Harvest and Use BMPs

Example E.10: Computing the Capture Efficiency of a Harvest and Use BMP

Given:

- 85th percentile, 24-hr storm depth = 0.85 inches
- Drainage Area = 3 acres
- Imperviousness = 70%
- Captured runoff will be used to irrigate 2 acres of turf
- Effect of provided HSCs (d_{HSC}) = 0.1 inches
- 30,000 gallon stormwater vault

Required:

- Determine the capture efficiency provided by the Harvest and Use BMP (and upstream HSCs)

Solution:

1. Compute EIATA from Appendix F.

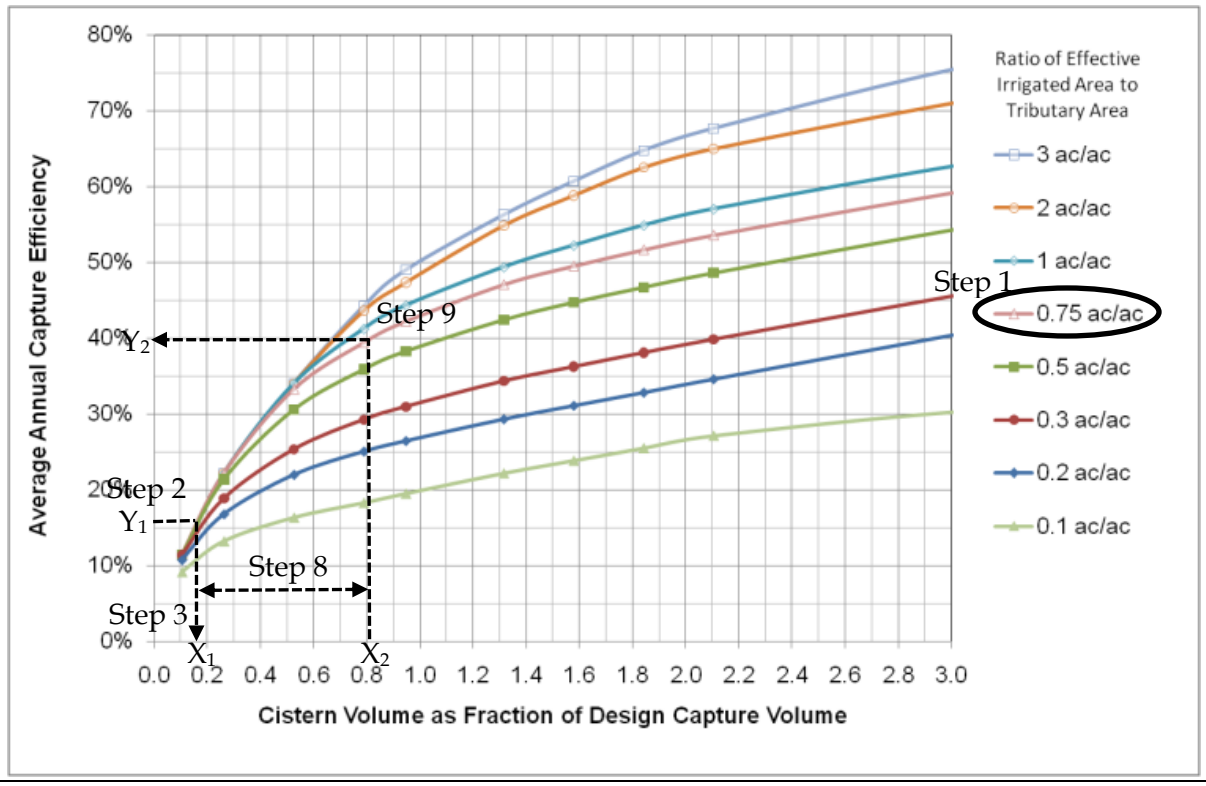
   LA = 2 acres

   K_L = 0.7

   EIATA = LA * K_L / 0.9 * Imp Area) = (2 *0.7) / (0.9 * 0.7 * 3) = 0.74 effective irrigated acre per impervious tributary acre

2. Capture efficiency achieved by 0.1 inches of HSCs = 16% (From Section E.2.1).
3. From Figure E-11: X_1 = 0.17
4. From Figure N-1, 85th percentile, 24-hour storm event is 0.85 inches
5. DCV = 3 ac × 0.85 inches × (0.7×0.75 + 0.15) × 43560 sf/ac × 1/12 in/ft = 6,248 cu-ft
6. V = 30,000 gallons/7.48 = 4,011 cu-ft
7. V/DCV = 4,011/6,248 = 0.64
8. $X_2 = X_1$ + V/DCV = 0.17 + 0.64 = 0.81
9. From Figure E-8: Long term capture efficiency of the Stormwater vault and upstream HSCs = 40%. This value can be used as the amount of upstream retention as part of other BMP sizing methods.

Graphical operations supporting solution:



E.3.6.3 Worksheet for Using the Capture Efficiency via Nomograph Method for Sizing Harvest and Use BMPs

Worksheet 14: Nomograph Method for Determining Capture Efficiency of Harvest and Use BMPs

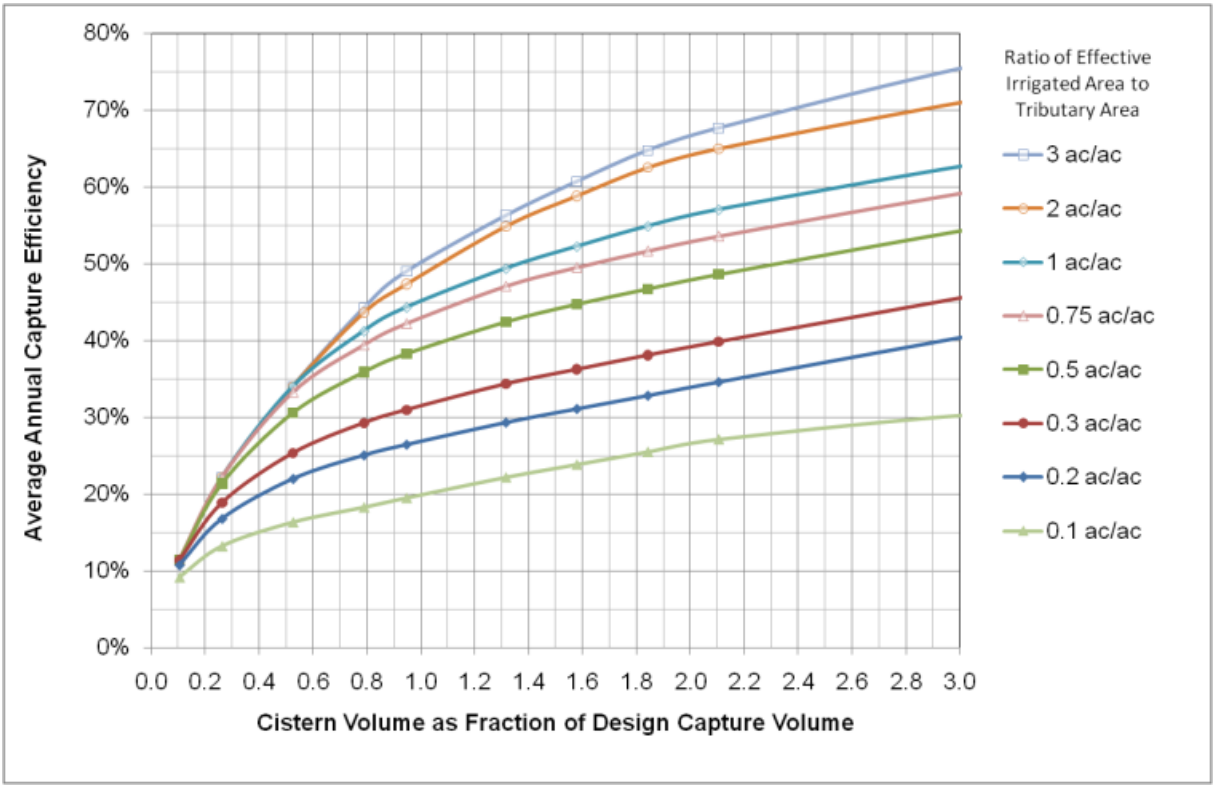
Part 1: Calculate the EIATA and the effect of upstream HSCs				
1a	Landscape area irrigated with harvested water	LA=		acres
1b	Area-weighted landscape coefficient (typically 0.7 for active turf, 0.35 for conservation landscape design)	K_L=		
1c	Irrigation efficiency (typically 0.90)	IE		
1d	Enter DMA area tributary to BMP (s), *A* (acres) (not including any self-retaining areas)	A=		acres
1e	Enter DMA Imperviousness, *imp* (unitless)	imp=		
1f	Effective Irrigated Area to Tributary Area ratio, EIATA = LA * K_L / (IE * imp * A)	EIATA		ac/ac
2	Enter capture efficiency corresponding to upstream HSCs (Worksheet 4) and locate on Figure E-8 or the figure within the worksheet below	Y_1=		%
3	Using Figure E-8 or the figure within the worksheet below, determine the cistern volume as a fraction of the DCV corresponding to the capture efficiency of the HSCs	X_1=		
Part 2: Calculate the DCV				
4	85th percentile, 24-hour design storm from Figure N-1	d =		inches
5a	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=		
5b	Calculate the DCV= *(C x d x A x 43560 sf/ac x (1 ft/12 in))*	DCV=		cu-ft
Part 3: Calculate capture efficiency				
6	Storage Volume of BMP (cistern, vault, etc.)	V		cu ft
7	Storage Volume as a fraction of DCV, V_{frac} = V/CDV	V_{frac}		
8	Final equivalent volume as a fraction of DCV from combination of HSCs and harvest and use BMPs, $X_2 = X_1 + V_{frac}$	X_2		
9	Using Figure E-8 or the figure within the worksheet below, determine the capture efficiency of the harvest and use BMPs and any upstream HSCs	Y_2		%

Worksheet 14: Nomograph Method for Determining Capture Efficiency of Harvest and Use BMPs

Supporting Calculations

Describe system:

Graphical Operations



Provide supporting graphical operations.

E.3.7 Flow-Based Capture Efficiency via Nomograph Method for Sizing Treatment Control BMPs

This method is used to size treatment control BMPs. Treatment control BMPs are only used to treat on-site runoff from the site when LID BMPs cannot feasibly meet LID requirements or when alternative off-site BMPs are used to meet LID requirements that do not treat runoff from the site. This method does not account for any upstream BMPs or HSCs because in those rare cases where LID BMPs are infeasible or where off-site BMPs are implemented.

The project proponent has the option of simply selecting 0.2 inches/hour as the design storm intensity or computing a design storm intensity based on an 80% capture efficiency. When the time of concentration is equal to 20 minutes, these will be the same. When the time of concentration is greater than 20 minutes, using the capture efficiency method will yield a smaller design intensity than 0.2 inches/hour.

E.3.7.1 Flow-Based Capture Efficiency via Nomograph Method Stepwise Instructions for Sizing Treatment Control BMPs

The method includes the following calculations:

1. Calculate the time of concentration for the DMA (See Section E.2.3)
2. If the time of concentration is less than 20 minutes, select 0.2 inches/hour as the design storm intensity. If the time of concentration is greater than 20 minutes, locate the line corresponding to the time of concentration (T_c) in using Figure E-7. Locate the point on the line that corresponds to 80% capture (y-axis) and record the corresponding value from the x-axis. This is the design intensity required in order to achieve 80% capture (I_1).
3. Convert the design intensity from step (2) to a design flow rate (See Section E.2.4).

E.3.7.2 Example Using the Flow-Based Capture Efficiency via Nomograph Method for Sizing Treatment Control BMPs

Example E.11: Sizing to Achieve Target Average Annual Capture Efficiency, Flow-based Biotreatment BMPs

Given:
• Drainage Area = 3.5 acres
• Imperviousness = 95%
Required:
• Determine media filter design flowrate
Solution:
1. Computed time of concentration, T_c = 30 minutes (See Section E.2.3)

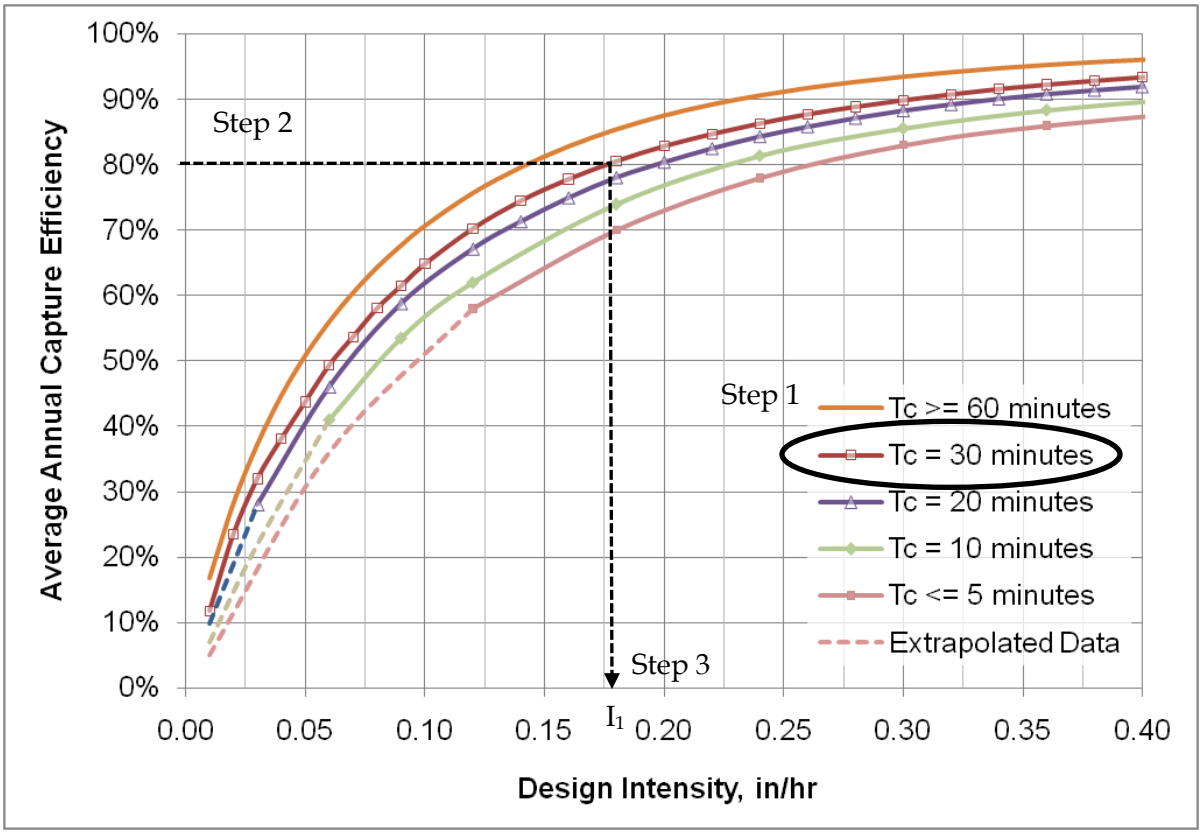
2. Because T_c is greater than 20 minutes, it will result in a more efficient size to compute the design intensity using 80% capture.

   From Using Figure E-7: I_1 = 0.18 in/hr

3. Q = [(0.95×0.75+0.15) × 0.18 in/hr × 3.5 ac]= 0.54 cfs

Graphical operations supporting solution:

Graphical Operations



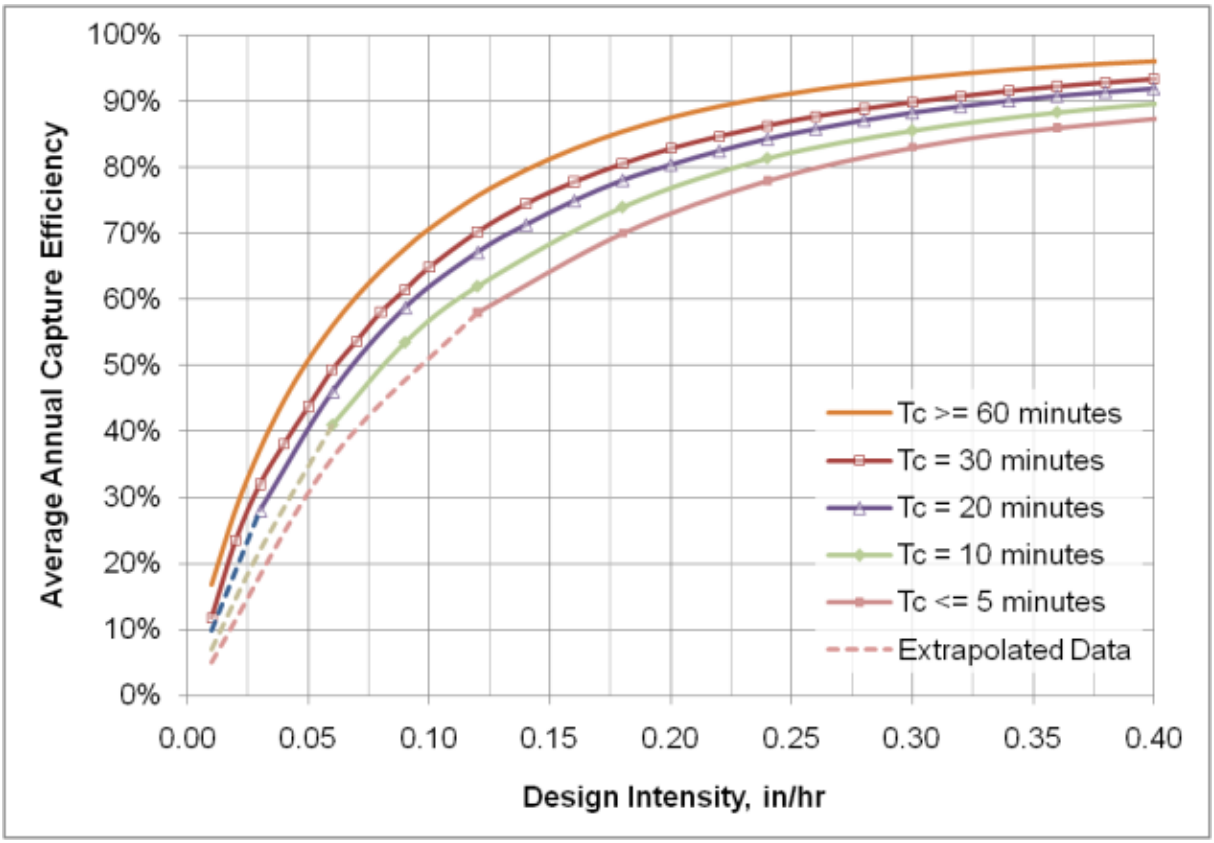
E.3.7.3 Worksheet for Using the Flow-Based Capture Efficiency via Nomograph Method for Sizing Treatment Control BMPs

Worksheet 15: Capture Efficiency and Multiplier Method for Flow-Based Biotreatment BMPs

Part 1: Determine the design storm intensity and flow rate				
1	Enter the time of concentration, Tc (min) (See Section E.2.3)	T_c=		min
2	If T_c is less than 20 minutes, then use I_1 = 0.2 in/hr. Otherwise, using Figure E-7or the figure included in the worksheet, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=		in/hr
3a	Enter DMA area tributary to BMP (s), *A* (acres)	A=		acres
3b	Enter DMA Imperviousness, imp (unitless)	imp=		
3c	Calculate runoff coefficient, *c= (0.75 x imp) + 0.15*	c=		
3d	Calculate design flowrate, *Q= (c x I_{design} x A)*	Q=		cfs
Supporting Calculations				
Describe system:				
Provide time of concentration assumptions:				

Worksheet 15: Capture Efficiency and Multiplier Method for Flow-Based Biotreatment BMPs

Graphical Operations



Provide supporting graphical operations.

E.4 Other Sizing Resources and Considerations

E.4.1 Calculating the Infiltrating Surface Area to Avoid Premature Clogging

The clogging of soil and media in BMPs is an expected outcome of filtration and infiltration treatment processes. Clogging risk can be a controlling factor in the footprint of infiltration and biofiltration BMPs. The rate of clogging is a function of:

- Sediment load in stormwater
- Effectiveness of pretreatment
- Whether the BMP is vegetated and exposed to the surface or below ground and not exposed to weathering
- Effective infiltrating surface area of the BMP

Further discussion is provided in Section 4.4.1 of the TGD. Rehabilitation of BMPs to alleviate sediment accumulation and associated clogging will be needed. This TGD establishes a minimum target of 10 years between rehabilitation events.

Table E-4 provides a lookup table of target minimum infiltration surface area, as a percent of the tributary impervious area, for a range of combinations of the factors listed above. This table should be consulted to select the target value that best represents the proposed BMPs design. This value is used as part of sizing methods as a check on minimum footprint sizing of the BMP. The minimum BMP surface area to avoid premature clogging should be measured against the BMP wetted surface area, including bottom and slopes or side walls, when the BMP is half full.

It may not be possible to exactly match site conditions to a value in Table E-4. The best match is acceptable. Alternatively, site-specific calculations can be performed. Table E-5 documents acceptable inputs to these calculations.

Proprietary BMPs are also subject to clogging. However, these BMPs have been tested and have defined maintenance regimes that allow them to operate at smaller footprints. This section is not intended to be applied to proprietary BMPs.

Table E-4. Infiltration Surface Area to Avoid Premature Clogging

DMA Dominant Land Cover Category	Pretreatment Approach	Subsurface BMP (load to clog = 1.0 lb/sq-ft)	Vegetated Surface BMP (load to clog = 2 lb/sq-ft)	Vegetated Surface BMP with High Permeability Media and Outlet Control (load to clog = 3 lb/sq-ft
		Target BMP Infiltrating or Filtering Surface Area as Percent of Tributary Impervious Area		
Urban Mix with Open Space 10 to 25% of Area	None	8.7%	4.3%	2.9%
	Forebay	6.5%	3.3%	2.2%
	Certified Pretreatment	4.3%	2.2%	1.4%
	Certified Treatment	2.2%	1.1%	0.72%
Urban Mix, no significant Open Space	None	5.6%	2.8%	1.9%
	Forebay	4.2%	2.1%	1.4%
	Certified Pretreatment	2.8%	1.4%	0.93%
	Certified Treatment	1.4%	0.7%	0.46%
High Vehicle Intensity (roads, commercial parking lots, light industrial)	None	6.6%	3.3%	2.2%
	Forebay	5.0%	2.5%	1.7%
	Certified Pretreatment	3.3%	1.7%	1.1%
	Certified Treatment	1.6%	0.83%	0.55%
Low Traffic Paths, Streets, Parking Lots (<20% landscaping/ slopes)	None	3.4%	1.7%	1.1%
	Forebay	2.7%	1.4%	0.90%
	Certified Pretreatment	2.0%	1.0%	0.68%
	Certified Treatment	1.4%	0.68%	0.45%
Rooftops and Paths (no landscaping)	None	0.91%	0.45%	0.30%
	Forebay	0.91%	0.45%	0.30%
	Certified Pretreatment	0.91%	0.45%	0.30%
	Certified Treatment	0.65%	0.32%	0.22%
DMA contains disturbed or erodible exposed soils; or open space > 25% of area	Isolate or stabilize sediment sources Route open space separately			

E.4.1.1 Basis for BMP Surface Area Calculations to Avoid Premature Clogging

The basis for the values in Table E-4 is explained in this section. The method is based on estimating the accumulation of sediment mass per unit area of BMP per year. At a certain degree of accumulation, the BMP is assumed to require maintenance. Table E-5 documents the inputs to these calculations.

Table E-5: Inputs and Results of Clogging Calculations

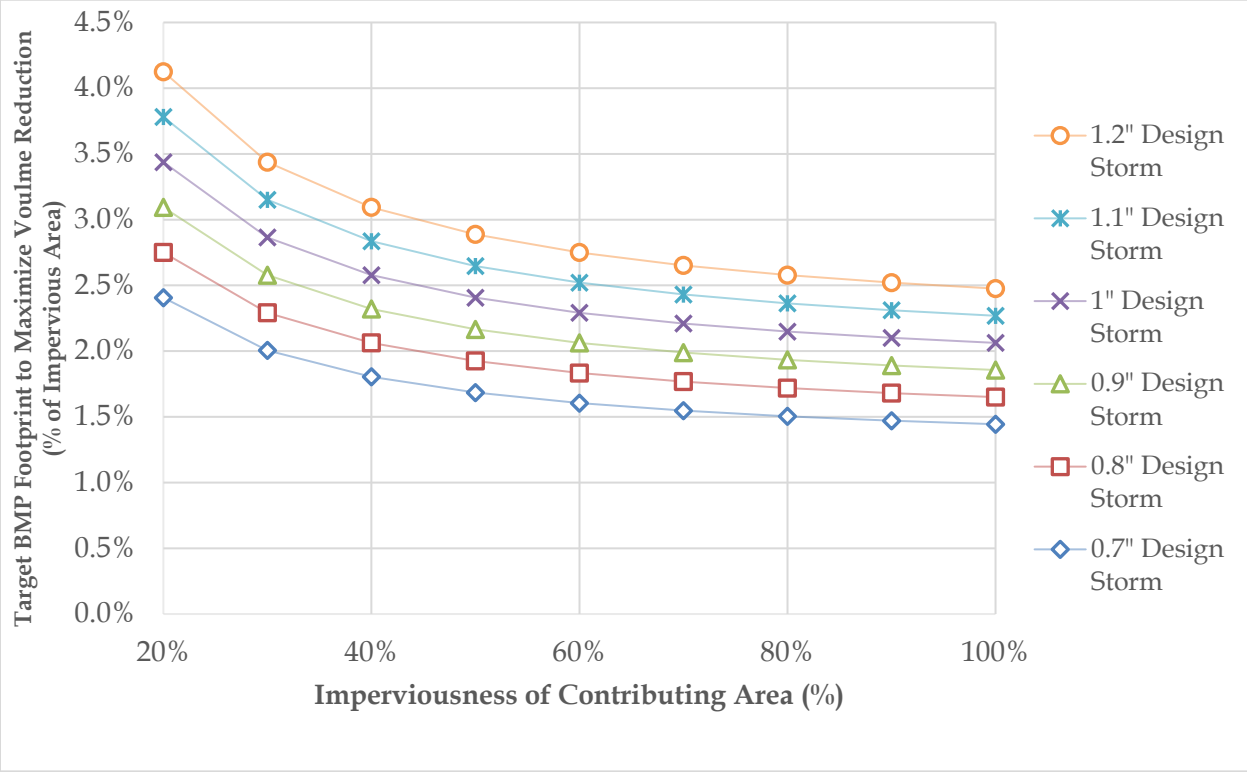
Parameter	Value	Reference
Representative TSS Event Mean Concentration (mg/L)	Urban mix: 120 Urban mix, no OS: 80 High vehicle intensity: 100 Low traffic paths, streets parking lots: 50 Rooftops: 14	Approximate average of EMCs based on Los Angeles County monitoring data (See Table 2-2 of the TGD)
Imperviousness	Based on land use	Based on land use type
Runoff coefficient of impervious surface	0.9	C = runoff coefficient = $(0.75 \times imp + 0.15)$
Average Annual Precipitation	11.4"-13.9"	Based on analysis of long term data from five rain gages in Orange County (http://www.ocalmanac.com/Weather/we02.htm)
Load to Initial Maintenance, lb/sq-ft	Subsurface BMP: 1 lb/sq-ft Vegetated Surface: 2 lb/sq-ft Vegetated Surface BMP with High Permeability Media and Outlet Control: 3 lb/sq-ft	Pitt, R. and S. Clark, 2010. Evaluation of Biofiltration Media for Engineered Natural Treatment Systems. Also based on various literature studies.
Allowable period to initial clogging, years	10	Policy-level assumption; more frequent maintenance may be acceptable in some cases
Adjustment to sediment load to account for pretreatment	Forebay: 25% Certified Pretreatment: 50% Certified Treatment: 75% (lower ratios when influent is lower)	Estimated based on International BMP Database and Washington State TAPE testing

E.4.2 Calculating the Target Biofiltration Footprint to Maximize Volume Reduction

This section applies to Biofiltration BMPs within DMAs categorized as "Biotreatment with Partial Infiltration," specifically BIO-1 (Bioretention with Elevated Underdrain Discharge) and BIO-5 (Compact Biofiltration with Supplemental Retention). The footprint of biofiltration BMPs is an important factor in the degree to which incidental volume reduction is expected to occur in these BMPs.

Figure E-9 provides a simple method to determine the target biofiltration BMP footprint to maximize volume reduction. This is expressed as a percent of the tributary impervious area. In some cases, this factor may control the sizing of biofiltration BMPs. It is used as a check in various sizing methods. Based on the design capture storm depth and the DMA imperviousness, the best match from this figure should be used. The presence of documented and supported space constraints (as discussed in Section 4.2.4 of the TGD) can be considered in establishing a target footprint smaller than the target in Figure E-9.

Figure E-9. Target Biofiltration Footprint to Maximize Volume Reduction



E.4.2.1 Basis for Target Footprint for Incidental Volume Reduction

This TGD establishes the goal that BMPs should achieve incidental volume reduction of 40 percent of average annual volume reduction. This is intended to provide equivalent pollutant load reduction in biofiltration BMPs as would be achieved in full infiltration BMPs. This

equivalence is based on page F-103 of the Regional MS4 Permit Fact Sheet. Further, this TGD acknowledges that it becomes increasingly challenging to achieve 40 percent volume reduction if soil permeability is lower. For sites at the threshold of feasibility (0.3 in/hr design infiltration rate) and no other infiltration feasibility limits, this value should be generally feasible. However, for sites with lower permeability, this may not be possible.

Figure E-9 was developed based on the capture efficiency nomographs using the following assumptions and methods:

- Assumes 18" gravel below underdrain discharge elevation and media depth of 24" which are the default standards for BIO-1 and BIO-7
- Assumes an underlying infiltration rate of 0.3 in/hour, which is the threshold of feasibility for full infiltration BMPs.
- DMA imperviousness and the depth of the 85th percentile, 24-hour storm were varied.
- For each combination of DMA imperviousness and the depth of the 85th percentile, 24-hour storm, the BMP footprint required to achieve 40 percent long term volume reduction was determined.

The results of this analysis are plotted in Figure E-9. Interpolation from this figure is acceptable to match site and DMA conditions.

It is acceptable for a project proponent to present a project-specific calculation demonstrating that a proposed biofiltration BMP meets the target of 40 percent volume. The Capture Efficiency Method via Nomograph Method for Sizing Full Infiltration BMPs (Section E.3.2) can be used. The main differences are the '80% capture' is replaced with '40% capture'.

E.4.3 Capture Efficiency via Continuous Simulation Method for Sizing LID BMPs

For projects with complex hydrologic conditions or for evaluation of BMP designs that include both LID and hydromodification, the SOHM can be used to compute long term capture efficiency and volume reduction. The model should be run using a local precipitation record and project-specific information about soils, slopes, and BMP designs.

When using continuous simulation methods for sizing a Full Infiltration BMP, the target to demonstrate appropriate sizing is 80 percent long term capture efficiency with all captured water being infiltrated. This can be done by using the model to calculate the long term runoff volume into the BMP and the volume that discharges from the BMP. If the total volume that discharges from the BMP is 20% or less of the total runoff volume, then the BMP is achieving 80% long term capture efficiency.

For biofiltration BMPs, the continuous model should be used to determine the BMP size needed for 80 percent long term capture efficiency and treatment. This can be done by using the model to calculate the long term runoff volume into the BMP and the total untreated volume

that discharges from or bypasses the BMP. After the volume to achieve 80 percent long term capture is determined, then the BMP should be increased in size by the required 150 percent multiplier. The SOHM can also be used to demonstrate that the target of 40 percent volume reduction is met for BIO-1 or BIO-5 BMPs.

Due to the variability of possible scenarios using continuous simulation modeling, no stepwise instructions, example, or worksheet is provided for continuous simulation methods.

E.4.4 Treatment Trains

The most common treatment trains involve LID BMPs downstream of HSCs and/or harvest and use BMPs, or supplemental volume reduction downstream of compact biofiltration BMPs. These cases have been incorporated into the BMP sizing methods in Section E.3.

However, it is allowable for project proponents to meet LID criteria using multiple BMPs in parallel or in series to meet applicable requirements. In those cases, any of the methods in Section E.3 can be adapted. BMPs should be evaluated from upstream to downstream. The portion of the DCV or the long term capture efficiently achieved in an upstream BMP can be used as an input to the sizing method for the downstream BMP.

Unconventional treatment trains should be modeled using continuous simulation models to demonstrate performance (See Section E.4.3).

E.4.5 Regional BMPs

Any of the sizing methods in Section E.3 can be applied to on-site or regional BMPs. However, when sizing regional BMPs, it is often not necessary to size them to achieve 80% capture from the entire contributing area. This will depend on the other surrounding developments planning to use the regional BMP, what partnerships and agreements have been made, etc. In general, however, as long as a regional BMP is large enough to capture the DCV from the site and other projects that plan to utilize it, it does not necessarily need to achieve 80 percent capture for its entire tributary area. A smaller percent capture from a much larger area can be a larger amount of long term volume captured than would have been achieved by capturing 80 percent of runoff from a given project site. The key metric in analyzing regional BMPs should be the total long term volume captured. This should be demonstrated to exceed 80 percent of long term runoff volume from the project site. Sizing to treat a greater volume could be used to generate water quality credits, if mechanism are in place.

APPENDIX F. HARVEST AND USE DEMAND CALCULATIONS AND DESIGN CONSIDERATIONS

F.1 Introduction

The purpose of this appendix is to provide guidance for calculating harvested water demand, provide the conditions where harvest and use BMPs is required to be considered as an LID BMP, and provide guidance and considerations when designing harvest and use BMPs beyond what is in the fact sheets (Appendix G). This appendix contains the following:

- Harvested water demand calculation methods and guidance for preparing project-specific harvested water demand calculations (Section F.2)
- The method to determine if harvest and use BMPs are required to be considered versus when they are optional (Section F.3)
- Information and requirements from the California Plumbing Code and other sources regarding the use of harvested rain water for indoor and outdoor uses (Section F.4)

F.2 Harvested Water Demand Calculation

The following sections provide technical methods and guidance for estimating the harvested water demand of a project. These methods are intended to be used as part of evaluating the feasibility of harvest and use (planning phase) and to support sizing harvest and use systems if they are selected as an LID BMP.

While harvested water capture efficiency is evaluated at the scale of a single DMA (Appendix E), harvested water demand should be evaluated at the scale of the project, and not limited to single drainage areas. It is assumed that harvested water collected from one drainage area could be used within another.

F.2.1 Key Differences in Demand Calculations for Harvest and Use Feasibility versus Water Supply Planning

It is very important to note that harvested water demand calculations differ in purpose and methods from water demand calculations done for water supply planning. When designing harvest and use systems for stormwater management, a reliable method of relatively quickly regenerating storage capacity (i.e., using water) must exist to provide storage capacity for subsequent storms. Therefore, demand calculations for harvest and use BMPs should attempt to estimate the ***actual demand that is reliably present to drain stormwater cisterns during the wet season and especially within short-term (week to a couple of weeks) series of storms that are typical***. This objective is fundamentally different from the objectives of water demand forecasting calculations done for water supply planning. Methods to estimate water demand may err toward higher estimates of demand to provide conservatism to account for uncertainty.

In contrast, harvested water demand calculations used to determine the feasibility of harvest and use BMPs must be based on estimates of actual expected demand that are reliably present to drain the cistern during the wet season.

F.2.2 Types of Harvested Water Demand

Types of non-potable water demand anticipated to be applicable in the foreseeable future include:

- Toilet and urinal flushing
- Irrigation
- Vehicle washing
- Evaporative cooling
- Dilution water for recycled water systems
- Industrial processes
- Other non-potable uses

The following sections are divided between toilet flushing, outdoor irrigation demand, and other non-potable demands. The primary distinction between toilet/urinal flushing and irrigation demand is the level of treatment and disinfection that is required to use the water (See Section F.4) and the seasonal pattern of the demand. Other non-potable demands (e.g. industrial processes for example) are anticipated to be highly project specific and should be estimated using project-specific information.

F.2.3 Toilet and Urinal Flushing Demand Calculations

The following guidelines should be followed for computing harvested water demand from toilet and urinal flushing:

- If reclaimed water (e.g. greywater, recycled wastewater, or other non-stormwater sources) is planned for use for toilet and urinal flushing, then the demand for harvested stormwater is equivalent to the total demand minus the reclaimed water supplied, and should be reduced by the amount of reclaimed water that is available during the wet season. The basis for this priority is provided in Section **F.2.8**.
- Demand calculations for toilet and urinal flushing should be based on the average rate during the wet season for a typical year. In buildings with fairly consistent occupancy, a seasonal adjustment is not likely needed. However, if periods of lower occupancy align with the wet season (e.g., tourist hotels, recreational facilities), then an adjustment to account for wet season demand may be needed.
- Demand calculations should include changes in occupancy over weekends and around holidays and changes in attendance/enrollment over school vacation periods.
- For facilities with generally high demand but periodic shut downs (e.g., for vacations, maintenance, or other reasons), a project specific analysis should be conducted to

determine whether performance stormwater management can be maintained despite shut downs. Such an analysis should consider the statistical distributions of precipitation and demand, foremost the relationship of demand to the wet seasons of the year. It may be acceptable to have short periods of lower use if the overall average is adequate.

Table F-1 provides planning level estimated toilet and urinal flushing demand per resident or employee for a variety of project types. The per capita use per day is based on daily employee or resident usage. For non-residential types of development, the "visitor factor" and "student factor" (for schools) should be multiplied by the employee use to account for toilet and urinal usage for non-employees using facilities.

Table F-1: Toilet and Urinal Water Usage per Resident or Employee (gallons)

Land Use Type	Toilet User Unit of Normalization	Per Capita Use per Day		Visitor Factor[4]	Water Efficiency Factor[5]	Total Use
		Toilet Flushing [1,2]	Urinals[3]			
Residential	Resident	18.5	NA	NA	0.5	9.3
Office	Employee (non-visitor)	9.0	2.27	1.1	0.5	7 (avg)
Retail	Employee (non-visitor)	9.0	2.11	1.4	0.5	
Schools	Employee (non-student)	6.7	3.5	6.4	0.5	33
Various Industrial Uses (excludes process water)	Employee (non-visitor)	9.0	2	1	0.5	5.5

1- Based on American Waterworks Association Research Foundation, 1999. Residential End Uses of Water. Denver, CO: AWWARF

2 - Based on use of 3.45 gallons per flush and average number of per employee flushes per subsector, Table D-1 for MWD (Pacific Institute, 2003)

3 - Based on use of 1.6 gallons per flush, Table D-4 and average number of per employee flushes per subsector, (Pacific Institute, 2003)

4 - Multiplied by the demand for toilet and urinal flushing for the project to account for visitors. Based on proportion of annual use allocated to visitors and others (includes students for schools; about 5 students per employee) for each subsector in Table D-1 and D-4 (Pacific Institute, 2003)

5 – Accounts for requirements to use ultra-low flush toilets in new development projects; assumed that requirements will reduce toilet and urinal flushing demand by half on average compared to literature estimates. Ultra low flush (ULF) toilets are required in all new construction in California as of January 1, 1992. ULF toilets must use no more than 1.6 gallons per flush (gpf) and ULF urinals must use no more than 1 gpf. (http://www.fypower.org/com/tools/products_results.html?id=100139) Note: If zero flush urinals are being used, adjust accordingly.

The demand for toilet and urinal flushing for the project is computed using the per capita demand from Table F-1 ('Total Use' column) multiplied by the expected number of residents or employees for all buildings on the project which will use harvested water for toilet flushing during the wet season. Site-specific adjustments to the values in Table F-1 are allowable if they are supported by sound evidence documented in the Project WQMP.

Toilet and urinal flushing demand can be used to evaluate the drawdown time of proposed harvest and use BMPs for the purpose of feasibility evaluation and BMP sizing.

F.2.4 General Requirements for Irrigation Demand Calculations

The following guidelines should be followed for computing harvested water demand from landscaping:

- If reclaimed water (greywater, recycled wastewater, or other non-stormwater) is planned for use for landscape irrigation, then the demand for harvested stormwater should be reduced by the amount of reclaimed water that is available during the wet season. The basis for this priority is provided in Section **F.2.8**.
- Irrigation rates should be based on the irrigation demand exerted by the types of landscaping that are proposed for the project, with consideration for water conservation requirements.
- Irrigation rates should be estimated to reflect the average wet season rates (defined as November through April) accounting for the effect of storm events in offsetting harvested water demand. In the absence of a detailed demand study, it should be assumed that irrigation demand is not present during days with greater than 0.1 inches of rain and the subsequent 3-day period. This irrigation shutdown period is consistent with standard practice in land application of wastewater and is applicable to stormwater to prevent irrigation from resulting in dry weather runoff. Based on a statistical analysis of Orange County rainfall patterns, approximately 30 percent of wet season days would not have a demand for irrigation.
- If land application of stormwater is proposed (i.e., irrigation in excess of agronomic demand), then this BMP must be considered to be an infiltration BMP and feasibility screening for infiltration must be conducted, including infiltration rates, geotechnical issues, water balance issues, and groundwater issues, as applicable. In addition, it must be demonstrated that land application would not result in greater quantities of runoff as a result of saturated soils at the beginning of storm events. Agronomic demand refers to the rate at which plants use water.

The following sections describe methods that should be used to calculate harvested water irrigation demand. While these methods are simplified, they provide a reasonable estimate of potential harvested water demand that is appropriate for feasibility analysis and project planning. These methods may be replaced by a more rigorous project-specific analysis that meets the intent of the criteria above.

F.2.5 OC Irrigation Code Demand Calculation Method

This method is based on the **County of Orange Landscape and Irrigation Code and Implementation Guidelines** Ordinance No. 09-010 (OC Irrigation Code). The OC Irrigation Code includes a formula for estimating a project's annual Estimated Applied Water Use (EAWU) based on the reference evaporation, landscape coefficient, and irrigation efficiency.

For the purpose of calculating harvested water irrigation demand applicable to the sizing of harvest and use systems, the EAWU has been modified to reflect typical wet-season irrigation demand. This method assumes that the wet season is defined as November through April. This method further assumes that no irrigation water will be applied during days with precipitation totals greater than 0.1 inches or within the 3 days following such an event. Based on these assumptions and an analysis of Orange County precipitation patterns, irrigation would not be applied during approximately 30 percent of days from November through April.

The following equation is used to calculate the Modified EAWU:

$$\text{Modified EAWU} = (ETo_{Wet} \times K_L \times LA \times 0.015) / IE$$

Where:

Modified EAWU = estimated daily average water usage during wet season
ETo_{Wet} = Average Reference ET from November through April (inches per month, See Section **F.2.5.1**)
K_L = Landscape Coefficient, $K_L = K_s \times K_d \times K_{mc}$ (See Section **F.2.5.2**)
- K_s = species factor
- K_d = density factor
- K_{mc} = microclimate factor

LA = Landscape Area (sq-ft)
IE = Irrigation Efficiency (assume 90 percent for demand calculations)

In this equation, the coefficient (0.015) accounts for unit conversions and shut down of irrigation during and for the three days following a significant precipitation event:

0.015 = (1 mo/30 days)×(1 ft/12 in)×(7.48 gal/cu-ft)×(approximately 7 out of 10 days with irrigation demand from November through April)

When using this method, the worksheets contained within the OC Irrigation Code may be useful to determine the irrigation use for a project site, with the appropriate modifications to reflect the Modified EAWU calculations. These worksheets allow the user to area-weight the inputs for irrigation from different landscapes within the project.

Note: this is a method to compute average wet season demand. It is not a complete harvest and use sizing method.

F.2.5.1 Reference ET Data

Table F-2 contains data derived from CIMIS for the cities of Irvine, Santa Ana, and Laguna Beach. These values can be used to compute ETo_{Wet} in the Modified EAWU equation above. Other values may also be used as long as they are supported by sound evidence and documented in the Project WQMP.

Table F-2: Monthly Reference ET Rates for Orange County (Inches)

Station	J	F	M	A	M	J	J	A	S	O	N	D	Annual	Wet Season Average (in/mo) (Nov to Apr)
Irvine	2.2	2.5	3.7	4.7	5.2	5.9	6.3	6.2	4.6	3.7	2.6	2.3	49.9	3.00
Laguna Beach	2.2	2.7	3.4	3.8	4.6	4.6	4.9	4.9	4.4	3.4	2.4	2.0	43.3	2.75
Santa Ana	2.2	2.7	3.7	4.5	4.6	5.4	6.2	6.1	4.7	3.7	2.5	2.0	48.3	2.93

Source: County of Orange Landscape and Irrigation Code and Implementation Guidelines

F.2.5.2 Landscape Coefficient (K_L)

The Water Use Classifications of Landscape Species (WUCOLS, University of California and Department of Water Resources, 2000) should be used to determine the landscape coefficient that is applicable to each landscape irrigation zone. The landscape coefficient, K_L, is based on the product of the species factor (K_s), the density (K_d), and the microclimate (K_{mc}).

- The species factor is based on plant water needs derived from available data. At the time of the 2000 WUCOLs, 1,800 plant species had been evaluated for relative water needs. Specific species factors for these plant species are available in WUCOLs.
- The density factor is related to the vegetative or leaf cover for different plantings. Thinner or thicker than average density conditions are assigned density coefficients less than or greater than 1.0, respectively.
- The microclimate factor is related to features present in the urban landscape that influence temperature, wind, shading, and other climatic factors. An 'average' microclimate is equivalent to reference ET conditions (1.0), which is relatively uninfluenced by nearby buildings, structures, etc.

Table F-3 provides a general overview of these factors, ranging from low to high water use plant palettes.

Table F-3: Species, Density, and Microclimate Factors from WUCOLs for High, Moderate, Low and Very Low Water Use Plant Palettes

	High	Moderate	Low	Very Low
Species Factor* (k_s)	0.7-0.9	0.4-0.6	0.1-0.3	<0.1
Density (k_d)	1.1-1.3	1.0	0.5-0.9	
Microclimate (k_{mc})	1.1-1.4	1.0	0.5-0.9	

Source: **Water Use Classifications of Landscape Species** (WUCOLS, University of California and Department of Water Resources, 2000)

Table F-4 provides recommended composite landscape coefficients that are appropriate for planning purposes and feasibility screening.

Table F-4: Planning Level Recommendations for Landscape Coefficient (K_L)

General Landscape Type	Recommended Planning Level Landscape Coefficient (K_L)
Conservation Landscape Design (non-active turf)	K_L = 0.35
Active Turf Areas	K_L = 0.7

F.2.5.3 Planning Level Irrigation Demands

Using the inputs above, daily average wet season demands were developed for an acre of irrigated area based on location and landscape type (Table F-5).

Table F-5: Modified EAWU Daily Average Irrigation Demand by Location and Landscape Coefficient

General Landscape Type	Daily Average Modified EWUA (gpd per irrigated acre)		
	Irvine	Santa Ana	Laguna
Conservation Landscape Design (non-active turf): K_L = 0.35	740	720	680
Active Turf Areas: K_L = 0.7	1,480	1,450	1,360

These demand estimates can be used to calculate the average drawdown time of harvest and use systems for the purpose of LID BMP sizing calculations (Simple DCV Method (E.3.1), or Constant Drawdown Nomograph Method (E.3.2).

F.2.6 EIATA Demand Calculation and Sizing Method

The TGD also supports an alternative approach for quantifying harvested water demand that relies on the Effective Irrigated Area to Tributary Area (EIATA) ratio as a tool for sizing stormwater harvest and use systems. This ratio was developed to be a primary indicator of the ability of a harvest and use system to effectively capture and manage stormwater.

The EIATA ratio is calculated as follows:

$$EIATA = LA \times K_L / [IE \times \text{Tributary Impervious Area (acres)}]$$

Where:

EIATA = effective irrigated area to tributary area ratio (acre/acre)
LA = landscape area irrigated with harvested water, acres
K_L = Area-weighted landscape coefficient (per guidance in Section F.2.5.2 above)
IE = irrigation efficiency (assume 0.90)

The calculated EIATA ratio can be used in the

Capture Efficiency via Nomograph Method for Harvest and Use BMPs in Section E.3.6 to compute the capture efficiency of a given cistern size.

F.2.7 Calculating Other Harvested Water Demands

Calculations of other harvested water demands should be based on the knowledge of land uses, industrial processes, and other factors that are project-specific. Demand should be calculated based on the following guidelines:

- Demand calculations should represent actual demand that is anticipated during the wet season (November through April).
- Sources of demand should only be included if they are reliably and consistently present during the wet season.
- Where demands are substantial but irregular, a more detailed analysis should be conducted based on a statistical analysis of anticipated demand and precipitation patterns.
- Where the feasibility of harvest and use is contingent on a water demand that may not exist for the life of the project, this is a valid basis for rejecting the use of this BMP type. It may still be possible for this to be approved. However, should the demand cease to exist at a high enough level, the project would need to update the Project WQMP and provide a different BMP type to satisfy applicable LID BMP requirements.

F.2.8 Reclaimed Water Priority in Demand Calculations

If reclaimed water is available to meet or partially meet project non-potable water demands, the decision to use reclaimed water or harvested runoff water rests with the project proponent. If the project proponent elects to use reclaimed water or is required to use reclaimed water based on conditions placed on the project, then the demand for harvested water should be reduced by the amount of reclaimed water available. This criterion effectively allows the project proponent to consider harvest and use to be infeasible if sufficient reclaimed water supply is available to meet the project demand for harvested water.

This criterion intentionally prioritizes the use of reclaimed water over harvested water in cases where demand overlaps. The use of reclaimed water is being prioritized based upon the following considerations:

- In Order 2009-06, the State Water Board finds that "…recycled water is safe for approved uses, and strongly supports recycled water as a safe alternative to potable water for such approved uses". There are several other state mandates for reduction of potable water demand.
- A substantial investment has been made in the production and distribution of reclaimed water by local agencies to reduce potable water demand to meet state mandates.

- Utilizing reclaimed water where available inherently reduces the amount of treated municipal effluent discharged to the ocean. For those entities that rely primarily on use of reclaimed water for disposal of treated wastewaters, such as the Irvine Ranch Water District, prioritizing use of runoff over reclaimed water could increase wastewater discharges significantly during wet weather periods.
- Utilizing the capacity of the reclaimed water system, where available, has a significantly larger benefit for offsetting potable water supply than stormwater harvest and use systems. Reclaimed water is available year round and therefore can effectively fulfill project non-potable water demands throughout the year. In contrast, a harvested water system designed for stormwater management would tend to make water available for a relatively minor fraction of the year (during storm events and for a relatively short period after), thereby meeting a substantially lower fraction of the project non-potable water demand.
- It is possible to engineer and deploy a combined reclaimed water/harvested stormwater non-potable use system. However, the costs of including both options would be much higher than employing one or the other. In addition, the most difficult time for reclaimed water disposal is during extended wet periods when irrigation demand is reduced and more wastewater from inflow and infiltration. This is the same time that stormwater harvested water is most plentiful.
- Potential impacts to groundwater quality related to use of reclaimed water, particularly salt and nutrient accumulation, must be evaluated and managed by providers of reclaimed water[8]. The priority for use of reclaimed water expressed in this TGD does not conflict or interfere with the obligation of reclaimed water providers to manage the application of reclaimed water. If, as a groundwater quality management action, a reclaimed water provider must limit the application of reclaimed water, it would be the responsibility of the reclaimed water provider to limit the amount of reclaimed water that is made available to a proposed project and/or limit its allowable uses on a project. This would limit the amount of project demand that can be offset by reclaimed water and would thereby require harvested water to be considered in applicable scenarios.
- Finally, it is noted that the State Board has evaluated, in general, the potential negative environmental consequences of reclaimed water on groundwater quality as part of developing its policy on reclaimed water, and the State Board supports the use of reclaimed water for landscape irrigation.

[8] In Water Quality Order No. 2000-07, the State Water Board determined that a Producer (i.e., reclaimed water purveyor) cannot shift responsibility for discharged salt to the User (i.e., project proponent).

F.3 Feasibility Evaluation and BMP Sizing

F.3.1 Planning Level Harvest and Use Feasibility Screening

Harvest and Use is required to be considered as an LID option if Full Infiltration BMPs cannot be used to capture the DCV. A simple test is used to determine whether harvest and use BMPs must be used:

- If the DCV for the project can be used within 48 hours of the end of precipitation and full infiltration is not feasible, then harvest and use is a mandatory BMP.
- If these conditions are not met, then harvest and use is an optional BMP. It may still be used as part of project compliance with LID requirements, but is not mandatory.

It is expected to be very rare that harvest and use will be mandatory. However, there are numerous cases where it may be a viable option for a portion of project LID BMP sizing requirements.

F.3.2 Options for Incorporating Harvest and Use into LID BMP Sizing

There are a few conceptual options for how harvest and use could be used as part of an overall LID BMP plan:

Partial capture: Size harvest and use based on available space and demand. Or size harvest and use for desired water supply benefits. Use the applicable calculation methods in Appendix E to estimate the long term stormwater capture efficiency of the proposed design. This is a function of the system size and use rate. Provide a biofiltration BMP for the overflow of the system to provide complementary treatment up to the full LID BMP sizing requirements. Because volume reduction is provided in the harvest and use system, it is not necessary to maximize volume reduction of biofiltration BMPs.

Full capture: Size harvest and use to capture 80 percent of long term runoff volume for all or a portion of the project. At typical demand rates, this may require a relatively large storage volume (several times larger than the DCV). However, no complementary BMPs are needed for the area captured by the harvest and use system.

Other configurations could be proposed that meet the underlying performance criteria for LID BMPs. If hydromodification control applies to the project, harvest and use can also be incorporated into hydromodification BMP designs.

F.4 Guidance and Considerations for Harvest and Use BMPs from California Plumbing Code and Other Sources

F.4.1 Introduction to Harvest and Use BMP Standards

When choosing to implement harvest and use BMPs in Orange County, systems must be implemented in accordance with plumbing code and any applicable local ordinances.

The 2013 California Plumbing Code is this current applicable code at the statewide level. The CPC is effectively the 2012 Uniform Plumbing Code, with some amendments. Chapters 16 and 17 of the California Plumbing Code (and the Uniform Pluming Code) contain regulations regarding alternate sources of water such as stormwater, rainwater, and gray water. This is currently the main standard which must be met in Orange County relative to harvest and use BMPs.

The Orange County Health Care Agency (OCHCA) Environmental Health Division conducts cross connection inspections in cases where recycled water is used. It should be assumed that this requirement applies to harvested stormwater unless otherwise notified in writing by OCHCA. Design of systems to adherence to the California Plumbing Code should avoid any issues with cross-connections between a harvested stormwater and a potable water system.

At the time of publication of this TGD, the permittees within Orange County utilize the 2013 CPC as part of project permitting. No additional policies are known to be in place. The requirements of the 2013 California Plumbing Code are explained below. This may be changed in the future, and the project proponent is responsible for following the most recent regulations when using harvest and use BMPs. For example, the Uniform Plumbing Code is typically updated every three years. The 2015 version of the Uniform Plumbing Code contains no significant changes regarding harvest and use BMPs, but that may change in the 2018 version, or in amendments made to the Uniform Plumbing Code in any future California Plumbing Code updates. In addition, local jurisdictions may develop their own standards and regulations relative to harvest and use BMPs. In general, the California Plumbing Code defers to any local jurisdiction when such regulations exist, as explained below. For example, the Los Angeles County Department of Public Health, developed Guidelines for Alternate Water Sources: Indoor and Outdoor Non-Potable Uses in 2016 which uses a tiered approach with several requirements above and beyond what is in the 2013 California Plumbing Code. It is possible that Orange County or local cities within Orange County will develop additional standards relative to harvest and use BMPs. The project proponent should therefore use the requirements from the 2013 California Plumbing Code below as guidance, but should always check to determine if local requirements exist.

F.4.2 Requirements in the 2013 California Plumbing Code

This sections explains the requirements contained in the 2013 California Plumbing Code Chapters 16 and 17 relative to harvest and use BMPs. Several of the standards depend on the storage capacity, the application of the captured stormwater, and/or the surface the stormwater

is collected from. This section is intended to help explain the California Plumbing Code for stormwater designers, but is not intended to modify it in any way. Where discrepancies are identified, the California Plumbing Code shall prevail.

F.4.2.1 General System Design

All harvest and use BMPs shall be designed by a person who demonstrates competency to design the system as required by the enforcing agency. The enforcing agency may also require plans and specifications to be prepared by a licensed design professional for complex systems.

In general, the harvest and use BMP is designated in the 2013 California Plumbing Code based on what surface it receives runoff from. Rainwater systems collect runoff only from rooftops or other impervious, man-made, above-ground surfaces that do not receive overflows or bleed-off discharges from roof-mounted equipment or appliances. Runoff from all other surfaces is termed on-site treated non-potable water and has some different requirements than rainwater, as outlined in the requirements below.

F.4.2.2 Permit Requirements and Local Authority Approval

Except the in the cases displayed in Table F-6 below, the project proponent may not construct, install, alter, or cause to be constructed, installed, or altered a harvest and use BMP in a building or on a premise without first obtaining a permit to do such work from the authority having jurisdiction. The local jurisdiction will typically be the agency responsible for building permit review. No permit shall be issued until complete plumbing plans, with data satisfactory to the authority having jurisdiction have been submitted and approved.

Table F-6 identifies cases that require a permit and those that do not. Where a permit is required, this means that the local jurisdiction responsible for plumbing permits must consider the harvest and use system as part of the plumbing permit.

Table F-6: Determination of Need for Plumbing Permit for Harvest and Use BMP Scenarios

<table>
<tr><th rowspan="2">Cistern Capacity</th><th rowspan="2">Application</th><th colspan="2">Runoff Collection Surface</th></tr>
<tr><th>Rooftops*</th><th>All Other Surfaces</th></tr>
<tr><td rowspan="6"><5000 gallons <u>and</u>
All equipment is outdoor, cistern is on-grade with <2:1 H:W ratio, no electrical connection, and no makeup water from potable</td><td>Subsurface irrigation</td><td rowspan="2">No permit required</td><td rowspan="12">Permit Required</td></tr>
<tr><td>Surface non-spray irrigation</td></tr>
<tr><td>Surface spray irrigation</td><td rowspan="4">Permit Required</td></tr>
<tr><td>Car Wash</td></tr>
<tr><td>Indoor non-potable uses</td></tr>
<tr><td>Other Outdoor Uses (cooling water, ornamental fountain)</td></tr>
<tr><td rowspan="6">>5000 gallons, or any of the other criteria above not met</td><td>Subsurface irrigation</td><td rowspan="6">Permit Required</td></tr>
<tr><td>Surface non-spray irrigation</td></tr>
<tr><td>Surface spray irrigation</td></tr>
<tr><td>Car Wash</td></tr>
<tr><td>Indoor non-potable uses</td></tr>
<tr><td>Other Outdoor Uses (cooling water, ornamental fountain)</td></tr>
</table>

*Rooftops include any impervious, manmade, above-ground surface which receive no bleed valve discharge or overflow from mounted equipment

No changes or connections shall be made to either the rainwater catchments system or the potable water system on a site containing a harvest and use BMP requiring a permit without approval by the authority having jurisdiction.

If the development falls under the jurisdiction of the California Housing and Community Development, an additional exemption from permit requirement is given for cisterns with a capacity less than 360 gallons with all equipment outdoors used for spray irrigation.

F.4.2.3 Minimum Treatment Requirements

The harvest and use BMP must be equipped with the following minimum treatments according to Table F-7 below. Rainwater tank openings shall be protected to prevent the entrance of insects, birds, or rodents into the tank and piping systems. Screens installed on vent pipes, inlets, and overflow pipes, shall have an aperture of not greater than 1/16 of an inch and shall be close fitting. The rainwater catchment conveyance system shall be equipped with means to prevent accumulation of leaves, needles, other debris, and sediment from entering the storage tank. Debris excluders shall be accessible and installed according to manufacturer's installation instructions. ***Note: Water quality requirements in Section F.4.2.4 also apply.***

Table F-7: Minimum Treatments Required for Various Harvest and Use BMP Applications

Application	Runoff Collection Surface	
	Rooftops*	**All Other Surfaces**
Subsurface irrigation	• 100 micron filter • Debris excluder	• 100 micron filter • Debris excluder
Surface non-spray irrigation		
Surface spray irrigation	• Debris excluder	• Disinfection • Debris excluder
Car Wash	• 100 micron filter • Debris excluder	• Disinfection • 100 micron filter • Debris excluder
Indoor non-potable uses		
Other Outdoor Uses (cooling water, ornamental fountain)	• Debris excluder	

*Rooftops include any impervious, manmade, above-ground surface which receive no bleed valve discharge or overflow from mounted equipment

F.4.2.4 Minimum Water Quality Requirements

The minimum water quality for harvested water shall meet the applicable water quality standards for the intended application as determined by the authority having jurisdiction for plumbing permit review. In the absence of water quality requirements from the authority having jurisdiction, the requirements in Table F-8 below shall apply.

Whenever disinfection is required as a minimum water quality treatment or to meet minimum water quality standards, the treatment must ensure the required water quality at the point of use. Where chlorine is used for disinfection, water shall be tested for residual chlorine according to ASTM D 1253. The levels of residual chlorine shall not exceed the levels allowed for the intended use in accordance with the requirements of the local enforcing agency.

Table F-8: Minimum Water Quality Standards for Various Harvest and Use BMP Applications

<table>
<tr><th rowspan="2">Cistern Capacity</th><th rowspan="2">Application</th><th colspan="2">Runoff Collection Surface</th></tr>
<tr><th>Rooftops*</th><th>All Other Surfaces</th></tr>
<tr><td rowspan="5"><360 Gallons</td><td>Subsurface irrigation</td><td rowspan="4">None</td><td>None</td></tr>
<tr><td>Surface non-spray irrigation</td><td rowspan="4">NSF/ANSI 350 Certified Treatment System

Title 22 is acceptable for R-1 and R-2 occupancies</td></tr>
<tr><td>Surface spray irrigation</td></tr>
<tr><td>Car Wash</td></tr>
<tr><td>Indoor non-potable uses</td><td>• < 100 CFU/ 100mL E. Coli
• <10 NTU Turbidity</td></tr>
<tr><td>Other Outdoor Uses (cooling water, ornamental fountain)</td><td>• < 100 CFU/ 100mL E. Coli
<10 NTU Turbidity</td></tr>
<tr><td rowspan="6">>360 Gallons</td><td>Subsurface irrigation</td><td rowspan="2">None</td><td>None</td></tr>
<tr><td>Surface non-spray irrigation</td><td rowspan="5">NSF 350 Certified Treatment System

Title 22 is acceptable for R-1 and R-2 occupancies</td></tr>
<tr><td>Surface spray irrigation</td><td>• < 100 CFU/ 100mL E. Coli
• <10 NTU Turbidity</td></tr>
<tr><td>Car Wash</td><td>None</td></tr>
<tr><td>Indoor non-potable uses</td><td rowspan="2">• < 100 CFU/ 100mL E. Coli
• <10 NTU Turbidity</td></tr>
<tr><td>Other Outdoor Uses (cooling water, ornamental fountain)</td></tr>
</table>

*Rooftops include any impervious, manmade, above-ground surface which receive no bleed valve discharge or overflow from mounted equipment

More information on NSF/ANSI 350: https://www.nsf.org/newsroom_pdf/ww_nsf_ansi350_qa_insert.pdf

More information on Title 22 Treatment Standards: http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/lawbook/RWregulations_20140618.pdf

F.4.2.5 Connections to Potable Water Supply or Other Alternate Water Sources

Harvest and Use BMPs shall have no unprotected connection to a potable water supply or alternate water source. Potable or alternate source water is permitted to be used as makeup water for a harvest and use BMP as long as the water supply connection is protected by an air gap or reduced-pressure principle backflow preventer in accordance with the 2013 California Plumbing Code.

Whenever a portion of a harvest and use BMP components are installed within a building, a cross-connection test is required before the building is occupied or the system is activated. The installer shall perform the cross-connection test in the presence of the authority having jurisdiction. The Orange County Health Care Agency also conducts regular inspections for cross-connections and backflow preventers.

F.4.2.6 Component Design, Sizing, and Materials

The following specific provisions apply to component design, sizing, and materials:

- Rainwater storage tanks shall be constructed of solid, durable materials not subject to excessive corrosion or decay and shall be watertight.
- Any materials that contain mercury shall not come in contact with the harvested water in any component of the systems.
- The materials used for components of the system used for supply and distribution must comply with the 2013 California Plumbing Code for potable supply and distribution systems.
- Materials used for drainage, including gutters, downspouts, conductors, and leaders shall comply with the 2013 California Plumbing Code for storm drainage.
- Any components of the harvest and use BMPs that are used indoor, as well as rainwater drains, gutter, conductors, and leaders shall all comply with all applicable parts of the 2013 California Plumbing Code including minimum slope requirements.
- Harvest and Use BMPs along with any indoor components shall be provided with the required appurtenances (e.g., valves, air or vacuum relief values, etc.) to allow for deactivation or drainage as required for maintenance and cross-connection tests.
- Rainwater storage tanks shall be provided with a means for draining and cleaning.
- The overflow outlet shall not be equipped with a shutoff valve and shall meet the 2013 California Plumbing Code requirements for overflow valves for stormwater systems.
- When overflow occurs to a storm drainage system, the overflow drain and tank shall be protected from backflows from the stormwater system.
- The overflow outlet shall be sized to accommodate the flow of rainwater entering the tank and shall not be less than the aggregate cross sectional area of all inflow pipes to the tank.
- Rainwater storage tanks must be equipped with at least one access opening for inspection and cleaning. Access openings and manholes shall be secured by either a lockable device or other approved method to prevent unauthorized access.
- Rainwater storage tanks must be equipped with a vent that is not connected to the sanitary system vents and is sized in accordance with the 2013 California Plumbing Code.
- Rainwater storage tanks shall be permitted above grade or below grade according to the requirements below:

- Above grade tanks shall be of an opaque material, approved for use in direct sunlight or shall be shielded from direct sunlight. Tanks shall be accessible to allow for inspection and cleaning. The tank shall be constructed on a foundation or platform constructed to accommodate loads in accordance with the building code.
- Below grade tanks shall be structurally designed to withstand anticipated earth or other loads. Tanks covers shall be capable of supporting an earth load of at least 300 psi where the tank is designed for underground installation. Underground tanks be constructed with manholes of at least a 24-inch diameter or square with 24 inch sides. The manhole covering shall not be less than 4 inches above, and the surrounding area must be sloped away from the manhole cover. Service ports in manhole covers shall be lea than 8-inch diameter. Underground tanks must also be ballasted, anchored, or otherwise secured to prevent the tank from floating out of the ground when empty. The combined weight of the tank and holding system must meet or exceed the buoyancy force of the tank.

Pumps serving harvest and use BMPs must be capable of delivering at least 15 psi of residual pressure to the highest and most remote outlet served. Where the water pressure within the building exceeds 80 psi, a pressure reducing value shall be installed to reduce the pressure to 80 psi in accordance with the 2013 California Plumbing Code.

F.4.2.7 Signage and Identification

Components of the harvest and use shall be labeled as follows:

- Interior components shall be labeled with a purple background with black, uppercase lettering with the words "CAUTION: NON-POTABLE RAINWATER WATER, DO NOT DRINK" for roof runoff[9] and "CAUTION: ON-SITE TREATED NON-POTABLE WATER, DO NOT DRINK" for runoff from any other surfaces. along with the direction of flow with lettering that meets the requirements in the table below. This label shall be indicated every 20 feet, but not less than once per room, and shall be visible from floor level.

[9] Roof runoff includes include only any impervious, manmade, above-ground surface which receive no bleed valve discharge or overflow from mounted equipment. Runoff from roofs which do not meet this requirement shall be considered runoff from any other surface.

Table F-9: Text requirements for indoor components of harvest and use BMPs (Per Table 601.2.2 of the 2013 California Plumbing Code)

Outside Diameter of Pipe or Covering (inches)	Minimum Length of Color Field (inches)	Minimum Size of Letters (inches)
½ to 1¼	8	½
1½ to 2	8	¾
2½ to 6	12	1¼
8 to 10	24	2½
Over 10	32	3½

- Outside hose bibs shall be allowed on rainwater piping systems if marked with the words "CAUTION: NONPOTABLE WATER, DO NOT DRINK" and the figure below

Figure F-1: Figure Required on Hose Bibbs on rainwater piping systems (Per Figure 1702.9 of the 2013 California Plumbing Code



- Rainwater tanks shall be permanently marked with the capacity of the tank and the language "NONPOTABLE RAINWATER". Where openings are provided to allow a person to enter the tank, the opening shall be marked as "DANGER-CONFINED SPACE"

Components, piping, pumps, fittings, and equipment used to treat rainwater used in any harvest and use BMP system shall be listed or labeled by a listing agency and approved for the intended application.

Buildings using rainwater shall include the following signs in the designated locations:

- Commercial, Industrial, Institutional restrooms and residential common-use restrooms: A sign shall be installed in restrooms which states, "TO CONSERVE WATER, THIS BUILDING USES RAINWATER TO FLUSH TOILETS AND URINALS"
- Equipment rooms: Each equipment room containing non-potable rainwater equipment shall have a sign posted with the following wording in 1 inch letters: "CAUTION NONPOTABLE WATER, DO NOT DRINK. DO NOT CONNECT TO DRINKING WATER SYSTEM. NOTICE: CONTACT BUILDING MANAGEMNT BEFORE PERFORMING ANY WORK ON THIS WATER SYSTEM"

F.4.2.8 Operation, Maintenance and Inspection

An initial inspection and test shall be performed on the rainwater catchment system to ensure there is no cross-connectivity between the rainwater catchment system and the potable water system prior to occupancy of the building or activation of the system.

Rainwater catchment systems (runoff collected from rooftop systems) shall be inspected and tested in accordance with the applicable provisions of the 2013 California Plumbing Code for potable water and storm drainage systems. Alternative water source systems (runoff collected from non-rooftop surfaces) and components shall be inspected and maintained in accordance with the manufacturer's recommendations and/or as required by the enforcing agency. Where no manufacturer's recommendations or requirements from the enforcing agency exist, additional recommendations are listed in the table below. The required maintenance and inspection of the systems is the responsibility of the property owner unless otherwise required by the authority having jurisdiction.

Table F-10: Recommended minimum alternative water source testing, inspection, and maintenance frequency where no manufacturer's recommendations exist (Per 2013 California Plumbing Code Table 1601.5)

Description	Minimum Frequency
Inspect and clean filers and screens, and replace as necessary	Every 3 months
Inspect and verify that disinfection, filters, and water quality treatment devices and systems are operational and maintaining minimum water quality requirements	No recommendation
Inspect pumps, valves, and pressure tanks and verify operation	After installation and every 12 months thereafter

Clear debris from and inspect storage tanks, locking devices and verify operation	After installation and every 12 months thereafter
Inspect caution labels and markings	After installation and every 12 months thereafter
Cross connection inspection and test	After installation and every 12 months thereafter

An operation and maintenance manual shall be supplied to the building owner by the system designer or installer for any rainwater or on-site treated water system required to have a permit. The operation and maintenance manual must include the following:

1. Diagram(s) of the entire system and location of system components
2. Instructions on operating and maintaining the system
3. Instructions on maintaining the required minimum water quality
4. Details on startup, shutdown, and deactivating the system maintenance, repair, or other purposes
5. Applicable testing, inspection, and maintenance frequencies
6. A method of contacting the installer and/or manufacturer(s)
7. Directions to the owner or occupant that the manual shall remain with the building throughout the life cycle of the structure

F.4.3 OCHCA Cross Connection Inspection

Where a harvested water system will have any connection to a potable water system, a backflow prevention device and cross connection inspection by OCHCA should be assumed to be required. This applies unless otherwise notified in writing by OCHCA that this does not apply. See guidelines and contact information here:
http://www.ochealthinfo.com/eh/water/backflow

APPENDIX G. BMP FACT SHEETS

This appendix contains BMP fact sheets for the following BMP categories. The BMP designs described in these fact sheets and in the referenced design manuals shall constitute what are intended as LID and Treatment Control BMPs for the purpose of meeting stormwater management requirements. Other BMP types and variations on these designs may be approved at the discretion of the reviewing agency if documentation is provided demonstrating similar functions and equivalent or better expected performance.

Hydrologic Source Control Fact Sheets (HSC)

HSC-1: Localized On-Lot Infiltration

HSC-2: Impervious Area Dispersion

HSC-3: Street Trees

HSC-4: Residential Rain Barrels

HSC-5: Green Roof / Brown Roof

HSC-6: Self-retaining areas

Miscellaneous BMP Design Element Fact Sheets (MISC)

MISC-1: Bioretention Media

MISC-2: Amended Soils

MISC-3: Filter Course Design

MISC-4: Recommended Plant List

MISC-5: Pretreatment Guidance

Full Infiltration BMP Fact Sheets (INF)

INF-1: Infiltration Basin Fact Sheet

INF-2: Infiltration Trench Fact Sheet

INF-3: Bioretention with no Underdrain

INF-4: Drywell

INF-5: Permeable Pavement (concrete, asphalt, and pavers)

INF-6: Underground Infiltration

Harvest and Use BMP Fact Sheet (HU)

HU-1: Cisterns for Harvest and Use

Biotreatment BMP with Partial Infiltration Fact Sheets (BIO)

BIO-1: Bioinfiltration (bioretention with raised underdrain)*

BIO-2: Vegetated Swale

BIO-3: Vegetated Filter Strip

BIO-4: Dry Extended Detention Basin

BIO-5: Proprietary Biotreatment with Supplemental Retention*

Biotreatment BMP without Infiltration Fact Sheets (BIO)

BIO-6: Bioretention with Underdrain and Impervious Liner*

BIO-7: Proprietary Biotreatment*

BIO-8: Wet Detention Basin

BIO-9: Constructed Wetland

BIO-10: Other Biotreatment BMPs with Impervious Liner

Treatment Control BMP Fact Sheets (TRT)

TRT-1: Sand Filters

TRT-2: Proprietary Treatment Control BMPs

Note: ET plays an important role in the performance of HSC, INF, HU, and BIO BMPs. However, specific fact sheets for ET are not included.

** Indicates BMPs that can potentially meet the definition of "biofiltration BMPs". Biofiltration BMPs are vegetated treat-and-release BMPs that filter stormwater through amended soil media that is biologically active, support plant growth, and also promote infiltration and/or evapotranspiration. Biotreatment BMPs that do not meet this definition are not considered to be LID BMPs, but may be used as treatment control or Pretreatment BMPs.*

G.1 Hydrologic Source Control Fact Sheets (HSC)

HSC-1: LOCALIZED ON-LOT INFILTRATION

'Localized on-lot infiltration' refers to the practice of collecting on-site runoff from small distributed areas within a catchment and diverting it to a dedicated on-site infiltration area. This technique can include disconnecting downspouts and draining sidewalks and patios into french drains, trenches, small rain gardens, or other surface depressions. This HSC is limited to systems with very shallow depth of ponding, which provides improved resiliency to infiltration rate variability and and does not require BMP-specific testing.

For downspout disconnections and other impervious area disconnection involving dispersion over pervious surfaces, but without intentional ponding, see

Also known as:

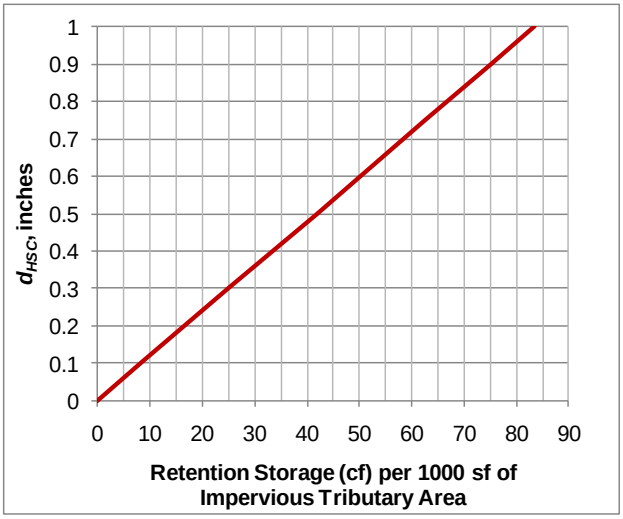
- *Downspout infiltration*
- *Retention grading*
- *French drains*
- *On-lot rain gardens*



On-lot rain garden
Source: lowimpactdevelopment.org

HSC-2: Impervious Area Dispersion.

Recommended Selection and Siting Criteria



- A single on-lot infiltration area should not be sized to retain runoff from impervious areas greater than 4,000 sq. ft (0.1 acres); if the drainage area exceeds this criteria, investigation and sizing should be based on guidelines for bioretention areas or infiltration trenches.
- 'Localized on-lot infiltration' should only be used in DMAs where full infiltration is feasible based on a reasonably-supported opinion.
- This HSC is appropriate in locations where runoff can be directed to and temporarily pond in pervious area depressions, rock trenches, or similar.
- Shallow utilities should not be present below infiltration areas.
- Setbacks from foundations or structures should be observed (minimum 8 feet or as recommended by project geotechncial professional).

Recommended Design Criteria and Considerations

- ☐ Maximum ponding depth should be should be no greater than 4 inches to reduce sensitivity to infiltration rate.
- ☐ Soil should be amended to a minimum depth of 12 inches based on the criteria in MISC-2.
- ☐ Side slopes of rain garden or depression storage should not be steeper than 3H:1V.
- ☐ Effective energy dissipation and uniform flow spreading methods should be employed to prevent erosion resulting from water entering infiltration areas.
- ☐ Overflow should be located such that it does not cause erosion is conveyed away from structures toward the downstream conveyance and treatment system.

Calculating HSC Retention Volume

- The retention volume provided by localized on-lot infiltration can be computed as the storage volume provided by surface ponding and the pore space within an amended soil layer or gravel trench.
- Estimate the average retention volume per 1000 square feet impervious tributary area provided by on-lot infiltration.
- Look up the storm retention depth, d_{HSC} from the chart to the right.
- The max d_{HSC} is equal to the design capture storm depth for the project site.

HSC-2: IMPERVIOUS AREA DISPERSION

Also known as:

- *Downspout disconnection*
- *Impervious area disconnection*
- *Sheet flow dispersion*

Impervious area dispersion refers to the practice of routing runoff from impervious areas, such as rooftops, walkways, and patios onto the surface of adjacent pervious areas via sheet flow. Runoff is dispersed uniformly via splash block or dispersion trench and soaks into the ground as it moves slowly across the surface of pervious areas. Minor ponding may occur, but it is not the intent of this practice to actively promote localized on-lot storage (See **MISC-2** if localized ponding is intended).

In contrast to HSC-1, this practice can be used where infiltration is either fully feasible or partially feasible.



Simple Downspout Dispersion
Source: toronto.ca/environment/water.htm

Recommended Selection and Siting Criteria

- Impervious area dispersion can be used in DMAs categorized as feasible for full infiltration or partial infiltration. It should be avoided if any level of infiltration would pose hazards.
- This HSC requires that there are significant pervious areas present in drainage area with shallow slopes that can receive runoff from adjacent impervious areas.
- The site plan should allow for verflow from pervious area to be appropriately managed.

Recommended Design Criteria and Considerations

- ☐ Soils should be preserved from their natural condition or restored via soil amendments to meet minimum criteria described in MISC-2.
- ☐ Lawn or landscaping should be well established
- ☐ A minimum of 1 part pervious area capable of receiving flow should be provided for every 2 parts of impervious area disconnected.
- ☐ The pervious area receiving flow should have a slope ≤ 2 percent and path lengths of ≥ 20 feet per 1000 sf of impervious area.
- ☐ For areas with sparse vegetation (e.g.. xeriscaped areas), appropriate contouring should be used to slow water, avoid preferential scour pathways and associated soil or mulch loss.
- ☐ Dispersion areas should be maintained to remove trash and debris, loose vegetation, and protect any areas of bare soil from erosion.
- ☐ Velocity of dispersed flow should not be greater than 0.5 ft per second to avoid scour.

Calculating HSC Retention Volume

- The retention volume provided by downspout dispersion is a function of the ratio of impervious to pervious area and the condition of soils in the pervious area.
- Determine flow patterns in pervious area and estimate footprint of pervious area receiving dispersed flow. Calculate the ratio of pervious to impervious area.
- Look up the storm retention depth, dHSC from the chart below.
- The max dHSC is equal to the design capture storm depth for the project site.



[1] Pervious area used in calculation should only include the pervious area receiving flow, not pervious area receiving only direct rainfall or upslope pervious drainage.

Chart extends to 0.25, but designs should not go below a minimum value of 0.5 (2 parts impervious to 1 part pervious).

HSC-3: STREET TREES

By intercepting rainfall, trees can provide several aesthetic and stormwater benefits including peak flow control, increased infiltration and ET, and runoff temperature reduction. The volume of precipitation intercepted by the canopy reduces the treatment volume required for downstream treatment BMPs. Shading reduces the heat island effect as well as the temperature of adjacent impervious surfaces, over which stormwater flows, and thus reduces the heat transferred to downstream receiving waters. Tree roots also strengthen the soil structure and provide infiltrative pathways, simultaneously reducing erosion potential and enhancing infiltration.

Also known as:

- *Canopy interception*



Street trees
Source: Geosyntec Consultants

Recommended Selection and Siting Criteria

- Street trees can be incorporated in green streets designs along sidewalks, streets, parking lots, or driveways.
- Street trees can be used in combination with bioretention systems along medians or in traffic calming bays.
- There must be sufficient space available to accommodate both the tree canopy and root system.

OC-Specific Design Criteria and Considerations

- ☐ Mature tree canopy, height, and root system should not interfere with subsurface utilities, suspended powerlines, buildings and foundations, or other existing or planned structures. Required setbacks should be adhered to.
- ☐ Depending on space constarints, a 20 to 30 foot diameter canopy (at maturity) is recommended for stormwater mitigation.
- ☐ Native, drought-tolerant species should be selected in order to minimize irrigation requirements and improve the long-term viability of trees.
- ☐ Trees should not impede pedstrian or vehicle sight lines.
- ☐ Planting locations should receive adequate sunlight and wind protection; other environmental factors should be considered prior to planting.
- ☐ Frequency and degree of vegetation management and maintenance should be considered with respect to owner capabilities (e.g., staffing, funding, etc.).
- ☐ A street tree selection guide, such as that specific to the City of Los Angeles, may need to be consulted to select species appropriate for the site design constraints (e.g., parkway size, tree height, canopy spread, etc.) (City of Los Angeles, Street Tree Division - Street Tree Selection Guide. http://bss.lacity.org/UrbanForestryDivision/StreetTreeSelectionGuide.htm
- ☐ Infiltration (if allowed into tree wells) should not cause geotechnical hazards related to adjacent structures (buildings, roadways, sidewalks, utilities, etc.)

Calculating HSC Retention Volume

- The retention volume provided by streets trees via canopy interception is dependent on the tree species, time of the year, and maturity.
- To compute the retention depth, the expected impervious area covered by the full tree canopy after 4 years of growth must be estimated using reasonable approaches. The maximum retention depth credit for canopy interception (dHSC) is 0.05 inches over the area covered by the canopy at 4 years of growth.

HSC-4: RESIDENTIAL RAIN BARRELS

Rain barrels are above ground storage vessels that capture runoff from roof downspouts during rain events and detain that runoff for later reuse for irrigating landscaped areas. The temporary storage of roof runoff reduces the runoff volume from a property and may reduce the peak runoff velocity for small, frequently occurring storms. In addition, by reducing the amount of storm water runoff that flows overland into a storm water conveyance system (storm drain inlets and drain pipes), less pollutants are transported through the conveyance system into local creeks and ocean. The reuse of the detained water for irrigation purposes leads to the conservation of potable water and the recharge of groundwater.

Also known as:

- *Small cistern*



Rain Barrel
Source: http://www.auburn.edu/projects/sustainability/website/newsletter/0910.php

Recommended Selection and Siting Criteria

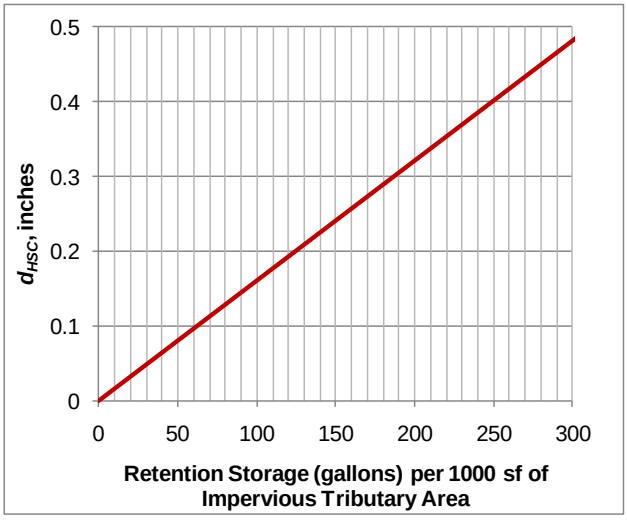
- Acceptable for rooftop downspouts or other suitable conveyances (e.g. rain chains).
- Sufficient vegetated areas must be present in drainage area to have a reasonable use for the water.
- An appropriate overflow pathway is needed.

Recommended Design Criteria and Considerations

- ☐ Screens on gutters and downspouts should be used to remove sediment and particles as the water enters the barrel or cistern. Removable child-resistant covers and mosquito screening should be used to prevent unwanted access.
- ☐ Above-ground barrels should be secured in place.
- ☐ Above-ground barrels should not be located on uneven or sloped surfaces; if installed on a sloped surface, the base where the cistern will be installed should be leveled prior to installation.
- ☐ Overflow dispersion should occur greater than 8 feet from building foundations.
- ☐ Dispersion should not cause geotechnical hazards related to slope stability.
- ☐ Dispersion should be only allowed to stable vegetated areas where erosion or suspension of sediment is minimized.
- ☐ Effective energy dissipation and uniform flow spreading methods should be employed to prevent erosion and facilitate dispersion.
- ☐ Aesthetics should be considered for placement of barrels and incorporation into surroundings. Placement should allow easy access for regular maintenance.
- ☐ To draw down a 55 gallon rain barrel within 4 days with plant watering, at least 800 square feet of conservation landscape or 400 square feet of active turf area is needed.

Calculating HSC Retention Volume

- At least 800 sq-ft of conservation landscape or 400 sq-ft of active turf landscape shall be provided for each rain barrel to claim an HSC credit volume
- The effective volume provided by rain barrels that are not actively managed can be computed as 50% of the total storage volume (e.g., 27.5 gallons for each 55 gallon barrel.)
- If the rain barrel is actively managed then it should be treated as a cistern as described in **Appendix E**.
- Estimate the average retention volume per 1000 square feet impervious tributary area provided by rain barrels. Example:
    - 1000 square feet of roof draining to two 55 gallon rain barrels
    - Credited retention volume = (110/2) = 55 gallons
    - Retention volume per 1000 sq feet = 55 gallons per 1000 sq-ft
    - Based on the retention storage estimated, look up the storm retention depth, d_{HSC} from the chart to the right = 0.09 inches
    - The max d_{HSC} is equal to the design storm depth for the project site.



HSC-5: GREEN ROOF / BROWN ROOF

Also known as:

- *Ecoroofs*
- *Roof Gardens*
- *Vegetated Roof Covers*
- *Brown Roofs*



Green Roof
Source: Milwaukee Department of Environmental Sustainability

Green roofs are also known as ecoroofs, roof gardens, or vegetated roof covers. Green roofs are roofing systems that layer a soil/vegetative cover over a waterproofing membrane. There are two types of green roofing systems; extensive, which is a light weight system and intensive, which is a heavier system that allows for larger plants but requires additional maintenance. A green roof mimics pre-development conditions by limiting the impervious area created by development. Green roofs filter, absorb, and evapotranspire precipitation to help mitigate the effects of urbanization on water quality and delivery of excess runoff to the local storm water conveyance systems.

Brown roofs are essentially a type of green roof designed to maximize biodiversity. Brown roofs typically utilize natural soil and locally available substrates to create a protected biodiverse habitat for specific species of local flora and fauna. Rather than landscaping the roof during construction, plants are left to germinate and grow on their own in the native soils, thus the "brown" (i.e., initially unvegetated) designation. Seeding may be implemented where self-colonization via airborne seeds is unlikley.

Recommended Selection and Siting Criteria

- Green roofs should be selected with consideration for their impacts on irrigation during the dry season and during dry periods of the wet season.
- Green roofs can be applied to multi-family residential, commercial, or institutional land uses including rooftops and decks above building structures (e.g., parking structures, outdoor eating area roofs, or storage facilities.
- Roofs are ideally multi-story, such that the additional weight of the soil, retained water, and plants, can be be accomodated without significant changes to the structure, as confirmed by a licensed structural engineer.
- Roofs are ideally relatively flat.

Recommended Design Criteria

- ☐ A licensed structural engineer should be consulted to confirm that the roof has appropriate strength to support the green roof.
- ☐ Soil depth should be consistent with minimum depths provided in Appendix H.
- ☐ A drain pipe (gutter) is required to convey runoff safely from the roof.
- ☐ A drainage layer is recommended to move the excess runoff off of the roof. A proven proprietary drainage layer product should be used.
- ☐ Green roofs should be about 90% vegetated with a mix of erosion resistant plant species that effectively bind the soil and can withstand the extreme environment of rooftops (i.e., heat, cold, and high winds).
- ☐ A diverse selection of low growing plants that thrive under the specific site, climatic, and watering conditions should be specified. A mixture of drought tolerant, self-sustaining (perennial or self-sowing without need for fertilizers, herbicides, and or pesticides) is most effective. Native or adapted sedum/succulent plants are preferred because they generally require less fertilizer, limited maintenance, and are more drought resistant than exotic plants. When appropriate, green roofs may be planted with larger plants; however, this depends on structural support, soil depth, and irrigation requirements.
- ☐ Irrigation is required if the seed is planted in spring or summer. Use of a permanent smart (self-regulating) irrigation system, or other watering system, may help provide maximal water quality performance. Drought-tolerant plants should be specified to minimize irrigation requirements. For projects seeking “High Performance Building” recognition, ASHRAE Standard 189.1 states that potable water cannot be used for irrigating green roofs after they are established.
- ☐ Locate the green roof in an area without excessive shade to avoid poor vegetative growth. For moderately shaded areas, shade tolerant plants should be used.
- ☐ Project-specific planting recommendations should be provided by a landscape professional including recommendations on appropriate plants and irrigation requirements (if any) to ensure healthy vegetation growth.

Sizing

Appendix H provides minimum criteria for green roofs to be considered self-retaining and should be the governing sizing basis for green roofs.

HSC-6: SELF-RETAINING AREAS

Self-retaining areas are DMAs with the project site that do not generate runoff volumes or pollutant loads higher than natural conditions during a design capture storm event (85th percentile, 24-hour event). These DMAs can be excluded from sizing of downstream LID BMPs. There are two primary types of self-retaining DMAs:

- DMAs with impervious surface where the full effects of the impervious surface are mitigated by HSCs
- DMAs without impervious surface where the condition of the pervious surface does not generate elevated runoff volumes or pollutant loads

The following subsections provide criteria and examples for each type of DMA.

Criteria for DMAs with Impervious Surfaces

- HSC-1, HSC-2, HSC-5, if adequately sized, have the potential to fully mitigate the hydrologic effects of impervious surfaces and associated pollutant loading.
- In order to be self-retaining, these HSCs must be sized per the criteria in the respective fact sheet to provide a d_{HSC} that is equal to greater than the design capture storm depth for the project location. Sizing approaches differ by HSC.
- These HSCs must be clearly delineated in the WQMP and O&M Plan with appropriate covenents or similar mechanisms to ensure that they are maintained for the life of the project.

Criteria for DMAs without Impervious Surfaces

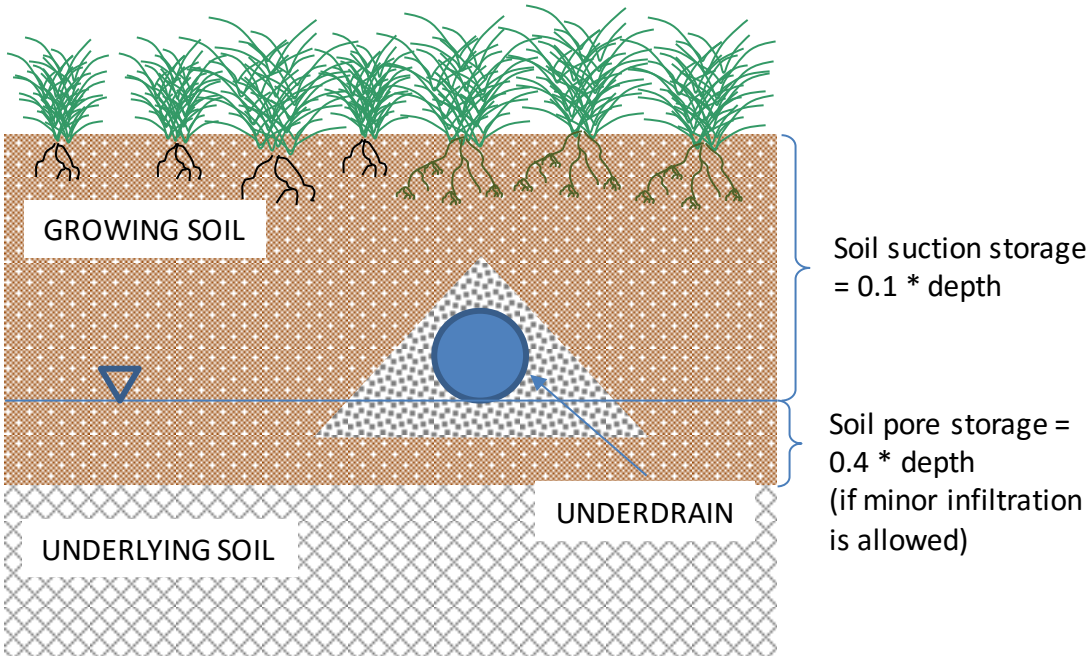
- If landscaped areas are designed as described in HSC-2 (impervious area dispersion), they are considered self-retaining.
- Other pervious areas may be considered self-retaining if it is reasonably demonstrated that they are not expected to produce runoff during the 85th percentile, 24-hour event. Examples of demonstration of self-retaining areas are provided below.

Examples of Methods of Demonstrating Self-Retaining Areas

- In areas that can allow some infiltration and do not require underdrains, examples of demonstrating self-retaining criteria include:
- Showing that soil infiltration rates reliably exceed 0.2 inches per hour
- Showing that soil amendments provide freely drained pore spaces equal to at least the design capture storm depth
- In locations where partial infiltration is not feasible or pervious areas are designed with underdrain systems, this poses special considerations. Examples of how these areas could be considered self-retaining include:

- Do not allow excessive fertilizer or pesticides in the landscaped or turf areas that could wash through into underdrains, and
- Minimize nutrient content of growing soils consistent with MISC-1, and
- The soil above the underdrains should have suction (non-drained) storage capacity equal to the design capture storm depth. A reasonable estimate of 0.1 times the soil depth can be used to estimate the soil suction storage depth, or
- A water retention layer is provided below the elevation of the underdrains equal to the portion of the design capture storm depth that is not retained in the soil suction storage. This option requires that a small amount of infiltrated volume is feasible.
- Diagrams of these compartments are provided below. Note that this is not a preferred case; an underdrain below pervious area should only be used where needed for other reasons.

Diagrams of Water Retention Compartments in Pervious Areas with Underdrains



G.2 Miscellaneous Design Elements Fact Sheets (MISC)

MISC-1: BIORETENTION SOIL MEDIA

Also known as:

- *Bioretention media*
- *Biofiltration media*



Street-end biofiltration with planting/storage media
Source: City of Portland

Bioretention soil media is a critical design element for bioretention BMPs, including INF-3, BIO-1, and BIO-6. It is also part of the design of some configurations of swales (BIO-2) and filter strips (BIO-3). Finally, it can be used as a filtering layer below infiltration systems to augment treatment and protect groundwater quality.

All bioretention soil media must provide appropriate properties for filtering stormwater and supporting vegetation.

In addition, for systems that filter water through BSM into an underdrain (BIO-1, BIO-6), additional criteria apply for media infiltration rate and chemical suitability to avoid pollutant leaching or premature clogging.

Applicability of BSM Specification Elements

The model specifications described in this fact sheet include elements that do not apply to all BMP types. The following table identifies the elements of the model specifications that apply to the different types of BMPs.

BMP Type	Composition and Material Specifications	Basic Testing of Combined Mix	Infiltration Testing of Combined Mix	Chemical Suitability Testing of Combined Mix (leaching potential)
Bioretention with Underdrains (BIO-1, BIO-6)	X	X	X	X
BIO-1 or BIO-6 draining to nutrient-sensitive water bodies	X	X	X	X
Bioretention without Underdrains (INF-3)	X	X		
Amended Soils as Treatment Layer in Other Infiltration BMPs	X	X		
Swales (BIO-2) with Amended Soil Layer	X	X		
Filter Strips (BIO-3)	X	X		

General Criteria and Composition

- BSM should consist of 70 to 80% fine sand and 20 to 30% stable, well aged compost **by volume**, each meeting the quality standards described in the following sections. Alternative mix designs may be developed and tested to demonstrate suitability. Deviations from these ranges and material types may also be needed to achieve low nutrient leaching designs, where necessary. [*Note: The unit weight of compost is typically less than half of the unit weight of sand. Therefore, the percentage by mass is different.]*
- BSM should be designed to achieve the long term hydraulic design requirements associated with the design of the facility (i.e., design infiltration rate).
    - For BIO-1 and BIO-6 (systems with underdrains), the hydraulic conductivity should be evaluated via testing and conform to an acceptable range due to the importance of this value in sizing and performance of systems. Selection of an appropriate infiltration rate and evaluation of mix acceptability is described in "Infiltration Rate Evaluation" section of this Fact Sheet.
    - For other applications of BSM, infiltration rate of media is not as critical in design and can be assured via simpler checks on particle size information obtained as part of "Basic Whole Mix Testing Recommendations" part of this Fact Sheet.
- BSM should support the growth of hardy native plants suited to a well drained sandy soil. However BSM should not be excessively enriched, which can lead to excessive weeds and leaching of nutrients. Agronomic suitability and avoidance of excessive nutrient leaching is evaluated as part of "Basic Whole Mix Testing Recommendations" part of this Fact Sheet.
- BSM for use in BIO-1 or BIO-6 (systems with underdrains) should be more carefully evaluated for nutrient and other pollutant leaching potential as described in "Chemical Suitability Evaluation" part of this Fact Sheet.
- Blending should be conducted at a soil blending facility using an appropriate mechanical method to achieve complete and uniform mixing, such as a drum mixer. Moving piles of material around with a loader and/or transferring back and forth between bins to mix components is typically not adequate to achieve uniform mixing.
- Testing of the actual whole BSM mix to be delivered to the project is strongly recommended; prior testing conducted by the manufacturer may be used in place of project-specific testing provided that it is recent (within 6 months) and represents the actual mix proportions and compontents that are proposed for the project.
- Procurement, handling, and placement of BSM should adhere to guidelines in "Construction Guidelines" part of this Fact Sheet.

Sand for Bioretention Soil Media

- Sand should be free of wood, waste, coating such as clay, stone dust, carbonate, etc., or any other deleterious material.
- Sand should be washed.
- All aggregate passing the No. 200 sieve size should be non-plastic.
- Sand for bioretention should be analyzed by an accredited lab using #200, #100, #40, #30, #16, #8, #4, and 3/8 sieves (ASTM D 422 or as approved by the local permitting authority) and meet the following gradation (Note: all sands complying with ASTM C33 for "fine aggregate concrete sand" comply with the gradation requirements below):

Sieve Size (ASTM D422)	Sieve Size (mm)	% Passing (by weight)	
		Minimum	Maximum
3/8 inch	9.5	100	100
#4	4.8	90	100
#8	2.4	70	100
#16	1.2	40	95
#30	0.60	15	70
#40	0.42	5	55
#100	0.15	0	15
#200	0.075	0	5

- Coefficient of Uniformity (Cu = D60/D10) should be equal to or equal to or greater than 4
- Note: the gradation of the sand component of the media an important major factor in the infiltration rate of the media mix. If the desired infiltration rate of the media cannot be achieved within the specified proportions of sand and compost), then it may be necessary to utilize sand at the coarser end of the range specified in the table above ("minimum" column) with more uniform particle size (i.e., poorly graded). Sand products such as "filter sand" and "top dressing sand" tend to meet the C33 specification and support higher infiltration rates.

Compost for Bioretention Soil Media

Compost should be a well decomposed, stable, weed free organic matter source derived from waste materials including yard debris, wood wastes, or other organic materials not including manure or biosolids meeting standards developed by the US Composting Council (USCC). The product shall be certified through the USCC Seal of Testing Assurance (STA) Program (a compost testing and information disclosure program). **It is expected that only select compost products will meet this specification**. Compost quality should be verified via a lab analysis to be:

- Feedstock materials shall be specified and include one or more of the following: landscape/yard trimmings, grass clippings, food scraps, and agricultural crop residues.
- Organic matter: 35-75% dry weight basis.
- Carbon and Nitrogen Ratio: 15:1 < C:N < 40:1; preferably above 20:1 to reduce the potential for nitrogen leaching/washout.
- Nitrogen between 0.9 and 3% by dry weight.
- Physical contaminants (manmade inert materials) not exceeding 1% by dry weight.
- Maturity/Stability (qualitative):Compost shall have dark brown color and a soil-like odor. Compost exhibiting a sour or putrid smell, containing recognizable grass or leaves, or is hot (120 F) upon delivery or rewetting is not acceptable.
- Maturity (seed emergence and seedling vigor): greater than 80% relative to positive control (Method TMECC 5.05-A, USDA and U.S. Composting Council)
- Stability (Carbon Dioxide evolution rate): less than 2.5 mg CO2-C per g compost organic matter (OM) per day or less than 5 mg CO2-C per g compost carbon per day, whichever unit is reported.

(Method TMECC 5.08-B, USDA and U.S. Composting Council). Alternatively a Solvita rating of 6 or higher is acceptable.

- Toxicity: any one of the following measures is sufficient to indicate non-toxicity:
  - NH4:NH3 < 3
  - Ammonium < 500 ppm, dry weight basis
  - Seed Germination > 80% of control
  - Plant trials > 80% of control
  - Total Boron should be <80 ppm, soluble boron < 2.5 ppm
- Salinity: < 6.0 mmhos/cm or Soluble Salt Concentration less than 10 dS/m (Method TMECC 4.10-A, USDA and U.S. Composting Council).
- pH between 6.5 and 7.5 (may vary with plant palette)
- Compost for bioretention should be analyzed by an accredited lab using #200, ¼ inch, ½ inch, and 1 inch sieves (ASTM D 422 or as approved by the local permitting authority) and meet the following gradation:

Sieve Size (ASTM D422)	% Passing (by weight)	
	Minimum	Maximum
1 inch	99	100
½ inch	90	100
¼ inch	40	90
#200	0	10

- Tests should be sufficiently recent to represent the actual material that is anticipated to be delivered to the site. If processes or sources used by the supplier have changed significantly since the most recent testing, new tests should be requested. Compost quality can vary significanly by season and by batch.
- Note: the gradation of compost used in bioretention media can have an important influence on the saturated hydraulic conductivity of the media. To achieve a higher saturated hydraulic conductivity, it may be necessary to utilize compost at the coarser end of this range ("minimum" column). The percent passing the #200 sieve (fines) is believed to be the most important factor in hydraulic conductivity. In addition, a coarser compost mix provides more heterogeneity of the bioretention media, which is believed to be advantageous for more rapid development of soil structure needed to support health biological processes. This may be an advantage for plant establishment with lower nutrient and water input.

Mulch for Bioretention Soil Media

- The bioretention panting area should generally be covered with 2 to 4 inches (average 3 inches) of well aged, double or triple shredded mulch at the time of construction and an additional placement of 1 to 2 inches of mulch should be added annually. Mulch should be stockpiled and stored at least 12 months prior to application to the BMP and must be non-floating to avoid clogging of overflow structures.*The intention is to help sustain the nutrient levels, suppress weeds, retain moisture, and maintain infiltration capacity*.

- Inorganic mulch such as rock, may be used.

Basic Whole Mix Testing Recommendations

Basic whole mix testing should be done for any application of BSM in stormwater BMPs. The blended BSM should be submitted to an agronomic laboratory for a standard "Agronomic Soil Suitability Test" with texture class and organic matter analyses included (estimated $110 to $150).

- Organic Matter: between 2 and 5 percent by dry weight

  [Note: This range is not incompatible with the organic content requirements of compost. If compost is 20 percent of the mix by volume, this represents about 7.5 percent of the mix by dry weight. If compost has an organic fraction of 35 percent to 75 percent by dry weight, then the total mix organic content would be 2.5 to 5.5 percent]

- Total Nitrogen: 0.1 to 0.5% by dry weight (100 to 500 mg/kg)

  [Note: Similar to the explanation above, this is not incompatible with the compost nitrogen requirements]

- Plant Available Phosphorus (also known as "P Index") (based on weak acid extraction: ammonium Bicarbonate/DTPA soil analysis or similar): 10 to 50 mg/kg (P Index 10 to 50)
- Percent Sand/Silt/Clay: Less than 2 percent clay; 5 to 20 percent silt or infiltration testing showing greater than 10 inches per hour
- pH range: 6.0-7.5
- Salinity less than 3.0 millimho/cm (as measured by electrical conductivity)
- Sodium adsorption ration (SAR) less than 3.0
- Chloride less than 150 ppm
- An assessment of agricultural suitability for hearty, well-suited plants based on test results should be conducted, including recommendations for adding amendments, chemical corrections, or both.

Testing reports should include:

- Date of Testing
- Project Name
- The Contractor's Name
- Source of Materials and Supplier's Name
- Adequate information to demonstration conformance with the criteria above.

Rationale: A BSM that aheres to the general guidelines for mix composition, sand properties, and compost properties should provide acceptable properties for most applications. However, due to ranges of physical and chemcial properties that exist in sand and compost specifications and variability in supply stocks, basic testing of the specific whole BSM proposed for the project is strongly recommended. The ranges of criteria are intended to avoid mixes that have clear material quality issues.

Infiltration Rate Evaluation

This section appiles to BIO-1 or BIO-6 where a specific range of media infiltration rates is established in design and is critical for sizing.

- The saturated hydraulic conductivity or infiltration rate of the whole BSM shall be measured by one of the following methods:

  - Measurement of hydraulic conductivity (USDA Handbook 60, method 34b) (commonly available as part of standard agronomic soil evaluation – estimated $30 to 50 per sample), or
  - ASTM D2434 Permeability of Granular Soils (at approximately 85 percent relative compaction Standard Proctor, ASTM D698)

- BSM should conform to hydraulic criteria associated with the BMP design configuration that best applies to the facility where the BSM will be installed (options describe below).
  - **Systems with hydraulic control on the outlet of the underdrain system** (i.e., outlet control). For systems in which the flowrate of water through the media is controlled via an outlet control device (e.g., orifice or valve) affixed to the outlet of the underdrain system, the infiltration rate or hydraulic conductivity of the media should be at least 20 inches per hour and not more than 40 inches per hour. The outlet control device should control the flowrate to between 5 and 12 inches per hour. This configuration reduces the sensitivity of system performance to the permeability of the material, reduces the likelihood of short circuiting through media, and allows more precise design and control of system flow rates. For these reasons, outlet control should be considered the preferred design option.
  - **Systems with free-flowing underdrain system** (i.e., flowrate is controlled by the permeability of the BSM). For systems with underdrains that are not restricted, the BSM should have minimum measured hydraulic conductivity of 8 inches per hour to ensure adequate flow rate through the BMP and longevity of the system. This results in a recommended design infiltration rate of 2 to 4 inches per hour to account for potential compaction and clogging. The BSM should have a maximum measured hydraulic conductivity of no more than 20 inches per hour to provide adequate contact time and treatment. Where this limit cannot be achieved, an outlet controlled configuration should be considered. In all cases, an upturned elbow system on the underdrain, measuring 6 to 12 inches above the invert of the underdrain, should be used to control velocities in the underdrain pipe and reduce potential for solid migration through the system.

Rationale: The media infiltration rate is a critical parameter in sizing and design of BIO-1 and BIO-6. It is necessary to confirm that the infiltration rate is reasonably consistent with what has been used in sizing and design and is capable of providing adequate treatment. Infiltration rates that are too slow may not provide long term capture performance adequate to meet sizing criteria. Infiltration rates that are too high may not provide adequate treatment or can be susceptible to short-circuiting unless used in an outlet controlled configuration.

Chemical Suitability Evaluation

This section appiles to BIO-1 or BIO-6 (systems with underdrains). In these systems, it is more critical to ensure that significant increases in pollutants will not occur as a result of filtration of water through the media (i.e., pollutant leaching). Nutrients are the most common form of leached pollutants. However, metals have also been observed.

The basic testing described above is adequate where nutrients or metals are not identified as impairments or TMDLs.

Where nutrients or metals are identified as impairments or TMDLs in any receiving water, the standard “Agronomic Soil Suitability Test” should be augmented with Saturated Media Extract Method (aka “saturation extract”) testing that covers at least the following parameters.

- Nitrate as N: < 3 mg/L
- Plant Available Phosphorus (P Index): 10 to 30 mg/kg (this is a tighter range than specified for basic evaluation above)

- Zinc < 0.1 mg/L (100 ppb)
- Copper < 0.025 mg/L (25 ppb)
- Lead < 0.025 mg/L
- Arsenic < 0.02 mg/L
- Cadmium < 0.01 mg/L
- Mercury < 0.01 mg/L
- Selenium < 0.01 mg/L

The Synthetic Precipitation Leaching Procedure (SPLP) (EPA SW-846, Method 1312) may also be used.

Criteria should be met as stated where a pollutant is associated with a water quality impairment or Total Maximum Daily Load (TMDL) in any downstream receiving water. Criteria may be waived or modified, at the discretion of the reviewer, where a pollutant does not have a nexus to a water quality impairment or TMDL of downstream receiving water(s).

Note that Saturation Extract and SPLP tests are expected to result in somewhat more leaching than would be experienced with real stormwater; therefore a direct comparison to water quality standards or effluent limitations is not appropriate.

Alternative Mix Components and Proportions

Alternative mix components and proportions may be utilized, provided that the whole blended mix conforms to the criteria identified in the Basic Whole Mix Testing, Infiltration Rate Evaluation, and Chemical Suitability Evaluation, as applicable. Alternative mix designs may include alternative proportions, alternative organic amendments (e.g., peat, coco coir pith) and/or use of natural soils. Alternative mixes are subject to approval by the reviewer. Alternative mixtures may be particularly applicable for systems with underdrains in areas where phosphorus is associated with a water quality impairment or a Total Maximum Daily Load (TMDL) in a downstream receiving water.

Construction Guidelines

- The Contractor should not deliver or place soils in wet or muddy conditions. The Contractor should protect soils and mixes from absorbing excess water and from erosion at all times. The Contractor should not store materials unprotected from rainfall events (>0.25 inches). If water is introduced into the material while it is stockpiled, the Contractor should allow material to drain prior to placement
- BSM should be thoroughly mixed prior to delivery using mechanical mixing methods such as a drum mixer.
- BSM should be lightly compacted and placed in loose lifts approximately 12 inches (300 mm) to ensure reasonable settlement without excessive compaction, such as via a rolling landscaping compaction drum (hand operated). Compaction within the BSM area should not exceed 75 to 85% standard proctor within the designed depth of the BSM. Machinery shouldl not be used in the bioretention facility to place the BSM. A conveyor or spray system should be used for media placement in large facilities. Low ground pressure equipment may be authorized for large facilities at the discretion of the reviewer.
- Placement methods and BSM quantities should account for approximately 10 percent reduction in media volume due to settling. Planting methods and timing should account for settling of media without exposing plant root systems.

- The Permittee construction inspector may request up to three double ring infiltrometer tests (ASTM D3385) or approved alternate tests to confirm that the placed material meets applicable infiltration rate range. In the event that the infiltration rate of placed material does not meet applicable criteria, the Permittee may require replacement and/or decompaction of materials.
- Close adherence to the material quality controls herein are necessary in order to assure sufficient permeability to infiltrate/filter runoff during the life of the facility, support healthy vegetation, and minimize pollutant leaching.
- Acceptance of the material should be based on test results conducted no more than 120 days prior to delivery of the blended BSM to the project site and certified to be representative of the mix composition that is actually used. For projects installing more than 100 cubic yards of BSM, batch-specific tests of the blended mix should be provided to the Permittee inspector for every 100 cubic yards of BSM along with a site plan showing the placement locations of each BSM batch within the facility.

Integration with Other Specifications

BSM specifications are related to, and may depend or have dependency on other specifications, including but not limited to:

- Filter course and drainage layer (See MISC-3)
- Plantings and Hydroseed (See MISC-4)
- Underdrains (See BIO-1)
- Outlet control structures (See BIO-1)

Narrative Guidance for Balancing Plant Growth with Nutrient Leaching

Where the BMP discharges to receiving waters with nutrient impairments or nutrient TMDLs, there is a particular balance that needs to be maintained between providing enough nutrients for plant growth while avoiding chronic leaching of nutrients from the media.

- In general, the potential for leaching of nutrients can be minimized by:
  - Utilizing stable, aged compost (as required of media mixes under all conditions).
  - Utilizing other sources of organic matter, as appropriate, that are safe, non-toxic, and have lower potential for nutrient leaching than compost (e.g., wood compost, peat, coco coir pith).
  - Reducing the content of compost or other organic material in the media mix to the minimum amount necessary to support plant growth and healthy biological processes.
- A botanist, agronomist, and/or landscape architect can be consulted to assist in balancing the interests of plant establishment, water retention capacity (irrigation demand), and the potential for nutrient leaching. The following practices should be considered in developing the media mix design:
  - The actual nutrient content and organic content of the selected compost source should be considered when specifying the proportions of compost and sand. The compost specification allows a range of organic content over approximately a factor of 2 and nutrient content may vary more widely. Therefore determining the actual organic content and nutrient content of the compost expected to be supplied is important in determining the proportion to be used for amendment.
  - A commitment to periodic soil testing for nutrient content and a commitment to adaptive management of nutrient levels can help reduce the amount of organic amendment that

must be provided initially. Generally, nutrients can be added planting areas through the addition of organic mulch, but cannot be removed.

- Plant palettes and the associated planting mix should be designed with native plants where possible. Native plants generally have a broader tolerance for nutrient content, and can be longer lived in leaner/lower nutrient soils. An additional benefit of lower nutrient levels is that native plants will generally have less competition from weeds.
- Nutrients are better retained in soils with higher cation exchange capacity (CEC). CEC can be increased through selection of organic material with naturally high CEC, such as peat, and/or selection of inorganic material with high CEC such as some sands or engineered minerals (e.g., low P-index sands, zeolites, rhyolites, etc). Including higher CEC materials would tend to reduce the net leaching of nutrients.
- Soil structure can be more important than nutrient content in plant survival and biologic health of the system. If a good soil structure can be created with very low amounts of compost, plants survivability should still be provided. Soil structure is loosely defined as the ability of the soil to conduct and store water and nutrients as well as the degree of aeration of the soil. While soil structure generally develops with time, planting/storage media can be designed to promote earlier development of soil structure. Soil structure is enhanced by the use of amendments with high hummus content (as found in well-aged organic material). In addition, soil structure can be enhanced through the use of compost/organic material with a distribution of particle sizes (i.e., a more heterogeneous mix).
- Younger plants are generally more tolerant of lower nutrient levels and tend to help develop soil structure as they grow. Starting plants from smaller transplants can help reduce the need for organic amendments and improve soil structure. The project should be able to accept a plant mortality rate that is somewhat higher than starting from larger plants and providing high organic content.

- With these considerations, it is anticipated that less than 20 percent compost amendment could be used, while still balancing plant survivability and water retention.

We wish to express our gratitude to following individuals for their feedback on the design of planting/storage media for nutrient sensitive receiving waters in Southern California.

Deborah Deets, City of Los Angeles Bureau of Sanitation

Drew Ready, LA and San Gabriel Rivers Watershed Council

Rick Fisher, ASLA, City of Los Angeles Bureau of Engineering

Dr. Garn Wallace, Wallace Laboratories

Glen Dake, GDML

Jason Schmidt, Tree People

The guidance provided herein does not reflect the individual opinions of any individual listed above and should not be cited or otherwise attributed to those listed.

MISC-2: AMENDED SOILS

Soil amendments alter the soil characteristics to allow it to absorb, infiltrate, and retain more water to help reduce runoff volume and velocity, filter pollutants, increase the quality and quantity of vegetation, and reduce erosion potential more effectively than soils without soil amendments. Mulch is an amendment that is added on the top of the soil, rather than mixed into the soil, which reduces evaporation and adds to the aesthetics of a site. Compost and fertilizers are common soil amendments that must be completely mixed into the soil to function properly.



Soil amended area at U.S. EPA Ariel Rios building.
Source: http://www.epa.gov/oaintrnt/stormwater/hq_projects.htm

General Criteria

- Compost, soil conditioners, and fertilizers should be roto-tilled into the native soil to a minimum depth of 6" (12 inches preferred). Mulch at grade should be spread over all planting areas to a depth of 3".
- Sand can be used as an amendment to improve the drainage rates of amended soils. Sand should be free of stones, stumps, roots or other similar objects larger than 5 mm
- Incorporating compost and other organics into the root zone results in enhanced biological activity, attenuation of envrionemntal contaminants, increased moisture holding capacity, and improved soil structure. Compost should be a well decomposed, stable, weed free organic matter source derived from waste materials including yard debris, wood wastes, or other organic materials not including manure or biosolids meeting standards developed by the US Composting Council (USCC). The product shall be certified through the USCC Seal of Testing Assurance (STA) Program (a compost testing and information disclosure program).
- All soil amendments should be free of stones, stumps, roots or other similar objects larger than 2 inches.
- All soil amendments should be free of glass, plastic, metal, and other deleterious materials.

Accounting for Soil Amendments in Sizing Calculations

Amended soils should be used as part of HSC-2 Impervious Area Dispersion, and to increase the retention volume of Infiltration and Biotreatment BMPs (except where a more specific bioretention soil mix is required as described in MISC-1)

Amending soils can be used to classify an area as self-retaining pervious area per HSC-6.

MISC-3: FILTER COURSE AND UNDERDRAIN PIPE DESIGN

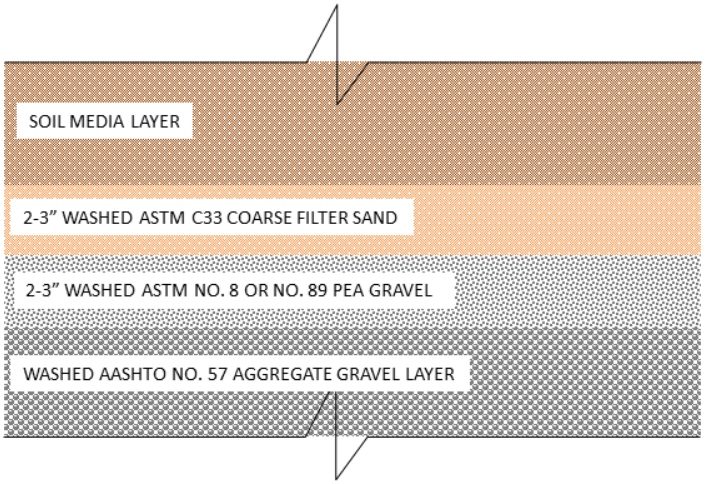
Many LID BMPs include a soil media layer underlain by an aggregate gravel layer that may or may not include an underdrain. To keep the media particles from migrating into the aggregate gravel layer, a filter course is used. While geotextile filter fabrics have been used in the past at the interface of the soil media and gravel aggregate layers, experience has shown that filter fabric is a common point of failure in stormwater BMPs, either by clogging, or by allowing media to migrate into the underdrain system. A 'bridging' or 'choking' layer is preferred to separate the gravel aggregate layer and the soil media. This approach consists of progressively graded layers that progress from finer to coarser materials moving from top to bottom.

This fact sheet provides a recommended filter course that has been estimated to provide appropriate bridging and permeability for typical soil media and aggregate gravel used in LID BMPs. This filter course consists of a coarse sand layer, underlain by pea gravel, underlain by the aggregate gravel. As long as the recommendations below are used for the filter course and aggregate gravel, then no calculations are needed to demonstrate the adequacy of the filter course.

This fact sheet also provides recommended design criteria for slotted underdrain pipe.

Recommended Filter Course and Aggregate Gravel Layer Design

The recommended design for the filter course is shown below. It consists of 2 to 3 inches of ASTM C33 coarse sand at the bottom of the media layer, underlain by 2 to 3 inches of ASTM No. 8 or No. 89 gravel. The design assumes that the aggregate gravel layer consists of AASHTO No. 57 gravel. The gradation limits to meet the standard classifications are shown in the tables below. If the project proposes significantly different gradations of any layer, then calculations showing that the filter course is adequate are required as references in the "Calculations to Support Custom Filter Course" section of this Fact Sheet.



Gradation Limits for ASTM C33 Concrete Sand

Sieve Size	Percent of Particles Smaller than Sieve Size
0.375 inches	100
No. 4 (0.187 inches)	95-100
No. 8 (0.093 inches)	80-100
No. 16 (0.046 inches)	50-85
No. 30 (0.024 inches)	25-60
No. 50 (0.012 inches)	5-30
No. 100 (0.006 inches)	0-10
No. 200 (0.003 inches)	0 [fines should not be present in washed stone]

Gradation Limits for ASTM No. 8 Pea Gravel (aka 3/8" stone)

Sieve Size	Percent of Particles Smaller than Sieve Size
0.5 inches	100
0.375 inches	85-100
No. 4 (0.187 inches)	10-30
No. 8 (0.093 inches)	0-10
No. 16 (0.046 inches)	0-5

Gradation Limits for ASTM No. 89 Pea Gravel (aka 1/4 to 3/8" stone)

Sieve Size	Percent of Particles Smaller than Sieve Size
0.5 inches	100
0.375 inches	90-100
No. 4 (0.187 inches)	20-55
No. 8 (0.093 inches)	5-30
No. 16 (0.046 inches)	0-5
No. 50 (0.046 inches)	0-5

Gradation Limits for AASHTO No. 57 Aggregate Gravel (aka 3/4" open graded base)

Sieve Size	Percent of Particles Smaller than Sieve Size
1.5 inches	100
1 inch	95-100
0.5 inches	25-60
No. 4 (0.187 inches)	0-10
No. 8 (0.093 inches)	0-5

For systems with deeper reservoirs, it is acceptable to utilize another layer of stone below the No. 57 stone, such as 1 ½" inch base or larger.

Custom Filter Course Layer

Other filter course configurations are also acceptable, but thorough descriptions of each of the materials used as well as supporting calculations showing their adequacy to maintain permeability and prevent migration of media particles is required. Methods of completing these calculations can be obtained from:

- Chapter 26 of the Natural Resources Conservation Service Part 633 National Engineering Handbook (**https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=18397.wba**) or
- Table 2 of the United States Golf Association Recommendations for a Method of Putting Green Construction **https://www.usga.org/content/dam/usga/images/course-care/2004%20USGA%20Recommendations%20For%20a%20Method%20of%20Putting%20Green%20Cons.pdf**.

Calculations need to be completed for each interface between media or gravel of different sizes to show adequate choking and permeability. For example, the recommended filter course design included calculations between the coarse sand layer and the pea gravel and between the pea gravel and the aggregate gravel layers.

Slotted Underdrain Pipe

- Underdrains should be slotted, PVC pipe conforming to ASTM D 3034 or equivalent or corrugated, HDPE pipe conforming to AASHTO 252M or equivalent.
- Slots should be 4-6 rows cut perpendicular to the axis of the pipe or right angles to the pitch of corrugations.
- Slots should be 0.04 to 0.1 inches wide and 1 to 1.25 inches long.
- Slots should be longitudinally spaced such that the pipe has a minimum of 2 square inches of "slot open area" in each lineal foot of pipe.
- Slot space is computed as the product of the length, width, number of rows, and number of slots per row in 1 foot of pipe. For example, a pipe containing 6 rows of 1"x 0.067" slots with 12 slots per lineal foot of pipe would have an open area of 6x12x1"x0.067" = 4.8 sq-inch open area per lineal foot of pipe.

MISC-4: RECOMMENDED PLANT LIST

Vegetation is an integral element of biotreatment BMPs in order to help remove pollutants, stabilize soils, support soil microbial communities, and resist clogging. However, not all vegetation will be effective for each BMP type, so selecting a suitable type of vegetation is very important to BMP performance. A recommended plant list is provided in this fact sheet along with general guidelines.



Source: Geosyntec Consultants

General Guidelines for Plant Selection

- Plants should be native or climate-appropriate non-invasive species.
- Multiple species per BMP are recommended to provide diversity. A mix of grasses, bunch grasses, and shrubs should be considered.
- Species should be suited to the conditions the BMP will encounter (periodic inundation, sustained dry periods, relatively course-grained soils, etc. The climate and conditions vary by location within Orange County, by BMP type, by application type, and even within a BMP. For example, within a bioinfiltration BMP, the vegetation at the bottom of the BMP will be regularly inundated, while the vegetation on the side slopes will only rarely be inundated, so different vegetation types may be necessary.
- Species selected should not require regular use of fertilizers and pesticides. Augmentation of surface soils with a stable, well-aged, certified compost is acceptable from time to time. Slow release organic fertilizers applied at a minimum necessary rate may be acceptable.
- Plants should be compatible with the irrigation proposed. Permanent irrigation may be necessary to sustain plants. However, plants should not be dependent on frequent irrigation. Additionally, plants that require or tolerate periodic irrigation should be planted in separate areas from those that do not tolerate seasonal irrigation.
- In any case, the vegetation selected should be suited to the climate and conditions of the BMP, must not cause or contribute to contamination of runoff or invasion of habitat, and, should be selected to remove pollutants and support biological communities that remove pollutants to the extent possible.
- This is not meant to be an exhaustive list of all compatible plant species. Other plant types may be used as long as they are compatible with the purposes of vegetation in the BMP as discussed above.

A qualified landscape architect or agronomist familiar with the stormwater BMPs may be consulted to select a plant palette that fits the needs of the project. Plant selection should fit the constraints and media selected for the BMP.

RECOMMENDED PLANT NAMES, IRRIGATION REQUIREMENTS, BMP LOCATION, AND BMP APPLICABILITY

Plant Name		Irrigation Requirements		Preferred Location in Basin		LID BMP Applicability[3]				
Latin Name	Common Name	Temporary Irrigation during Plant Establishment Period	Permanent Irrigation (Drip / Spray)[1]	Basin Bottom	Basin Side Slopes	Biofiltration (BIO-1/BIO-5/BIO-6/BIO-7/INF-3)	Vegetated Swale (BIO-2) [2]	Vegetated Filter Strip (BIO3) [2]	Dry Extended Detention Basin (BIO-4)	Infiltration Basin (INF-1)
SHRUBS / BUNCH GRASSES										
Achillea millefolium	Yarrow[2]	X			X	X	X		X	X
Anemopsis californica	Yerba Manza	X			X	X	X		X	X
Baccharis douglasii	Marsh Baccahris	X	Optional	X		X	X		X	X
Carex praegracillis	California Field Sedge	X	Optional	X		X	X		X	X
Carex spissa	San Diego Sedge	X	Optional	X		X	X		X	X
Carex subfusca	Rusty Sedge	X	Optional	X	X	X	X		X	X
Eleocharis macrostachya	Pale Spike Rush	X	Optional	X		X	X		X	X
Iva hayesiana	Hayes Iva[2]	X			X	X	X		X	X
Juncus Mexicana	Mexican Rush	X	Optional	X	X	X	X		X	X
Jucus patens	California Gray Rush	X	Optional	X	X	X	X		X	X
Mahonia nevinii	Nevin's Barberry	X			X	X	X		X	X
Mimulus cardinalis	Scarlet Monkeyflower[2]	X		X	X	X	X		X	X
Ribes speciosum	Fushia Flowering Goose. [2]	X			X	X	X		X	X
Rosa californica	California Wild Rose[2]	X	Optional		X	X	X		X	X
Scirpus cernuus	Low Bullrush	X	Optional	X		X	X		X	X
Sisyrinchium bellum	Blue-eyed Grass[2]	X			X	X	X		X	X
GRASSES/GROUNDCOVER										
Agrostis pallens	Thingrass	X			X	X	X	X	X	X
Distichlis spicata	Salt Grass	X	Optional	X		X	X	X	X	X
Festuca californica	California Fescue[2]	X	Optional		X	X	X	X	X	X
Festuca rubra	Red Fescue[2]	X	Optional	X	X	X	X	X	X	X
Leymus condensatus	Canyon Prince Wild Rye	X	Optional	X	X	X	X	X	X	X
Muhlenburgia rigens	Deergrass	X	Optional	X	X	X	X	X	X	X

1. Some plants will benefit from supplemental irrigation, particularly those on basin side slopes and further inland. However, the irrigation regime should be sparse and allow for complete drying. Excessive watering during the summer can be problematic for native plants. Plants that could benefit from or tolerate periodic irrigation are identified as "optional" in this column.
2. Bunching grasses should be avoided entirely in filter strips as the desire is to provide a very uniform stem structure. Bunching grasses can be used in swales but should be augmented with non-bunching grasses and ground covers.
3. Many of these plants could be applicable to many different BMP types. In general, BMPs such as biofiltration that have mulch on the basin bottom will use shrubs/bunchgrasses on the basin bottom and grasses/groundcover on the side slopes. BMPs that do not use mulch require denser groundcover, so they typically use grasses, but may also incorporate shrubs/bunchgrasses, as needed.

MISC-5: PRETREATMENT GUIDANCE

The fact sheet is intended to define what is meant by various pretreatment approaches and providing ratings of effectiveness of these approaches. See Section 4.4.2 of the TGD for additional information. This fact sheet contains a replication of some information from Section 4.4.2.

Pretreatment Approach or BMP Type	Description	Performance		Appropriate Uses
		Sediment Removal	GW Protection	
Settling chambers or sacrificial forebay	At least 10 percent (preferably 20 percent) additional volume beyond DCV is set aside for pre-settling of particulates at the entry point to the BMP	Moderate	Negligible	Where land use is low risk or in combination with other approaches
Catch basin inserts	Manufactured systems intended to strain coarse solids from stormwater as it enters catch basins.	Negligible	Negligible	For trash control only; no significant benefit for clogging or GW quality.
Sacrificial mulch layer	Mulch layer provided on the surface of vegetated systems with commitments to yearly maintenance of mulch such that sediment will be removed as it accumulated	Moderate	Limited	Bioretention systems where clogging risk is low
Sacrificial sand layer	A course sand layer above the infiltrating surface with a filtration rate 5 to 10 times higher than underlying soil; Filter layer will be removed and replace when drawdown rates become impaired	Moderate	Negligible	Non-vegetated surface or subsurface systems where sand layer can be removed and replaced
Amended media layers	An engineered bioretention soil media layer (Meeting specification for MISC-1) installed in the surface of a bioretention BMP or infiltration basin to pre-filter sediment and treat other pollutants. Infiltration rate is at least 5 times higher than underlying soil, up to a maximum of 20 inches per hour. Filter layer will be removed and replace when drawdown rates become impaired	Moderate to high	Medium to high	Bioretention or infiltration systems; Ensure that media layer K_{design} has an appropriate factors of safety over the underlying K_{design} to not become the limiting surface

Pretreatment Approach or BMP Type	Description	Performance		Appropriate Uses
		Sediment Removal	GW Protection	
Approved "pretreatment" devices	A system with an approved General Use Level Designation for "pretreatment" by Washington State TAPE or equivalent. This must be supported by current ratings. Maintenance must be performed at intervals specified in TAPE approval documents.	Moderate	Limited	Underground or surface systems with adequate head for pretreatment device and low to moderate clogging risk
Non-proprietary biotreatment or treatment control BMPs	A biotreatment or treatment control BMP with M or H performance for pollutants of concern. Full design and O&M criteria applicable to the BMP type must be met.	High	Medium to high	Where clogging risk and/or groundwater risks are elevated.
Approved "treatment" or "biofiltration" proprietary BMP devices	A system with an approved General Use Level Designation for "basic treatment" or "enhanced treatment" by Washington State TAPE or equivalent. Full design and O&M criteria applicable to the BMP type must be met.	High	Medium to high	Where clogging risk and/or groundwater risks are elevated.

G.3 Full Infiltration BMP Fact Sheets (MISC)

INF-1: INFILTRATION BASIN

Also known as:
Recharge Basin
Infiltration Pond

Category: Full Infiltration

Infiltration basins are BMPs designed to capture runoff and infiltrate it into the underlying soil. An infiltration basin consists of an earthen basin constructed with a flat bottom. An energy dissipating inlet must be provided, along with an emergency spillway to control excess flows. A forebay settling basin or separate measure must be provided as pretreatment. An infiltration basin retains the full DCV in the basin and allows it to percolate into the underlying soils, so it is only used for DMAs categorized as feasible for full infiltration. The bottom of an infiltration basin is typically vegetated with dryland grasses; however, other types of vegetation are permissible if they can survive periodic inundation and long inter-event dry periods. Vegetation is required as it is helpful in maintaining infiltration rates over time and helps reduce erosion from the side slopes into the basin.



Source: Emily Benson

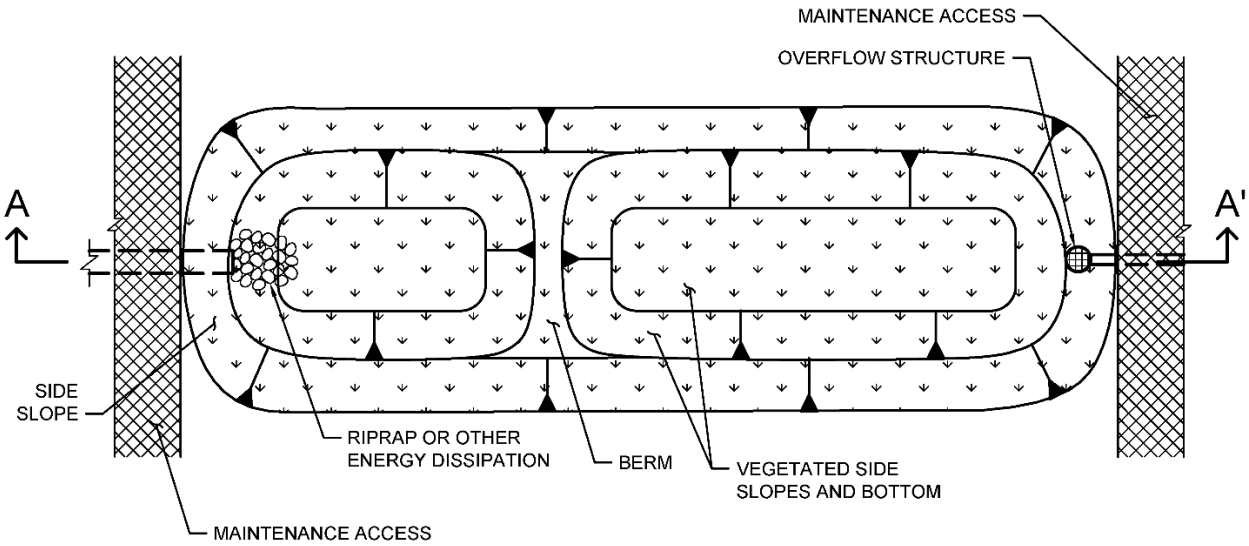
Pollutant Removal Considerations

Phosphorus	Nitrogen	Metals	Bacteria	Oil & Grease	Organics
H	H	H	H	H	H

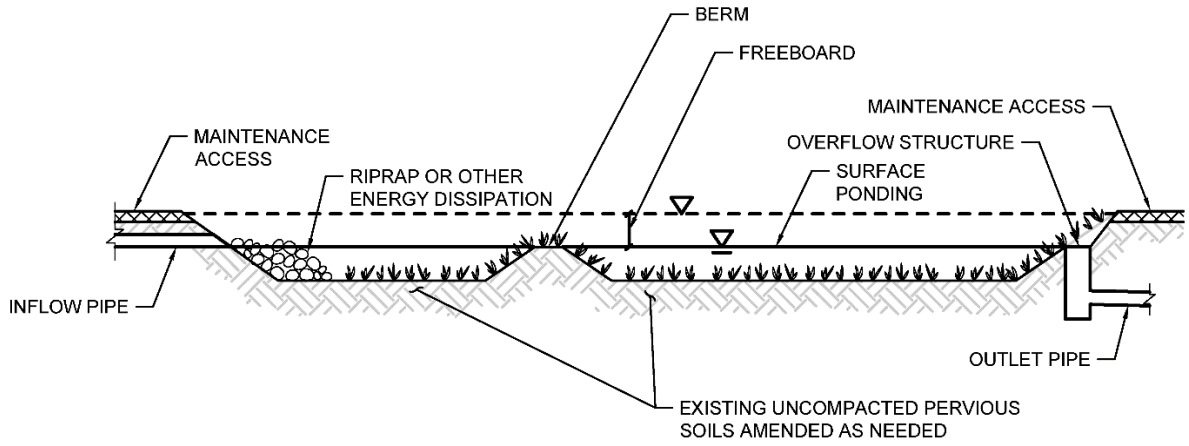
Recommended Siting Criteria

Siting Criteria	Intent/Rationale
☐ BMP placement adheres to geotechnical recommendations with respect to geological hazards and setbacks.	Must not negatively impact existing site geotechnical concerns.
☐ BMP is located in areas of the site most suitable for full infiltration.	A full infiltration BMP must be sited such that the underlying soil infiltration rates will facilitate infiltration of the full DCV and this can be assured through construction and operation.
☐ BMP should not be located in fill areas, unless permeable engineered fill can be used.	The ability to fully infiltrate the DCV must be determined prior to construction and assured through construction. In areas that will have traditional compacted fill, it is not possible to determine the infiltration rate. Additionally, where the infiltrating surface is deep below existing grade, the quality of investigation may be compromised.
☐ Sediment sources must be controlled prior to operation of the system.	Facility should not be used in areas that will continue to receive elevated sediment loading following construction, such as from open space areas.

Example Schematic Design - Plan and Section View



PLAN
NOT TO SCALE



SECTION A-A'
NOT TO SCALE

Recommended BMP Component Dimensions

BMP Component	Dimension	Intent/Rationale
Freeboard	≥ 1 foot (offline facilities) ≥ 2 foot (inline facilities)	Freeboard provides room for head over overflow structures and minimizes risk of uncontrolled surface discharge. Lower freeboard is allowable if there is an acceptable alternative overflow method.
Surface Ponding	≤ 3 feet preferred	Increasing ponding depth increases the risk of clogging and mounding. It also increases the sensitive of the system to declines in infiltration rates.
Ponding Area Side Slopes	3H:1V or shallower	Gentler side slopes are safer, less prone to erosion, able to establish vegetation more quickly and easier to maintain.
Forebay Volume (if forebay used for pretreatment)	20 percent of total volume (not counted in DCV) to provide a moderate level of pretreatment	Provides a dedicated volume for settling and sediment accumulation.

Recommended Design Criteria and Considerations

Design Criteria	Intent/Rationale
Pretreatment	
☐ Pretreatment is provided to remove coarse sediment and organic debris per criteria in **TGD Chapter 4**.	BMP performance and longevity is increased. Premature clogging is avoided.
☐ Mechanical pretreatment (e.g., hydrodynamic separator, treatment control BMP) are preferred.	A forebay has limited effectiveness and can become clogged rapidly, leading to standing water.
Forebay	
☐ Volume is ≥ 20% of facility volume, if forebay is used.	An adequately sized forebay to trap sediment can decrease frequency of required maintenance.
Surface Ponding	
☐ Finish grade of the facility has ≤3 inches of elevation difference across the bottom of the facility.	Flatter surfaces reduce erosion and channelization within the facility and reduce the potential for development of preferential pathways.
☐ Surface ponding is limited to a maximum 48-hour drawdown time.	A maximum 48-hour drawdown time is recommended for plant health and vector control. A shorter surface ponding drawdown time increases the volume available to capture subsequent storms and can result in smaller required volume.

Design Criteria	Intent/Rationale
Vegetation	
☐ Temporary irrigation is needed; a permanent irrigation system should be considered to support periodic reestablishment of vegetation after maintenance.	Seasonal irrigation may be needed to ensure robust vegetative processes in relatively coarse-grained media material.
☐ Plant materials should be tolerant of summer drought (unless irrigated), ponding fluctuations, and saturated soil conditions for up to 96 hours (accounting for back to back storms); native plant species and/or hardy cultivars that are not invasive and do not require chemical fertilizers or pesticides should be used to the maximum extent feasible. See recommended plant list in **Fact Sheet MISC-4**.	Plants suited to the climate and ponding depth are more likely to survive.
Inflow and Outflow Structures	
☐ Inflow and outflow structures are accessible for inspection and maintenance.	Maintenance access is essential to ensure long-term performance.
☐ Inflow velocities onto the infiltration basin bottom are held to less than 1 ft/s. Dispersed flow or energy dissipation for piped inlets should be provided at inlet to prevent erosion.	High inflow velocities can cause erosion, scour and/or channeling.
☐ A staff gage is provided (can be attached to a structure) to allow inspection of drawdown time.	This feature is necessary to facilitate inspection and performance confirmation (i.e., the facility is infiltrating).
☐ An overflow device is required at the top of the ponding depth to safely convey overflow to the downstream receiving system.	Planning for controlled overflow lessens the risk of property damage due to flooding.
Soil Amendment (as needed)	
☐ If underlying infiltration rates (prior to factor of safety adjustment) are greater than 12 inch/hour or have less than 3 percent organic content, then amend soil by incorporating 3 inches of compost into the top 12 inches of soil.	In very sandy soils, soil amendment is needed to protect groundwater quality and support plants.
☐ If amendments are used, infiltration rates should be remeasured after amendment.	Amendments can change the infiltration rate of soils. An example amended plot can be used during site investigation rather than measuring after full scale amendment.

Calculations and Sizing Method

See **Appendix E** for acceptable sizing methods. Basin volume below the overflow, excluding the forebay, can be counted towards the DCV. Checks on clogging risk must be conducted as part of sizing.

Construction Guidance

Construction Guidance	Intent/Rationale
☐ Plans should include a construction sequence for the BMP. Revisions proposed by the contractor should be reviewed by the engineer. The construction sequence should address erosion control, utilities, BMP installation, inspections, testing and certifications, final grading, vegetation, stabilization, and post-construction monitoring.	Construction sequencing is critical to avoid issues/damage and allow appropriate inspections, testing, and certifications to be performed.
☐ Conduct earthwork in dry weather or at least 48 hours after the end of rainfall.	Wetter soil is typically more susceptible to compaction.
☐ Avoid compaction of the base and sidewalls of the facility. Alleviate compaction as needed using mechanical tilling equipment (e.g., rototiller).	Infiltration rates are typically very susceptible to compaction. Infiltration should be maximized.
☐ Keep sediment out of the facility during construction. If the basin will be used as a temporary sediment control measure, it must be lined for this use, and the liner must be removed before placing it into service for post-construction purposes.	Sediment accumulation can impair infiltration rates.
☐ Traffic within the BMP must be avoided entirely. Excavation should occur from outside of the facility or via low-ground pressure equipment.	Compaction of the system must be avoided as much as possible.
☐ Fully stabilize sources of sediment within the tributary area (i.e., no exposed soil) prior to placing the finished BMP into service.	Erosion and sedimentation can seriously impair the hydraulic conductivity of the basin subgrade soils and require restoration and revegetation of the basin bottom.
☐ Allow plants to stabilize for as long as practicable (preferably several months) prior to placing the finished BMP into service.	Stabilization of the system allows plants to mature before stressing the system with stormwater loading.
☐ As part of verifying the system, conduct infiltration testing to confirm infiltration rates are equal or greater than the design infiltration rate. Require remediation if infiltration rates are lower than design.	The proponent must demonstrate that the BMP is constructed per design. Infiltration rate is an important design parameter.

Adaptability Considerations

This type of BMP has limited adaptability should actual conditions differ from those estimated as part of the design level investigation. Infiltration basins should only be used in locations where the ability to reliably infiltrate can be determined in the design phase. Reliability can be improved through (1) conducting a thorough investigation, (2) minimizing construction

impacts that could change conditions, and (3) providing a higher factor of safety in design. If there is uncertainty in the ability to support full infiltration, then a bioretention BMP (INF-3/BIO-1) is strongly recommended, including an underdrain system that can be activated if necessary. In certain cases, a project could consider a contingency plan allowing for conversion to an infiltration/partial dry extended detention basin combination (INF-1/BIO-4). This case would require that the portion designed as BIO-4 be adequately sized to meet biotreatment sizing criteria and addresses the project pollutants of concern.

O&M Activities and Frequencies

Activity	Frequency
GENERAL INSPECTIONS	
Identify eroded facility areas	Four times per year during wet season, including inspection just before the wet season and within 24 hours after at least two storm events ≥ 0.5 inches
Observe and record drawdown rate	
Estimate degree of sediment accumulation in pretreatment system and infiltration basin	
Identify areas of compromised plant health or density	
Identify any needed corrective maintenance that will require site-specific planning or design	
ROUTINE MAINTENANCE	
Sediment, Trash, and Debris	
Remove trash from facility	Each visit; as needed
Remove sediment from forebay when estimated sediment accumulation exceeds 25% of the forebay volume	As needed
Remove sediment from pretreatment system per manufacturer's recommendations or when sediment storage volume is more than 50% full	Per manufacturer recommendation, or as needed
Vegetation and Infiltration Bed	
Irrigate as recommended by a landscape professional, typically for the first 3 years to establish vegetation	As needed
Remove undesirable vegetation	Four times per year during wet season, including inspection just before the wet season
Replant or reseed areas of thin or missing vegetation	Annually
Scrape soil from top 3 to 6 inches of infiltration bed and reestablished vegetation; augment soil amendment if needed	When infiltration rate drops below design infiltration rate
Inflow and Outflow Structures	
Check energy dissipation function and add riprap	Four times per year during wet season, including

Activity	Frequency
	inspection just before the wet season
Inspect inlets and outlets and remove accumulated sediment	Four times per year during wet season, including inspection just before the wet season
Repair structural damage to inlets and outlets	As needed
CORRECTIVE (MAJOR) MAINTENANCE	
Prepare documentation of issues and resolutions for review by appropriate parties; modify WQMP if needed.	Before major maintenance
Document major maintenance activities; record modified WQMP and as-built plan set if needed	After major maintenance
Take photographs before and after from the same vantage point	Before and after

INF-2: INFILTRATION TRENCH

Category: Full Infiltration

Also known as:
- French Drain
- Rock Trench
- Exfiltration Trench



Source: Caltrans

An infiltration trench is a long, narrow, rock-filled trench designed to infiltrate runoff into the underlying soil. An infiltration trench retains the full DCV in the void space between stones and allows it to infiltrate through the bottom and sides of the trench into surrounding soils. Infiltration trenches are only applicable for DMAs in the full infiltration category. These facilties are commonly used adjacent to parking lots, driveways, roadway medians and shoulders. An infiltration trench provides the majority of its pollutant removal benefits through volume reduction. Pretreatment is important for limiting amounts of coarse sediment entering the trench which can clog the soil and render the trench ineffective. Maintenance to restore infiltration rates requires substantial rebuilding of the facility, therefore premature clogging must be avoided.

If an infiltration trench is deeper than its longest surface dimension, it must be classified as a dry well, adhere to associated guidelines, and be registered as a Class V injection well. See Appendix I.

Pollutant Removal Considerations

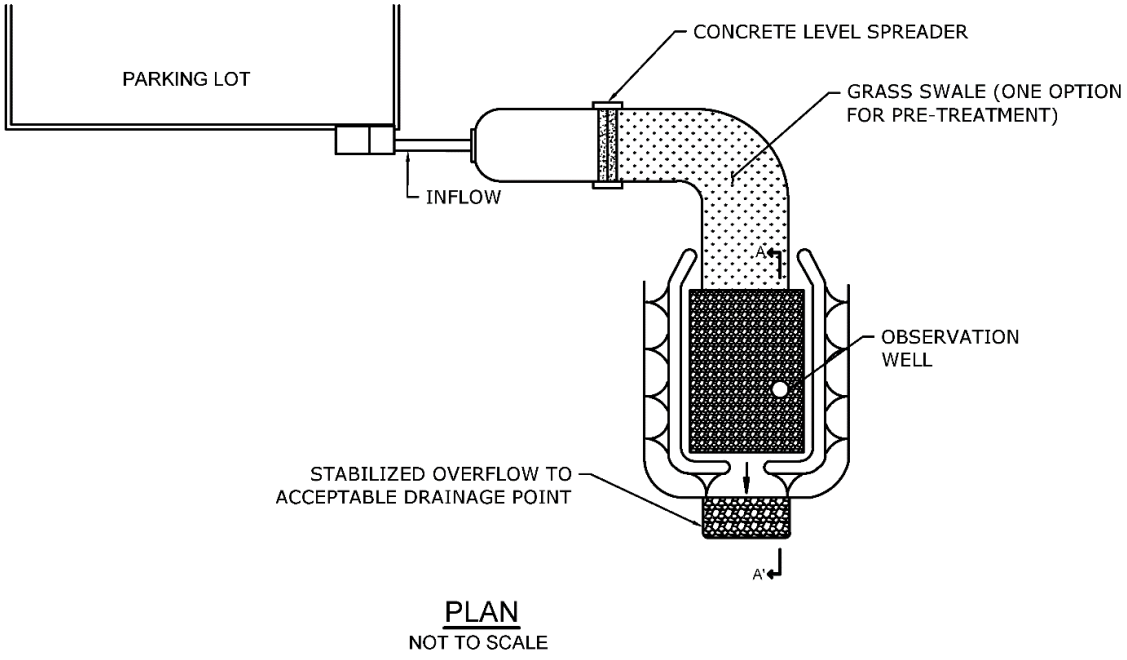
Phosphorus	Nitrogen	Metals	Bacteria	Oil & Grease	Organics
H	H	H	H	H	H

Recommended Siting Criteria

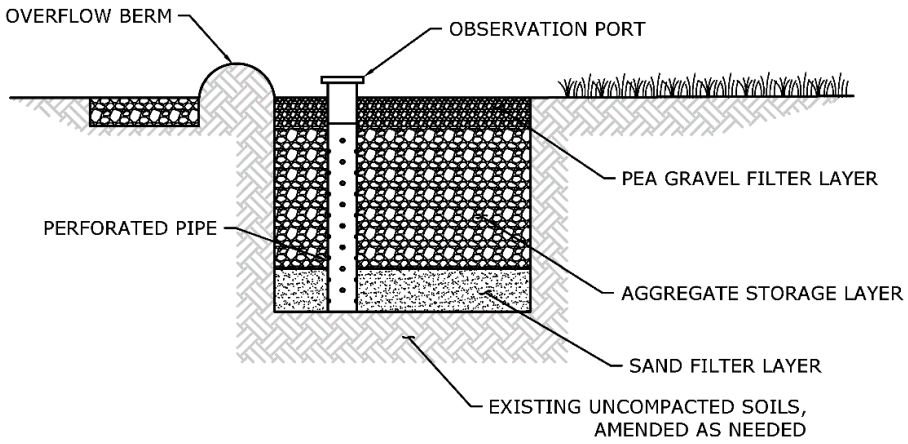
Siting Criteria	Intent/Rationale
☐ BMP placement adheres to geotechnical recommendations with respect to geological hazards and setbacks.	Must not negatively impact existing site geotechnical concerns.
☐ BMP is located in areas of the site most suitable for full infiltration.	A full infiltration BMP must be sited such that the underlying soil infiltration rates will facilitate infiltration of the full DCV and this can be assured through construction and operation.
☐ BMP should not be located in fill areas, unless permeable engineered fill can be used, or in significant cut areas.	The ability to fully infiltrate the DCV must be determined prior to construction and assured through construction. In areas that will have traditional compacted fill, it is not possible to determine the infiltration rate. Additionally,

	where the infiltrating surface is deep below existing grade, the quality of investigation may be compromised.
☐ Sediment sources must be controlled prior to operation of the system.	Facility should not be used in areas that will continue to receive elevated sediment loading following construction, such as from open space area.

Example Schematic Design - Plan and Section View



PLAN
NOT TO SCALE



SECTION A-A'
NOT TO SCALE

Other configurations of this BMP are also possible including mechanical pretreatment and inflow coming from a storm drain rather than the surface.

Recommended BMP Component Dimensions

BMP Component	Dimension	Intent/Rationale
Overall Trench Geometry	Depth ≤ Width	If an infiltration trench is deeper than its widest surface dimension, or includes an assemblage of perforated pipes, drain tiles, or other similar mechanisms intended to distribute runoff below the surface of the ground, it would likely be considered a Class V Injection Well under the federal Underground Injection Control (UIC) Program, which is regulated in California by U.S. EPA Region 9. A UIC permit may be required for such a facility. Additionally, dry well guidelines in Appendix I should be followed.
Surface ponding	3 inches	The overflow elevation should be set to allow 3 inches of surface ponding to avoid premature bypass.
Freeboard	≥ 6 inches	The system should be able to overflow to an acceptable drainage point with adequate freeboard to prevent localized flooding or unacceptable overflow pathways.
Trench Width	≥ 24 inches	Facilitates excavation using conventional equipment
Pea Gravel Filter Layer	≥ 4 inches	Provides filtering of coarse sediment for inflows into the underlying aggregate storage layer
Trench Depth	≥ 3 feet	Infiltration into side walls is the most important pathway; deeper trenches better support side wall infiltration.
Sand Filter Layer	≥ 6 inches	Provides filtering of fine sediment prior to infiltration into subsurface soils. The sand layer can accommodate a greater degree of sedimentation before clogging than the underlying soils.
Observation Port Diameter	≥ 6 inches	Facilitates clear observation and measurement of facility water level to verify drawdown and performance

Recommended Design Criteria and Considerations

Design Criteria	Intent/Rationale
Pretreatment	
☐ Pretreatment is provided to remove coarse sediment and organic debris per criteria in **TGD Chapter 4**.	BMP performance and longevity is increased. Premature clogging is avoided.
Pea Gravel Filter Layer	
☐ Longitudinal trench slope is ≤ 3%.	Facilitates runoff interception and capture into the facility.
☐ A pea gravel filter layer is used to prevent migration of coarse sediment into the aggregate storage layer. Filter fabric is not used. See **MISC-3** for criteria for a pea gravel layer	Sediment can cause clogging of the aggregate storage layer void spaces. Filter fabric is more likely to clog.
☐ Pea gravel is washed and free of fines.	Washing aggregate will help eliminate fines that could clog the facility. Washing shall not occur in situ as it could clog the underlying infiltration surface.
Aggregate Storage Layer	
☐ Washed river rock or open-graded, crushed rock with porosity of at least 40 percent.	Washing aggregate will help eliminate fines that could clog the aggregate storage layer void spaces or subgrade.
Sand Filter Layer	
☐ Sand is uniform coarse washed sand, as specified in MISC-3.	Washed coarse sand can withstand greater sediment loading before becoming the limiting clogging surface.
Inflow and Outflow Structures	
☐ Inflow and outflow structures are accessible for inspection and maintenance.	Maintenance access is essential to ensure long-term performance.
☐ At least one observation port is provided in each cell of the trench to allow inspection of subsurface water level.	This feature is necessary to facilitate inspection and performance confirmation (i.e., the facility is infiltrating).
☐ A stabilized overflow is required to safely convey overflow to an acceptable drainage point. This could include an inlet located downstream. An inlet can also be located within the infiltration trench set at a depth of 3 inches above the surface of the trench.	Planning for controlled overflow lessens the risk of property damage due to flooding.

Calculations and Sizing Method

See **Appendix E** for acceptable sizing methods. The pore spaces in the gravel can be claimed as part of the DCV. Infiltration out of the bottom and half of the side wall area may be included in drawdown calculations.

Construction Guidance

Construction Guidance	Intent/Rationale
☐ Plans should include a construction sequence for the BMP. Revisions proposed by the contractor should be reviewed by the engineer. The construction sequence should address erosion control, utilities, BMP installation, inspections, testing and certifications, final grading, vegetation, stabilization, and post-construction monitoring.	Construction sequencing is critical to avoid issues/damage and allow appropriate inspections, testing, and certifications to be performed.
☐ Conduct earthwork in dry weather or at least 48 hours after the end of rainfall.	Wetter soil is typically more susceptible to compaction or smearing.
☐ Avoid compaction of the base and sidewalls of facilities. Alleviate compaction as needed using mechanical tilling equipment (e.g., rototiller) and/or scarification.	Infiltration rates are typically very susceptible to compaction. Infiltration should be maximized.
☐ Keep sediment out of the facility during construction. If the trench will be used as a temporary sediment control measure, it must be lined for this use, and the liner must be removed before placing it into service for post-construction purposes.	Sediment accumulation can impair infiltration rates.
☐ Traffic within the BMP should be avoided entirely.	Compaction of the system must be avoided as much as possible. There is no reasonable rationale for equipment or traffic within an infiltration trench.
☐ Fully stabilize sources of sediment within the tributary area (i.e., no exposed soil) prior to placing the finished BMP into service.	Erosion and sedimentation can seriously impair the hydraulic conductivity of the basin subgrade soils and require restoration and revegetation of the basin bottom.
☐ Phase construction to allow each layer of the facility to be inspected before it is covered.	Once layers are covered, they cannot be adequately inspected.
☐ Prior to backfill with gravel, conduct infiltration testing to confirm infiltration rates are equal or greater than the design infiltration rate. Require remediation if infiltration rates are lower than design.	The proponent must assure that the BMP is constructed per design. Infiltration rate is an important design parameter.

Adaptability Considerations

This type of BMP has very limited adaptability should actual conditions differ from those estimated as part of the design level investigation. Infiltration trenches should only be used in locations where the ability to reliably infiltrate can be determined in the design phase.

Reliability can be improved through (1) conducting a thorough investigation, (2) minimizing construction impacts that could change conditions, and (3) providing a higher factor of safety in design. If there is uncertainty in the ability to support full infiltration, then a bioretention BMP (INF-3/BIO-1) is strongly recommended, including an underdrain system that can be activated if necessary. If there is no ability to have an underdrain, then a Vegetated Swale (BIO-2) underlain by a gravel reservoir could be considered as a contingency plan, provided that the vegetated swale would be adequately sized and address pollutants of concern.

O&M Activities and Frequencies

Activity	Frequency
GENERAL INSPECTIONS	
Identify eroded facility areas	Four times per year during wet season, including inspection just before the wet season and within 24 hours after at least two storm events ≥ 0.5 inches
Observe and record drawdown rate via the observation port	
Estimate degree of sediment accumulation in the pea gravel, thickness of surface layer or depth of penetration	
Identify any needed corrective maintenance that will require site-specific planning or design	
ROUTINE MAINTENANCE	
Pea Gravel Filter Layer	
Remove sediment via scraping of the top layers of this layer and replacement with clean washed pea gravel	Annually or when sediment has accumulated within more than 2 inches of the pea gravel layer
Replace full depth of pea gravel	When full comingled with sediment
Gravel Bed	
Excavate the entire facility, rehabilitate bottom and sides via over-excavation, and replace aggregate layers. Aggregate layers can be reused if they are washed before replacement.	When infiltration rate drops below design infiltration rate
Inflow and Outflow Structures	
Repair structural damage to inlets and outlets	As needed
CORRECTIVE (MAJOR) MAINTENANCE	
Prepare documentation of issues and resolutions for review by appropriate parties; modify WQMP if needed.	Before major maintenance
Document major maintenance activities; record modified WQMP and as-built plan set if needed	After major maintenance
Take photographs before and after from the same vantage point	Before and after

INF-3: BIORETENTION WITHOUT UNDERDRAIN

Category: Full Infiltration ("Standard Configuration")

Adaptable to Partial Infiltration if Capped Underdrain is Included ("Adaptable Configuration")

Also known as:
Rain Gardens



Source: Geosyntec Consultants

Bioretention BMPs without underdrains are shallow landscaped depressions that capture and filter stormwater runoff prior to infiltrating into underlying soils. These facilities are designed to infiltrate the full DCV and are therefore only used for DMAs in the full infiltration category. With appropriate design features, these BMPs can be adaptable to partial infiltration conditions. They are commonly incorporated into parking lots islands, cul-de-sacs, traffic circles, road shoulders, and road medians. Bioretention without underdrain functions as a soil and plant-based filtration device that removes pollutants primarily through volume reduction, but avoids transport of pollutants to groundwater through a variety of physical, biological, and chemical treatment processes.

This fact sheet is not intended to be standalone. See Fact Sheet BIO-1 for primary guidance on siting, design, construction, and O&M. Only guidance that differs from BIO-1 is provided in this fact sheet. This fact sheet supports two configurations of INF-3:

Adaptable Configuration (preferred): This configuration is designed, constructed, operated and maintained identically to BIO-1, but the underdrain outlet structure is capped. The cap can be removed to convert the system to BIO-1 if actual infiltration rates are less than estimated and drainage rates are deficient.

Standard Configuration: This configuration is designed and constructed similarly to BIO-1, except no underdrains are included. This configuration is not adaptable to partial infiltration should infiltration rates be less than estimated.

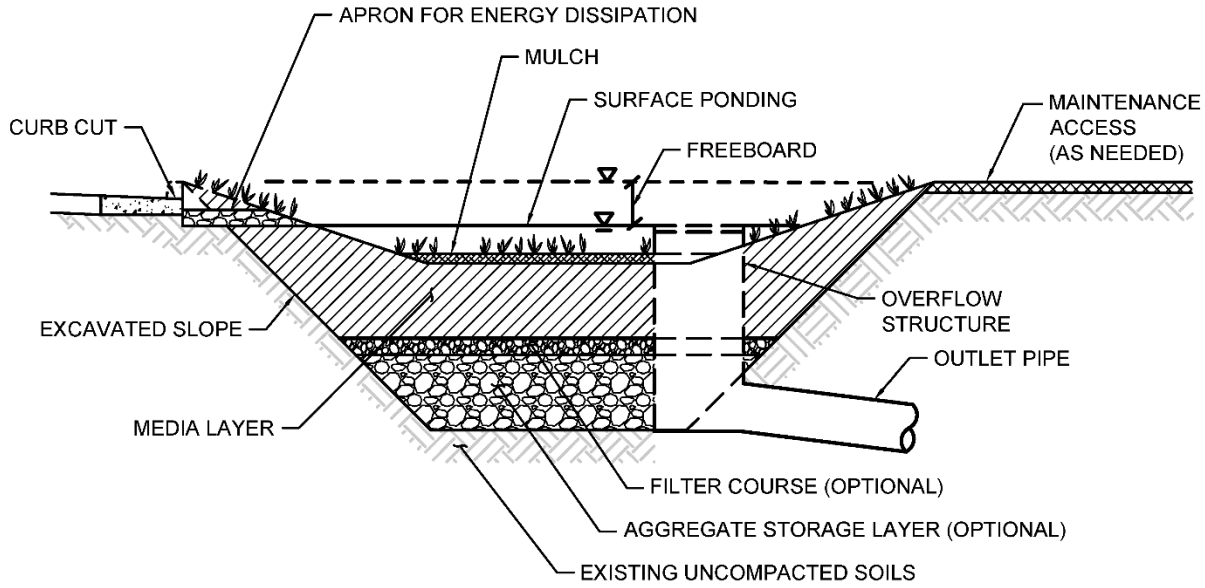
Pollutant Removal Considerations

Configuration	Sediment	Phosphorus	Nitrogen	Metals	Bacteria	Oil & Grease	Organics
Full Infiltration (no underdrain or capped underdrain)	H	H	H	H	H	H	H
Partial Infiltration (BIO-1) with underdrain activated	H	M	M	H	M	M	H

Recommended Siting Criteria

Siting Criteria	Intent/Rationale
☐ See BIO-1, except as follows	
☐ For standard designs without backup underdrains, the BMP should not be located in fill areas. In fill areas, a backup underdrain is required even if potential fill infiltration rates are estimated to be adequate for full infiltration.	The ability to fully infiltrate the DCV must be determined prior to construction and assured through construction. In areas that will have traditional compacted fill, it is not possible to determine the infiltration rate. Additionally, where the infiltrating surface is deep below existing grade, the quality of investigation may be compromised.

Example Schematic Design - Section View (Plan View same as BIO-1)



SECTION A-A'
NOT TO SCALE

Section View of Standard Configuration without Backup Underdrain

For Adaptable Configuration, see Fact Sheet BIO-1

Recommended BMP Component Dimensions

BMP Component	Dimension	Intent/Rationale
Freeboard	≥ 6 inches if system has internal overflow Freeboard not required if offline with acceptable bypass	Freeboard provides for water to enter overflow structures and minimizes risk of uncontrolled surface discharge. Lower freeboard (or no freeboard) is allowable if there is an acceptable bypass pathway when the WQ storage is full, such as flow along the curb line to a storm inlet downstream.
Surface Ponding	≥ 3 inches	A lower limit is needed to provide enough surface storage for water to be able to enter the media. Also, very shallow depths are more susceptible to construction error and change over time with O&M activities.
Surface Ponding	≤ 18 inches	Deeper surface ponding depths may require demonstration that premature clogging is not likely and may require fencing.
Ponding Area Side Slopes	3H:1V or shallower	Gentler side slopes are safer, less prone to erosion, able to establish vegetation more quickly and easier to maintain. Vertical walls may be acceptable with appropriate considerations for safety.
Mulch	2-4 inches (average 3 inches)	Mulch is intended to suppress weeds and maintain moisture for plant growth. Mulch also retains sediment and allows sediment to be removed before it clogs the media bed.
Media Layer	≥ 18 inches (24 to 36 inches preferred)	A deeper media layer provides additional filtration and supports plants with deeper roots. The media layer must extend across the BMP to the waterline at full ponding depth to ensure no infiltrated water bypasses the media.
Filter Course (if stone storage layer is used)	4-6 inches	Typically made up of 2 to 3 inches of coarse sand and 2 to 3 inches of pea gravel, both washed. Thinner layers are less effective and may be more challenging to accurately construct.
Stone Storage Layer Depth (optional, may be used to augment storage)	No limitation	This feature can be included to increase storage capacity. The drawdown time of this storage must be considered in sizing methods.

Recommended Design Criteria and Considerations

Design Criteria	Intent/Rationale
☐ See BIO-1 for primary guidance. Additional guidance applying to INF-3 is provided in this Fact Sheet	BMP performance and longevity is increased. Premature clogging is avoided.
Differences from BIO-1 for Standard Configuration	
☐ Optionally eliminate filter course rock and stone reservoir	This is not necessary; it may be included to provide additional storage, if desired.
☐ Amended soil media should be tested to ensure permeability at least 4x higher than the design underlying infiltration rate, up to a maximum of 12 inches per hour. But chemical testing of media as described in MISC-1 is not required.	Leaching of pollutants from media is not a significant issue for bioretention without underdrains. However, media should provide adequate permeability without being excessively well drained.
Differences from BIO-1 for Adaptable Configuration	
☐ Include a screw cap on underdrain such that the system operates as a full infiltration BMP unless activation of the underdrain is determined to be needed.	A screw cap, or multiple caps at different levels allows simple adjustment.

Calculations and Sizing Method

See **Appendix E** for acceptable sizing methods. Checks on clogging risk should be conducted as part of sizing. Infiltration volume includes volume in ponding storage and pores of media and gravel. For an adaptable configuration, sizing calculations should be conducted for both the full infiltration condition as well as the partial infiltration condition where underdrains are activated and the system operates as a BIO-1 system.

Construction Guidance

Construction Guidance	Intent/Rationale
☐ See BIO-1 for guidelines. Differences are listed below.	
☐ As part of verifying the system, conduct infiltration testing of underlying soil prior to backfill to confirm infiltration rates are equal or greater than the design infiltration rate. Require remediation of soil infiltration rates or adaptation to BIO-1 if infiltration rates are lower than design.	The proponent must assure that the BMP is constructed per design. Infiltration rate is an important design parameter.

Adaptability Considerations

The "Adaptable Configuration" of this BMP is a preferred option for infiltration in areas where there is uncertainty in long-term, full-scale infiltration rates. The method of adaptation is to

remove the underdrain cap and operate the facility as BIO-1. This adaptation could be activated at a number of points in project development or implementation, including:

- Between discretionary approval (Preliminary/Conceptual WQMP) and final grading approval (Final Project WQMP), if needed, based on more detailed investigation.
- During construction, based on measurements taken following excavation of the basin.
- After the system is placed in to service based on observed drainage rates.

In any case, this contingency plan needs to be disclosed and considered as part of the discretionary approval. Also, sizing calculations need to be included in the WQMP to demonstrate that activation of the contingency plan to convert the system to BIO-1 would still conform to LID sizing criteria.

O&M Activities and Frequencies

Activity	Frequency
Same as BIO-1, except:	
For the adaptable configuration, utilize results of drawdown observations to determine the need for adjustment of the outlet structure (i.e., uncapping closed underdrain)	Based on twice-yearly drawdown observations following events 0.5 inch or larger

INF-4: DRY WELL

Category: Full Infiltration

This type of BMP requires special considerations for design and permitting. See **Appendix I** for guidelines for dry wells.

INF-5: PERMEABLE PAVEMENT

Category: Full Infiltration

Also known as:
Pervious Pavement



Source: Geosyntec Consultants

Permeable pavement is a type of pavement that allows for percolation through void spaces in the pavement surface into subsurface layers. Permeable pavement comes in a variety of forms (concrete, grass and gravel pavers; porous concrete or asphalt) and is designed to retain the full DCV by allowing it to percolate through the pavement and infiltrate into the underlying soil. This facilitates stormwater management while providing the structural and functional features needed for a roadway, parking lot, or sidewalk. Pollutant control is provided via infiltration, filtration, sorption, sedimentation and biodegradation processes. Permeable pavement as a structural LID BMP is designed to capture and infiltrate runoff from surrounding areas. This distinguishes it from permeable pavement as a site design BMP which does not receive significant runoff from other areas, only infiltrating rainfall that falls directly on the permeable pavement.

Pollutant Removal Considerations

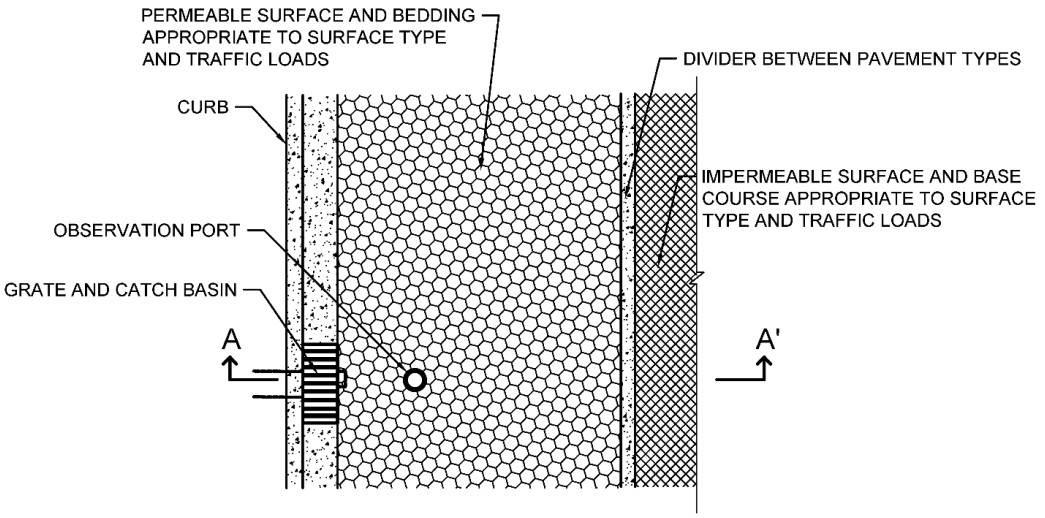
Sediment	Phosphorus	Nitrogen	Metals	Bacteria	Oil & Grease	Organics
H	H	H	H	H	H	H

Recommended Siting Criteria

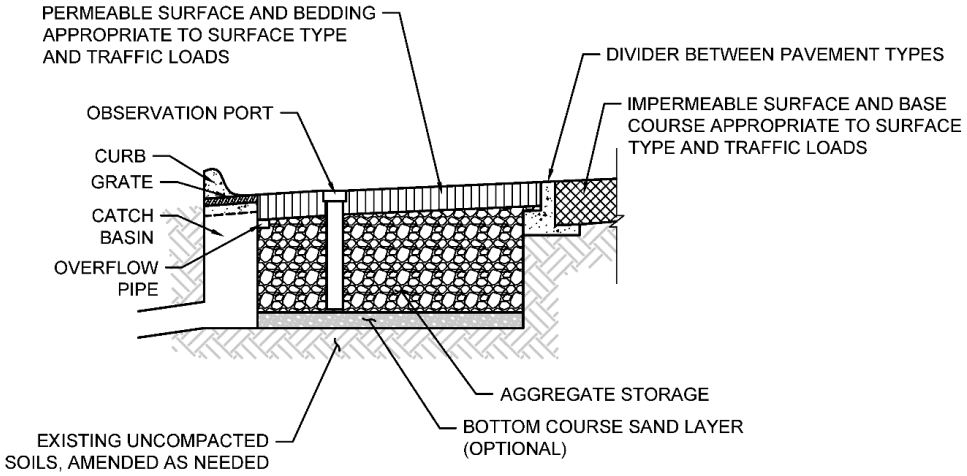
Siting Criteria	Intent/Rationale
☐ BMP placement adheres to geotechnical recommendations with respect to geological hazards and setbacks.	Must not negatively impact existing site geotechnical concerns.
☐ BMP is located in area of the site most suitable for full infiltration.	A full infiltration BMP must be sited such that in-situ infiltration rates will facilitate infiltration of the full DCV. Permeable pavement can be supported by infiltration rates lower than needed for other infiltration BMP types.
☐ The ratio of the total drainage area (including the permeable pavement) to the permeable pavement should not exceed 4:1.	Higher ratios increase the potential for clogging but may be acceptable for relatively clean tributary areas that do not have any significant sediment sources
☐ Sediment sources are controlled prior to operation of the system.	Facility should not be used in areas that will continue to receive elevated sediment loading following construction, such as from open space area.

☐ BMP is not placed in an area with significant overhanging trees or other vegetation.	Leaves and organic debris can clog the pores in the pavement surface.
☐ Direct discharges to permeable pavement are only from rooftops or other impervious areas with low pollutant and gross solids loading.	Bypassing the pavement surface increases the risk of clogging underlying layers. Roof runoff typically carries less sediment than runoff from other impervious surfaces and is less likely to cause premature clogging of the underlying soil.

Example Schematic Design - Plan and Section View



PLAN
NOT TO SCALE



SECTION A-A'
NOT TO SCALE

Recommended BMP Component Dimensions

BMP Component	Dimension	Intent/Rationale
Permeable Surface and Bedding Layer Thickness/Properties	Varies by design	This component of the design is specific to the type of permeable surface and the traffic loading. The designer should consult appropriate design references.
Bottom Coarse Sand Layer	≥ 4 inches	Provides filtering of fine sediment prior to infiltration into subsurface soils
Aggregate Layer Depth	Varies by design	The aggregate layer depth can be controlled by structural requirements or stormwater management requirements. The amount of tributary area and the underlying infiltration rate are the most important factors in selecting an aggregate storage depth for stormwater management goals.
Observation Port Diameter	≥ 6 inches	Facilitates simpler cleaning.

Recommended Design Criteria and Considerations

Design Criteria	Intent/Rationale
Permeable Surface Layer	
☐ Finish grade of the permeable pavement has a slope ≤ 5%. (the infiltrating surface should be flat or constructed in terraces that are flat)	Flatter surfaces facilitate increased runoff capture.
☐ Permeable surface layer type and thickness are appropriately chosen based on pavement use and expected vehicular loading.	Pavement may wear more quickly if not designed to be durable for expected loads or frequencies. Design criteria vary greatly by pavement type and loading. A designer with experience in permeable pavement design should make and document appropriate design decisions.
☐ Permeable surface layer type is appropriate for expected pedestrian traffic.	Expected demographic and accessibility needs (e.g., adults, children, seniors, runners, high-heeled shoes, wheelchairs, strollers, bikes) requires selection of appropriate surface layer type that will not impede pedestrian needs.
Bedding Layer	
☐ Bedding thickness and material is appropriate for the chosen permeable surface layer type.	Bedding (e.g., sand, aggregate, permeable treated asphalt base, no bedding) is chosen based on the structural and leveling requirements of the permeable pavement form (concrete, grass and gravel pavers; porous concrete or asphalt) and, depending on bedding material gradation, may require an underlying filter course layer to prevent migration to the aggregate storage layer.

Design Criteria	Intent/Rationale
☐ If sand or aggregate is used for a bedding layer, it is washed prior to placement.	Washing bedding will help eliminate fines that could clog the underlying infiltrating surfaces.
Aggregate Storage Layer	
☐ The aggregate storage layer depth below the overflow elevation is determined based on structural and stormwater management objectives.	The intent of this layer is to provide sub-surface storage in order to provide full infiltration of the DCV. Depth requirements for stormwater management depend on the underlying infiltration rate and how much tributary area are routed to the pavement. The aggregate storage layer may also be controlled by structural requirements, particularly if used in heavier traffic areas.
☐ Aggregate storage layer consists of washed river rock or open-graded, crushed rock.	Washing aggregate will help eliminate fines that could clog the aggregate storage layer void spaces or subgrade.
☐ Drain pipes are slotted per **MISC-3** if included in the design.	
Bottom Filter Course	
☐ Sand is coarse washed sand as described in the filter course specifications in **MISC-3**.	Washed sand free of larger objects will help eliminate fines and obstructions that could clog the aggregate storage layer void spaces or subgrade.
Soil Amendment (as needed)	
☐ If underlying infiltration rates (prior to factor of safety adjustment) are greater than 12 inch/hour or have less than 1 percent organic content, then amend soil by incorporating 3 inches of compost into the top 12 inches of soil before constructing pavement.	In very sandy soils, soil amendment is needed to protect groundwater quality.
☐ If amendments are used, infiltration rates should be remeasured after amendment.	Amendments can change the infiltration rate of soils. An example amended plot can be used during site investigation rather than measuring after full scale amendment.
Transition from Adjacent Pavement	
☐ An appropriate transitional design should be used at the transition from adjacent traditional pavement to permeable pavement. This could include a concrete stem wall or a line of pavers.	This can be a necessary structural element. It can also serve to demark the extent of the BMP and help avoid inadvertent overlay of the BMP with traditional pavement.
Outflow Structures	
☐ A piped connection from the aggregate storage layer to the storm drain system should be used, if feasible, to prevent saturation of the permeable pavement surface.	Saturation of the pavement surface during traffic loading can lead to damage to the pavement.
☐ An overflow route should be defined, such as a curb inlet, for events that exceed the design volume.	This helps ensure safe operations, even in larger storms.

Design Criteria	Intent/Rationale
☐ At least one observation port is provided in each cell/terrace to allow inspection of subsurface water level.	This feature is necessary to facilitate inspection and performance confirmation (i.e., the facility is infiltrating and providing the volume reduction anticipated).

Calculations and Sizing Method

See **Appendix E** for acceptable sizing methods. The entire volume of the aggregate pores below the overflow elevation can be considered infiltrated volume. If the underlying soil interface is sloped (which is not recommended) sizing calculations must assume a level pool within the aggregate storage reservoir, which may reduce the effective storage.

Unless there are no sediment sources in the watershed, the allowable ratio of adjacent tributary area to permeable pavement area should not exceed 4 to 1. Rainfall on the permeable pavement area should be included as a 100 percent runoff coefficient for sizing purposes.

Construction Guidance

Construction Guidance	Intent/Rationale
☐ Plans should include a construction sequence for the BMP. Revisions proposed by the contractor should be reviewed by the engineer. The construction sequence should address erosion control, utilities, BMP installation, inspections, testing and certifications, final grading, vegetation, stabilization, and post-construction monitoring.	Construction sequencing is critical to avoid issues/damage and allow appropriate inspections, testing, and certifications to be performed.
☐ The contractor should have recent demonstrated successful experience with permeable pavement installation of the type specified or should utilize a subcontractor that has this experience.	This is intended to improve the chances of success of permeable pavement.
☐ Conduct earthwork in dry weather, or at least 48 hours after the end of rainfall.	Wetter soil is typically more susceptible to compaction.
☐ Avoid compaction of the base and sidewalls of facilities. Alleviate compaction as needed using mechanical tilling equipment (e.g., rototiller).	Infiltration rates are typically very susceptible to compaction. Infiltration should be maximized.
☐ Keep sediment out of the facility during construction as much as practicable using sediment and erosion control measures (e.g., silt fence, filter logs, check dams).	Sediment accumulation can impair infiltration rates.
☐ Traffic within the BMP should be avoided unless impractical. If traffic within the system is allowed, only wide track and low-ground pressure equipment is allowed.	Compaction of the system must be avoided as much as possible.

Construction Guidance	Intent/Rationale
☐ Use staking, surveying, or other methods to confirm thickness of layers.	A uniform thickness of layers is important for effectiveness.
☐ Establish the construction sequence to allow for inspection of buried infrastructure (e.g., filter course) before it is buried.	It is impractical to inspect buried elements once they are covered.
☐ Fully stabilize sources of sediment within the tributary area (i.e., no exposed soil) prior to placing the finished BMP into service.	Erosion and sedimentation can seriously impair the hydraulic conductivity of the media bed and require restoration and revegetation of the surface of the media bed.
☐ As part of verifying the system, conduct infiltration testing of underlying soil before constructing pavement to confirm infiltration rates are equal or greater than the design infiltration rate. Require remediation if infiltration rates are lower than design.	The proponent must demonstrate that the BMP is constructed per design. Infiltration rate is an important design parameter.

Adaptability Considerations

This type of BMP has limited adaptability should actual conditions differ from those estimated as part of the design level investigation. Permeable pavement should only be used in locations where the ability to reliably infiltrate can be determined in the design phase. Reliability can be improved through (1) conducting a thorough investigation, (2) minimizing construction impacts that could change conditions, and (3) providing a higher factor of safety in design. It is often acceptable to utilize a relatively high factor of safety to improve reliability. Permeable pavement tends to have a larger footprint and lower effective storage depth than other BMPs, which can allow it to infiltrate the full DCV at lower design infiltration rates than other BMPs.

Permeable pavement could potentially be combined with a proprietary biotreatment BMP to provide partial retention of the DCV and biotreatment of 150 percent of the remaining portion of the DCV. Water that overflows the permeable pavement would be treated by the biotreatment BMP before entering the storm drain. In this use, permeable pavement would be part of a treatment train categorized as "Biotreatment with Partial Infiltration."

O&M Activities and Frequencies

Activity	Frequency
GENERAL INSPECTIONS	
Inspect for areas of sediment accumulation in the pavement surface	Four times per year during wet season, including inspection just before the wet season and within 24 hours after at least two storm events ≥ 0.5 inches.
If sediment accumulation is elevated, inspect for potential sources of sediment in the tributary area and recommend control approaches	
Observe and record drawdown rate via observation port following storm event	
Periodically (every 2 to 5 years) measure the permeability of the surface of the permeable pavement	
Identify any damage to pavement	
Inspect overflow structures	
Identify any needed corrective maintenance that will require site-specific planning or design	
ROUTINE MAINTENANCE	
Permeable Surface Layer	
Remove sediment and leaf litter using a mechanical sweeper (i.e., regenerative air or vacuum-assisted sweeper)	Two to four times per year during wet season including just before the wet season, depending on sediment and debris load
Manually remove weeds	Annually
Power wash surface layer (without using surfactants)	Annually
Patch pavement surface where needed	As needed
Other activities specific to pavement surface type	As needed
Coordinate with maintenance of adjacent pavement to ensure permeable pavement is protected	As needed
Underdrain and Outflow Structures	
Inspect outlets and remove accumulated sediment	Four times per year during wet season, including inspection just before the wet season.
Repair structural damage to outlets	As needed
CORRECTIVE (MAJOR) MAINTENANCE	
Prepare documentation of issues and resolutions for review by appropriate parties; modify WQMP if needed.	Before major maintenance
Document major maintenance activities; record modified WQMP and as-built plan set if needed	After major maintenance
Take photographs before and after from the same vantage point	Before and after

INF-6: UNDERGROUND INFILTRATION

Category: Full Infiltration

Also known as:
- Infiltration Vault
- Infiltration Chamber
- Infiltration Gallery
- Recharge Vault

Note, this fact sheet also supports use of infiltration galleries as a supplemental retention BMP in combination with proprietary biotreatment to provide partial infiltration.



Source: Contech

Underground infiltration is a vault or chamber with an open bottom that is used to store runoff and infiltrate it into the underlying soil. These vaults or chambers may be designed using any number of configurations or structural components as long as they meet the requirements of the permit. A number of vendors offer proprietary products that allow for subsurface storage while offering durable prefabricated structures. There are many varieties of proprietary products that can be used to store runoff below roads and parking lots, parks and open spaces, single and multi-family residential, or mixed-use and commercial uses, and infiltrate it into the underlying soil. These facilities can be used to retain and infiltrate the full DCV as stand-alone BMPs or can be used to provide supplemental retention for proprietary biotreatment BMPs. Pretreatment is a mandatory and integral element of underground infiltration, as the ability to remove sediment and scarify the infiltrating surface is limited in most designs. When used as part of a treatment train downstream of biotreatment BMPs, they are used to provide supplemental retention.

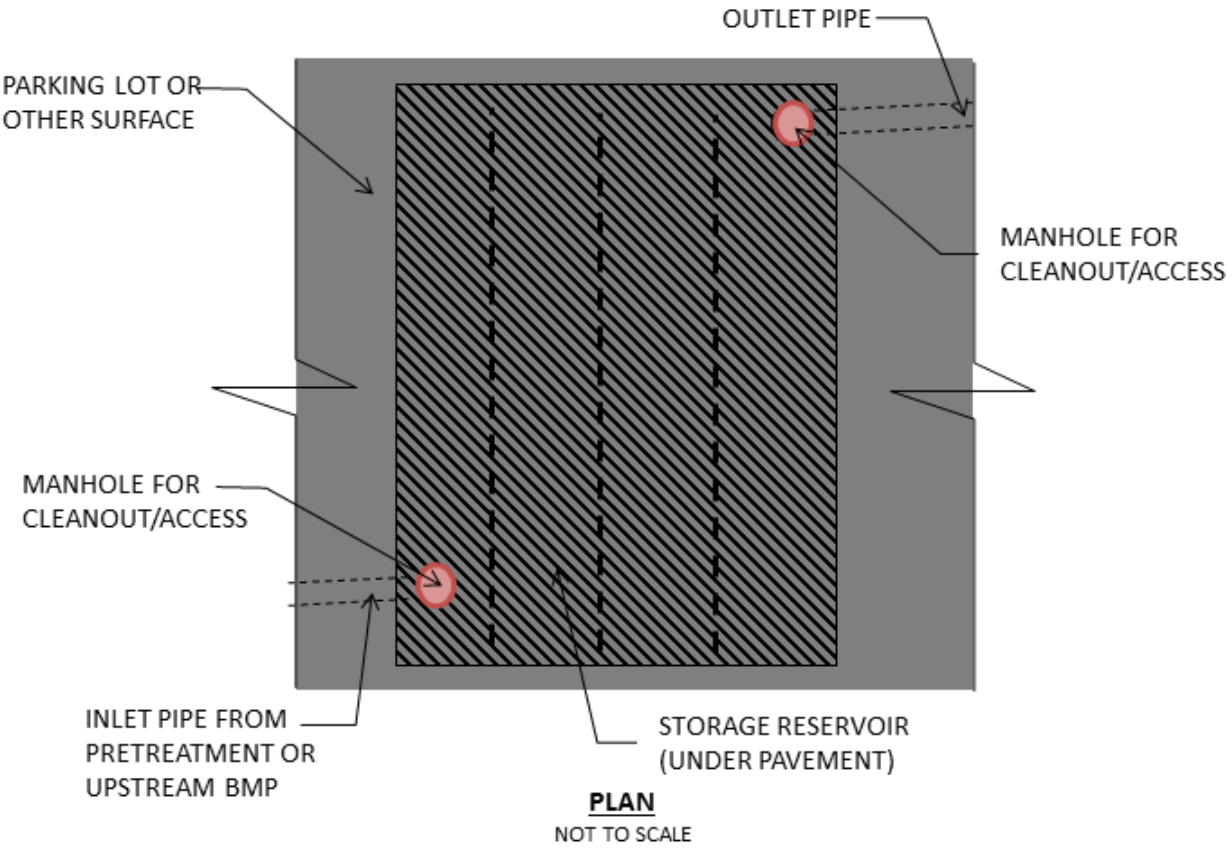
Pollutant Removal Considerations

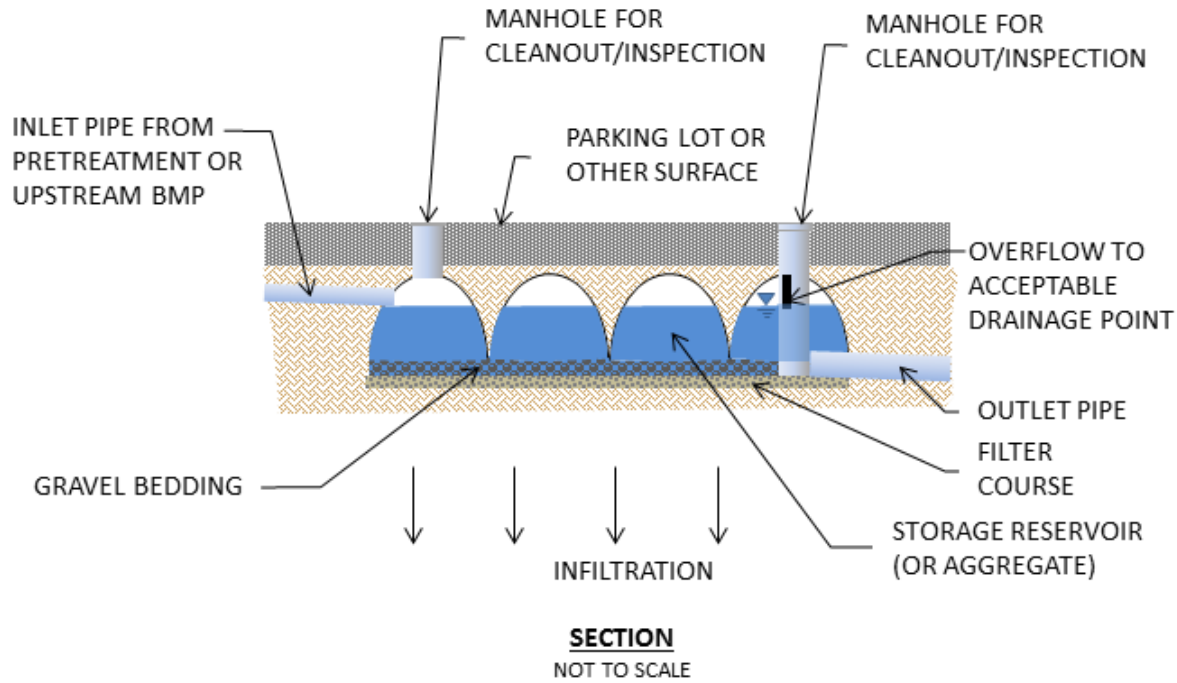
Sediment	Phosphorus	Nitrogen	Metals	Bacteria	Oil & Grease	Organics
H	H	H	H	H	H	H

Recommended Siting Criteria

Siting Criteria	Intent/Rationale
☐ BMP placement adheres to geotechnical recommendations with respect to geological hazards and setbacks.	Must not negatively impact existing site geotechnical concerns.
☐ BMP is located in areas of the site most suitable for full infiltration.	A full infiltration BMP must be sited such that the underlying soil infiltration rates will facilitate infiltration of the full DCV and where this can be assured through construction and operation.
☐ BMP should not be located in fill areas or within infiltrating surface more than 10 feet below existing grade.	The ability to fully infiltrate the DCV must be determined prior to construction and assured through construction. In areas that will have fill, it is not possible to determine the infiltration rate prior to construction. Additionally, where the infiltrating surface is too deep below existing grade, the quality of investigation may be compromised. A borehole test provides a poor approximation of full scale infiltration from this BMP.
☐ BMP can be placed beneath roads, parking lots, parks, and athletic fields. For facilities located under roads, traffic loading requirements (e.g., HS-20, H-20) is observed.	This type of facility allows the overlying land use to serve a different purpose other than stormwater management. The overlying land use needs (e.g., structural, geotechnical, aesthetical, etc.) is addressed in the design. The activities over top of the BMP must not interfere with appropriate inspection and maintenance and reconstruction of the system on a 10- to 30-year lifecycle. Placement beneath buildings or other infrastructure is not acceptable.
☐ Sediment sources are controlled prior to operation of the system.	Facility should not be used in areas that will continue to receive elevated sediment loading following construction, such as from open space area.

Example Schematic Design - Plan and Section View





Recommended BMP Component Dimensions

BMP Component	Dimension	Intent/Rationale
Freeboard from Grate/Manhole Cover	≥ 1 foot	Freeboard provides room for head over overflow structures and minimizes risk of uncontrolled surface discharge. Lower freeboard is allowable if there is an acceptable alternative overflow method.
Access Hatch Diameter	≥ 24 inches (36 inches preferred)	Facilitates maintenance entry and sediment cleanout.
Bottom Coarse Sand Layer	≥ 4 inches	Typically sand to provide filtering of fine sediment prior to infiltration into subsurface soils.

Recommended Design Criteria and Considerations

Design Criteria	Intent/Rationale
Pretreatment	
☐ Pretreatment should be appropriately selected based on estimated loading, BMP depth, and target time to clog per guidance provided in **TGD Chapter 4.4 and Appendix E.4**.	Pretreatment is mandatory for underground infiltration due to the elevated risk of failure and cost to restore infiltration capacity if failure occurs.
Storage Reservoir	
☐ Reservoir chamber depth preferably less than 3 feet effective depth. Depth should be selected based on drawdown rate into underlying soils, potential for mounding, and clogging risk.	Deeper systems may take longer to drain, have higher risk of groundwater mounding, and be more susceptible to clogging.
☐ The bottom of the storage reservoir is flat	This allows uniform infiltration.
☐ A wide range of products is potentially acceptable, at the discretion of the reviewing jurisdiction.	Product suitability and durability should be reviewed.
☐ An observation port should be included in each distinct cell of the facility to inspect drawdown. A manhole can serve as an observation port.	This is needed to periodically inspect for drawdown rate.
Bottom Filter Course	
☐ Sand is coarse washed sand as described in the filter course specifications in MISC-3.	Washed sand free of larger objects will help eliminate fines and obstructions that could clog the aggregate storage layer void spaces or subgrade.
Inflow, Outflow, and Access Structures	
☐ Inflow, outflow, and access structures are accessible for inspection and maintenance.	Maintenance access is essential to ensure long-term performance.
☐ A stabilized overflow is required to safely convey overflow to the downstream receiving system.	Planning for controlled overflow lessens the risk of property damage due to flooding.

Calculations and Sizing Method

See **Appendix E** for acceptable sizing methods. The entire volume below the overflow elevation can be tabulated as infiltration volume.

Construction Guidance

Construction Guidance	Intent/Rationale
☐ Plans should include a construction sequence for the BMP. Revisions proposed by the contractor should be reviewed by the engineer. The construction sequence should address erosion control, utilities, BMP installation, inspections, testing and certifications, final grading, vegetation, stabilization, and post-construction monitoring.	Construction sequencing is critical to avoid issues/damage and allow appropriate inspections, testing, and certifications to be performed.
☐ Excavate in dry weather or at least 48 hours after the end of rainfall.	Wetter soil is typically more susceptible to compaction.
☐ Avoid compaction of the base and sidewalls of facilities. Alleviate compaction as needed using mechanical tilling equipment (e.g., rototiller).	Infiltration rates are typically very susceptible to compaction. Infiltration should be maximized.
☐ Keep sediment out of the facility during construction as much as practicable using sediment and erosion control measures (e.g., silt fence, filter logs, check dams). Remove any confining layer that accumulates as a result of sedimentation. If the location of BMP is used as a temporary erosion and sediment control facility, it should be completely rehabilitated via over excavation, before being placed into service as a post-construction BMP.	Sediment accumulation can impair infiltration rates.
☐ Traffic within the BMP should be avoided unless impractical. If traffic within the system is allowed, only wide track and low-ground pressure equipment is allowed.	Compaction of the system must be avoided as much as possible.
☐ Establish the construction sequence to allow for inspection of buried infrastructure before it is buried.	It is impractical to inspect buried elements once they are covered.
☐ Fully stabilize sources of sediment within the tributary area (i.e., no exposed soil) prior to placing the finished BMP into service.	Erosion and sedimentation can seriously impair the hydraulic conductivity of the basin subgrade soils and require restoration and revegetation of the basin bottom.
☐ For deep installs, shoring with sheet piling or other methods are used to provide safe excavation. Proper bedding and backfill is used to stabilize the	Facilities must be safely and properly installed.

	Construction Guidance	Intent/Rationale
	structure. Proprietary structures are installed per manufacturer's specifications.	
☐	As part of verifying the system, conduct infiltration testing of underlying soil before placing chambers to confirm infiltration rates are equal or greater than the design infiltration rate. Require remediation if infiltration rates are lower than design.	The proponent must demonstrate that the BMP is constructed per design. Infiltration rate is an important design parameter.

Adaptability Considerations

This type of BMP has limited adaptability should actual conditions differ from those estimated as part of the design level investigation. Infiltration galleries should only be used as standalone BMPs in locations where the ability to reliably infiltrate can be determined in the design phase. Reliability can be improved through (1) conducting a thorough investigation, (2) minimizing construction impacts that could change conditions, and (3) providing a higher factor of safety in design.

The most practical option for adaptability is to utilize a proprietary biotreatment BMP as a pretreatment system. If this BMP is sized for the 150 percent of the DCV (full biotreatment sizing criteria), then the infiltration gallery can serve a complementary volume reduction purpose without being required to fully infiltrate the DCV. This could allow the depth of the infiltration gallery to be reduced should actual infiltration rates be lower than design infiltration rates.

If this option is used, this must be identified as a contingency plan in the Conceptual/ Preliminary WQMP as part of discretionary approval and appropriately supported with design phase and/or construction phase investigation to justify the need to infiltrate less than the full DCV.

O&M Activities and Frequencies

Activity	Frequency
GENERAL INSPECTIONS	
Inspect condition of pretreatment BMP to determine need for maintenance	Four times per year during wet season, including inspection just before the wet season and within 24 hours after at least two storm events ≥ 0.5 inches.
Inspect degree of sediment accumulation in storage reservoir, if possible	
Observe and record drawdown rate	
Identify any needed corrective maintenance that will require site-specific planning or design	
ROUTINE MAINTENANCE	
Pretreatment System	
Remove accumulated trash and debris	Each visit; as needed
Remove sediment from pretreatment system per manufacturer's recommendations or when sediment storage volume is more than 50% full	Per manufacturer recommendation, or as needed
Storage Reservoir	
It is not typically practical to maintain the storage reservoir or infiltrating surface; plan for overall reconstruction when infiltration falls below the design infiltration rate	Estimate frequency of clogging maintenance using guidance in Appendix E.4.
If infiltration has declined and the system has the flexibility to be adapted to serve as a biotreatment BMP with partial infiltration (i.e., through use of a proprietary BMP as a pretreatment system), then adjust outlet to infiltrate a shallower depth of water and operate as biotreatment with partial infiltration system while infiltration rates allow. This can extend the period before rehabilitation is needed.	As needed and acceptable.
Inflow and Outflow Structures	
Inspect inlets and outlets and remove accumulated sediment	Four times per year during wet season, including inspection just before the wet season.
Repair structural damage to inlets and outlets	As needed
CORRECTIVE (MAJOR) MAINTENANCE	
Prepare documentation of issues and resolutions for review by appropriate parties; modify WQMP if needed.	Before major maintenance
Document major maintenance activities; record modified WQMP and as-built plan set if needed	After major maintenance
Take photographs before and after from the same vantage point	Before and after

G.4 Harvest and Use BMP Fact Sheet (HU)

HU-1: RAINWATER HARVESTING CISTERNS AND TANKS

Category: Harvest and Use



Source: Sunset Publishing Corporation

Cisterns are containers that can capture rooftop runoff and store it for future use. With controlled timing and volume release, the captured rainwater can be used for irrigation or alternative grey water (e.g., toilet flushing) between storm events, thereby reducing runoff volumes and associated pollutants to downstream water bodies as well as demand for potable water. Cisterns are larger systems (generally>100 gallons), which distinguishes them from distributed hydrologic source controls like rain barrels.

Project applicants should consult Appendix F for harvested water demand calculations and design requirements related to the plumbing and building codes based on different end uses of the retained water.

Note: Design of harvest and use systems is highly site specific. Appropriate design expertise is likely to be needed. This fact sheet provides general criteria, but is not intended to replace the need for design expertise and project-specific considerations.

Pollutant Removal Considerations

TSS	Phosphorus	Nitrogen	Metals	Bacteria	Oil & Grease	Organics
H	H	H	H	H	H	H

Recommended Design Criteria and Considerations

Design Criteria	Intent/Rationale
Pretreatment	
☐ Pretreatment is provided in the form of screens on gutters and downspouts to remove vegetative debris and sediment from the runoff prior to entering the cistern.	BMP performance and longevity is increased. Premature clogging is avoided.
Storage Reservoir	
☐ Cistern is vented with a screened pipe/opening in the direction of prevailing winds for maximum ventiliation.	Allows fresh air to circulate into the storage reservoir for odor control.
☐ A structurally-sound foundation design for the cistern and supporting calculations must be provided.	Ensures cistern stability and public safety.

Design Criteria	Intent/Rationale
Inflow, Outflow and Access Structures	
☐ Inflow, outflow and access structures are accessible for inspection and maintenance.	Maintenance access is essential to ensure long-term performance.
☐ Water entry holes have child-resistant covers and mosquito screens.	Ensures safety and vector control.
☐ Flow control device such as an orifice or valve is included to limit outflow in accordance with drawdown time requirements.	Flow control provides flow attenuation benefits and limits cistern discharge to downstream facilities during storm events.
Plumbing and Health Code Requirements	
☐ Applicable plumbing and health code requirements are met. See Appendix F.	Legal requirements intended to protect public health and property.
☐ A treatment system may be needed to meet applicable plumbing and health code requirements. This requires project-specific design expertise.	System design is highly site-specific.

Calculations and Sizing Method

See **Appendix E** for acceptable sizing methods.

Construction Guidance

Construction Guidance	Intent/Rationale
☐ Plans should include a construction sequence for the BMP. Revisions proposed by the contractor should be reviewed by the engineer. The construction sequence should address BMP installation, inspections, testing and certifications and post-construction monitoring.	Construction sequencing is critical to avoid issues/damage and allow appropriate inspections, testing, and certifications to be performed.

O&M Activities and Frequencies

Design-specific O&M planning is typically needed for cisterns and rainwater harvesting systems. The following provides general guidance, which will likely need to be augmented.

Activity	Frequency
GENERAL INSPECTIONS	
Check for leaks	Four times per year during wet season, including inspection just before the wet season and within 24 hours after at least two storm events ≥ 0.5 inches.
Inspect for minor sediment in cistern bottom	
Inspect for vector control issues	
Identify any needed corrective maintenance that will require site-specific planning or design	
ROUTINE MAINTENANCE	
Clean out gutters, screening, and/or first-flush diverter	As-needed
Remove sediment, trash, debris, and oil accumulation from cistern	Semi-annually or as needed
Clean inside surfaces of cistern and disinfect	Annually
Maintain treatment systems per manufacturer or designer recommendations	As specified
CORRECTIVE (MAJOR) MAINTENANCE	
Prepare documentation of issues and resolutions for review by appropriate parties; modify WQMP if needed.	Before major maintenance
Document major maintenance activities; record modified WQMP and as-built plan set if needed	After major maintenance

G.5 Biotreatment BMP with Partial Infiltration Fact Sheets (BIO)

BIO-1: BIOINFILTRATION

Category: Biotreatment with Partial Infiltration

[This fact sheet also supports INF-3 and BIO-6.]

Also known as:
- Rain Gardens
- Bioretention with Internal Water Storage
- Bioretention with Elevated Underdrain

Bioinfiltration facilities are designed for biotreatment with partial infiltration of runoff. Water is biotreated via filtering through a vegetated bed of engineered media. Water is infiltrated via an aggregate storage layer that is designed to discharge only when the storage layer is full. Bioinfiltration facilities are commonly incorporated into parking lot islands, cul-de-sacs, traffic circles, road shoulders, and road medians. These facilities can be used in areas where there are no hazards associated with partial infiltration but infiltrating the full DCV is infeasible. These facilities may not result in retention of the full DCV, but they can be used to achieve the maximum feasible volume reduction through infiltration and ET while providing biotreatment of the remaining portion of the required treatment volume.



Source: Geosyntec Consultants

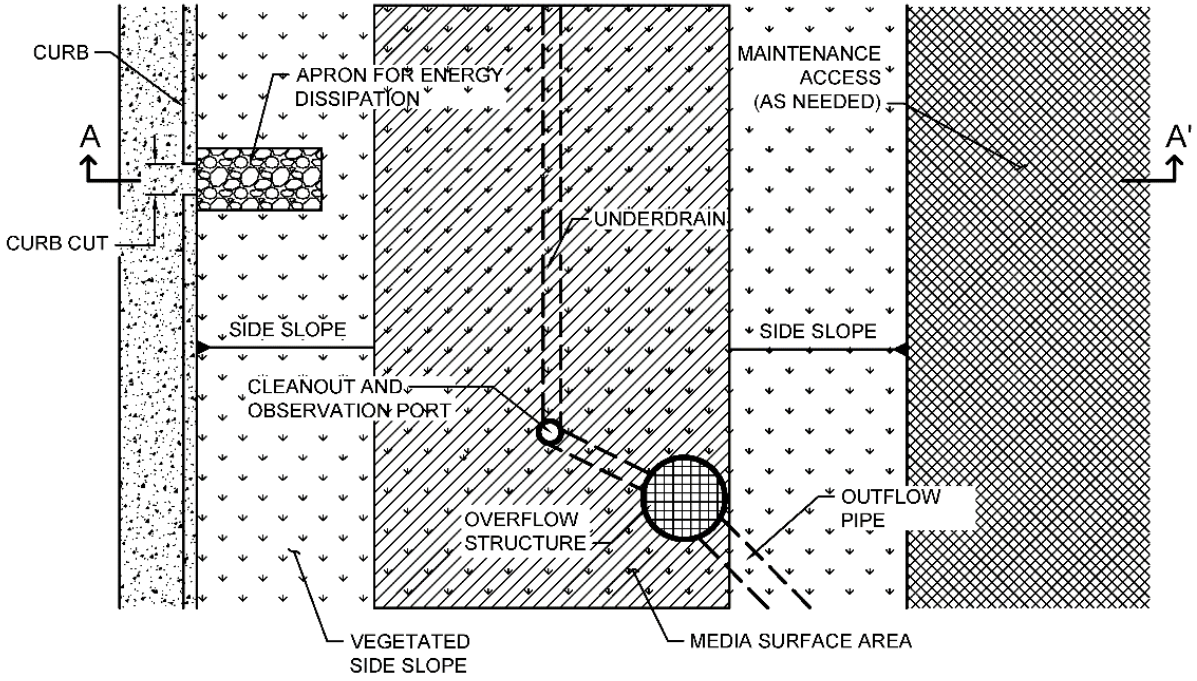
Pollutant Removal Considerations

TSS	Phosphorus	Nitrogen	Metals	Bacteria	Oil & Grease	Organics
H	M	M	H	M	M	H

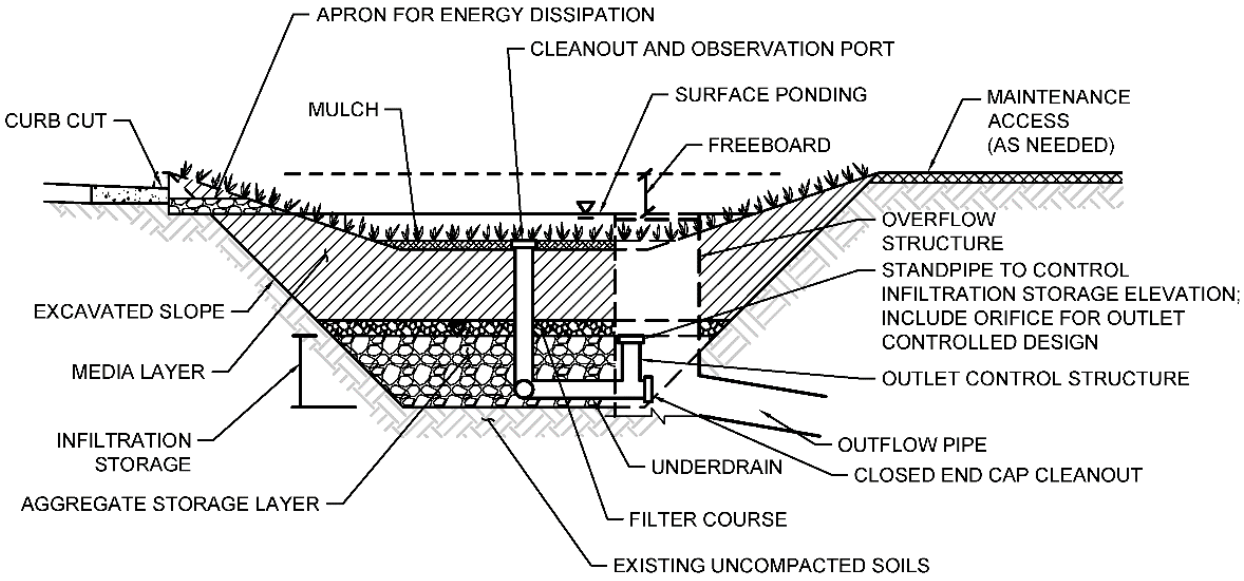
Recommended Siting Criteria

Siting Criteria	Intent/Rationale
☐ BMP placement adheres to geotechnical recommendations with respect to geological hazards and setbacks.	Must not negatively impact existing site geotechnical concerns.
☐ BMP is located in an area of the site most suitable for partial infiltration.	To the extent practicable, BMPs must be sited to take advantage of areas where infiltration is likely to be highest.
☐ Tributary area is ≤ 5 acres, preferably ≤ 1 acre.	Larger biofiltration facilities have a higher potential for scour and short circuiting and may require more specific construction methods. Section 4.4.7 provides specific design considerations for larger facilities.
☐ Sediment sources are controlled prior to operation of the system.	Facility should not be used in areas that will continue to receive elevated sediment loading following construction, such as from open space area.

Example Schematic Design - Plan and Section View



PLAN
NOT TO SCALE



SECTION A-A'
NOT TO SCALE

Recommended BMP Component Dimensions

BMP Component	Dimension	Intent/Rationale
Freeboard	≥ 6 inches if system has internal overflow Freeboard not required if offline with acceptable bypass	Freeboard provides for water to enter overflow structures and minimizes risk of uncontrolled surface discharge. Lower freeboard (or no freeboard) is allowable if there is an acceptable bypass pathway when the WQ storage is full, such as flow along the curb line to a storm inlet downstream.
Surface Ponding	≥ 3 inches	A lower limit is needed to provide enough surface storage for water to be able to enter the media. Also, very shallow depths are more susceptible to construction error and change over time with O&M activities.
Surface Ponding	≤ 18 inches	Deeper surface ponding depths may require demonstration that premature clogging is not likely and may require fencing.
Ponding Area Side Slopes	3H:1V or shallower	Gentler side slopes are safer, less prone to erosion, able to establish vegetation more quickly and easier to maintain. Vertical walls may be acceptable with appropriate considerations for safety.
Mulch	2-4 inches (average 3 inches)	Mulch is intended to suppress weeds and maintain moisture for plant growth. Mulch also retains sediment and allows sediment to be removed before it clogs the media bed.
Media Layer	≥ 18 inches (24 to 36 inches preferred)	A deeper media layer provides additional filtration and supports plants with deeper roots. The media layer must extend across the BMP to the waterline to ensure no infiltrated water bypasses the media.
Filter Course	4-6 inches	Typically made up of 2 to 3 inches of coarse sand and 2 to 3 inches of pea gravel, both washed. Thinner layers are less effective and may be more challenging to accurately construct.
Infiltration Storage	≥ 18 inches	Provides enhanced volume control. May include the pea gravel portion of the filter course and the full depth of the aggregate storage layer, depending on the outlet control elevation and design.
Underdrain Diameter	≥ 6 inches	Facilitates simpler cleaning.
Cleanout Diameter	≥ 6 inches	Facilitates simpler cleaning.

Recommended Design Criteria and Considerations

Design Criteria	Intent/Rationale
Pretreatment	
☐ Select pretreatment to provide acceptable clogging timeframe per guidance in Fact Sheet MISC-5 and Appendix E.4.1.	BMP performance and longevity is increased. Premature clogging is avoided.
Surface Ponding	
☐ Finish grade of the facility has ≤3 inches of elevation difference across the bottom of the facility.	Flatter surfaces reduce erosion and channelization within the facility and reduce the potential for development of preferential pathways.
☐ Surface ponding is limited to a 24-hour drawdown time.	24-hour drawdown time is recommended for plant health.
Vegetation	
☐ An irrigation system with a connection to water supply should be provided, as needed.	Seasonal irrigation may be needed to ensure robust vegetative processes in relatively coarse-grained media material.
☐ Plant materials should be tolerant of summer drought (unless irrigated), ponding fluctuations, and saturated soil conditions for up to 48 hours; native plant species and/or hardy cultivars that are not invasive and do not require chemical fertilizers or pesticides should be used to the maximum extent feasible. See recommended plant list in **Fact Sheet MISC-4.**	Plants suited to the climate and ponding depth are more likely to survive.
☐ In right of way areas, plant selection should not impair traffic sightlines or vehicle access.	Vegetation should be selected to be compatible with operation of the system and support adjacent uses.
Mulch	
☐ Well-aged, double or triple shredded hardwood mulch that has been stockpiled or stored for at least 12 months. Mulch must be non-floating to avoid clogging of overflow structure.	Mulch provides moisture retention and captures some sediment before it enters the media. Aged hardwood mulch will not rob the soil of nitrogen needed for new plants and will decompose slowly.
Media Layer	
☐ Planting/storage media shall conform to the criteria in **Fact Sheet MISC-1.**	Media is one of the most critical elements of the system and must be specified carefully to avoid pollutant export issues, plant health issues, or premature clogging.
Filter Course Layer	
☐ A filter course is used to prevent migration of fines through layers of the facility. Filter fabric is not used.	Migration of media can cause clogging of the aggregate storage layer void spaces or subgrade. Filter fabric is more likely to clog.
☐ Filter course is washed and free of fines.	Washing aggregate will help eliminate fines that could clog the facility and produce turbidity

Design Criteria	Intent/Rationale
	washout events. For infiltration and partial infiltration systems, washing shall not occur in situ as it could clog the underlying infiltration surface.
☐ Filter course should adhere to guidance provided in **Fact Sheet MISC-3.**	Gradation relationship between layers can evaluate factors (e.g., bridging, permeability, and uniformity) to determine if particle sizing is appropriate or if an intermediate layer is needed.
Aggregate Storage Layer	
☐ The aggregate storage layer depth below the underdrain invert is determined based on a minimum of 18 inches of stone or the depth, which can include the pea gravel portion of the filter course, that will drain within 48 hours at the design infiltration rate of the underlying soil.	The intent of this layer is to maximize incidental volume reduction.
☐ Washed river rock or open-graded, crushed rock.	Washing aggregate will help eliminate fines that could clog the aggregate storage layer void spaces or subgrade.
Inflow, Underdrain and Outflow Structures	
☐ Inflow, underdrains and outflow structures are accessible for inspection and maintenance.	Maintenance access is essential to ensure long-term performance.
☐ Inflow velocities are held to less than 1 ft/s. Dispersed flow or energy dissipation (e.g., riprap, level spreader, curb cut drop and apron) for piped inlets should be provided at inlet to prevent erosion.	High inflow velocities can cause erosion, scour and/or channeling.
☐ An underdrain cleanout with a lockable cap is placed every 100 to 200 feet as required based on underdrain length.	Properly spaced cleanouts will facilitate underdrain maintenance.
☐ At least one observation port is provided in each cell to allow inspection of subsurface water level.	This feature is necessary to facilitate inspection and performance confirmation (i.e., the infiltration storage is draining and providing the volume reduction anticipated).
☐ Underdrain is placed 3 inches above the bottom elevation of the aggregate storage layer.	Separation from subgrade or the liner lessens the risk of fines entering the underdrain and can improve hydraulic performance by allowing perforations to remain unblocked. This configuration allows the system to be fully drained, if needed. Under normal conditions, the water level is controlled via an elbow or standpipe configuration such that the sump storage depth can be adjusted without excavation of the media bed, if needed.
☐ An outlet control approach to maintain subsurface water level and manage flow rates through the media is strongly preferred. To maintain the subsurface water level, an upturned	Outlet control helps prevent preferential pathways and media loss. It also reduces the sensitivity of system performance on the hydraulic conductivity of the media, allowing

	Design Criteria	Intent/Rationale
	elbow/standpipe system or equivalent is used in the receiving outlet structure. To control flow rates through the media, an orifice is used, if possible. Orifice size should not be less than 0.5 inches.	media to be specified with a greater factor of safety against clogging.
☐	The outlet control is provided in the catch basin or manhole where the underdrain connects and is accessible for observation and maintenance.	Using outlet control in the receiving catch basin or manhole allows the system to be adapted without requiring excavation.
☐	Underdrains made of are slotted pipe per **MISC-3**.	Slotted underdrains provide greater intake capacity, clog resistant drainage, and reduced entrance velocity into the pipe, thereby reducing the chances of solids migration.
☐	An overflow device is required at the top of the ponding depth to safely convey overflow to the downstream receiving system unless the system is offline and will bypass externally to the facility.	Planning for controlled overflow lessens the risk of property damage due to flooding.

Calculations and Sizing Method

See **Appendix E** for acceptable sizing methods. Checks on footprints associated with clogging risk and volume reduction should be conducted as part of sizing. Retention volume is the volume within the stone reservoir below the underdrain elevation and up to 0.1 inch per inch of pores within the soil (suction/ET storage). Biotreatment volume is the volume in ponded water and soil pores.

Construction Guidance

	Construction Guidance	Intent/Rationale
☐	Plans should include a construction sequence for the BMP. Revisions proposed by the contractor should be reviewed by the engineer. The construction sequence should address erosion control, utilities, BMP installation, inspections, testing and certifications, final grading, vegetation, stabilization, and post-construction monitoring.	Construction sequencing is critical to avoid issues/damage and allow appropriate inspections, testing, and certifications to be performed.
☐	Excavate and place media in dry weather, or at least 48 hours after the end of rainfall.	Wetter soil is typically more susceptible to compaction.
☐	Avoid compaction of the base and sidewalls of facilities. Alleviate compaction as needed using mechanical tilling equipment (e.g., rototiller).	Infiltration rates are typically very susceptible to compaction. Infiltration should be maximized.
☐	Keep sediment out of the facility during construction as much as practicable using sediment and erosion control measures (e.g., silt fence, filter logs, check dams). Remove any confining layer that accumulates as a result of sedimentation. If the location of BMP is used as	Sediment accumulation can impair infiltration rates.

	Construction Guidance	Intent/Rationale
	a temporary erosion and sediment control facility, it should be completely rehabilitated via over excavation, before being placed into service as a post-construction BMP.	
☐	Traffic within the BMP should be avoided unless impractical. If traffic within the system is allowed, only wide track and low-ground pressure equipment is allowed.	Compaction of the system must be avoided as much as possible.
☐	Account for settlement of media when setting finished grades and planting depths.	Media will tend to settle approximately 10 percent. Failure to account for this can result in dimensions different than intended and/or exposure of plant roots.
☐	Use staking, surveying, or other methods to confirm thickness of filter course and media layers.	A uniform thickness of layers is important for effectiveness and to reduce preferential pathways.
☐	Establish the construction sequence to allow for inspection of buried infrastructure (e.g., underdrain, filter course) before it is buried.	It is impractical to inspect buried elements once they are covered.
☐	Fully stabilize sources of sediment within the tributary area (i.e., no exposed soil) prior to placing the finished BMP into service.	Erosion and sedimentation can seriously impair the hydraulic conductivity of the media bed and require restoration and revegetation of the surface of the media bed.
☐	Allow plants and mulch to stabilize for as long as practicable (preferably several months) prior to placing the finished BMP into service.	Stabilization of the system allows plants to mature and mulch to settle and "knit" before stressing the system with stormwater loading.

Adaptability Considerations

This type of BMP provides a high degree of adaptability. Adjustments to the design and/or operation of the system may be needed if observations from more detailed investigation, construction, or operation are different than what was estimated in design and permitting.

Adjust standpipe elevation and/or uncap lower underdrain (pre- or post-construction) – this can be done to reduce the amount of infiltrated volume and make the system act as bioretention with underdrains (BIO-6). This adaptation could take place between the Preliminary/Conceptual WQMP and the Final Project WQMP should issues with infiltration be identified or following construction should infiltration rates be determined to be lower than estimated.

Add a liner as part of detailed design (prior to construction) – this can be done to further limit infiltration if issues with any level of infiltration are identified as part of detailed design. This adaptation could take place between the Preliminary/Conceptual WQMP and the Final Project WQMP.

To allow for these adaptations, calculations in the WQMP should demonstrate that the system will still be adequately sized if the retention compartment is converted to biofiltration.

O&M Activities and Frequencies

Activity	Frequency
GENERAL INSPECTIONS	
Remove trash and debris	Four times per year during wet season, including inspection just before the wet season and within 24 hours after at least two storm events ≥ 0.5 inches
Repair eroded facility areas	
Inspect and maintain access roads	
Inspect and resolve areas of standing water	
Remove minor sediment in facility bottom	
Provide vector control if needed	
Identify any needed corrective maintenance that will require site-specific planning or design	
ROUTINE MAINTENANCE	
Vegetation	
Irrigate as recommended by a landscape professional, typically for the first 3 years to establish vegetation	As needed
Remove undesirable vegetation	Four times per year during wet season, including inspection just before the wet season.
Reseed or replant areas of thin or missing vegetation	Annually
Mulch	
Remove and replace mulch in areas where significant sediment (>1 inch) has accumulated	Annually
Add an additional 1-2 inches of mulch; replace any mulch that is removed	Annually
Media Layer	
Scarify media to promote infiltration while removing mulch	Annually
Replace top 3-6 inches of media layer and replace vegetation	Estimated every 10 years (highly site specific)
Replace full depth of media and replace vegetation	Estimated every 30 years (highly site specific)
Inflow, Underdrain and Outflow Structures	
Check energy dissipation function and add riprap	Four times per year during wet season, including inspection just before the wet season.
Inspect inlets and outlets and remove accumulated sediment	Four times per year during wet season, including

Activity	Frequency
	inspection just before the wet season.
Flush underdrain	As needed
Repair structural damage to inlets, outlets, and underdrain	As needed
CORRECTIVE (MAJOR) MAINTENANCE	
Prepare documentation of issues and resolutions for review by appropriate parties; modify WQMP if needed.	Before major maintenance
Document major maintenance activities; record modified WQMP and as-built plan set if needed	After major maintenance
Take photographs before and after from the same vantage point	Before and after

BIO-2: VEGETATED SWALE

Category: Biotreatment (Treatment Control)

Vegetated swales do not meet the definition of biofiltration BMPs, so they are not considered LID BMPs for the purposes of fulfilling LID requirements. They may be used as treatment control BMPs or pretreatment BMPs.

Also known as:
- Grass Swale
- Bioswale
- Bioinfiltration swale



Source: Geosyntec Consultants

Vegetated swales are open, shallow channels designed to provide pollutant removal through settling and filtration in the vegetation, usually grasses, and promote volume reduction, via infiltration and ET, where feasible. An effective vegetated swale achieves uniform sheet flow through a densely vegetated areas. Where soil conditions allow, volume reduction in vegetated swales should be enhanced by adding aggregate storage layer underneath the swale and/or check dams in the swale surface, allowing additional runoff volume to be retained and infiltrated. Where slopes are shallow and there is no appreciable infiltration that will occur or be allowed, an underdrain system or low flow channel for dry weather flows may be required to minimize ponding and convey treated and/or dry weather flows to an acceptable discharge point. Vegetated swales do not meet the required definition of biofiltration and may only be used for pretreatment or as a treatment control BMP.

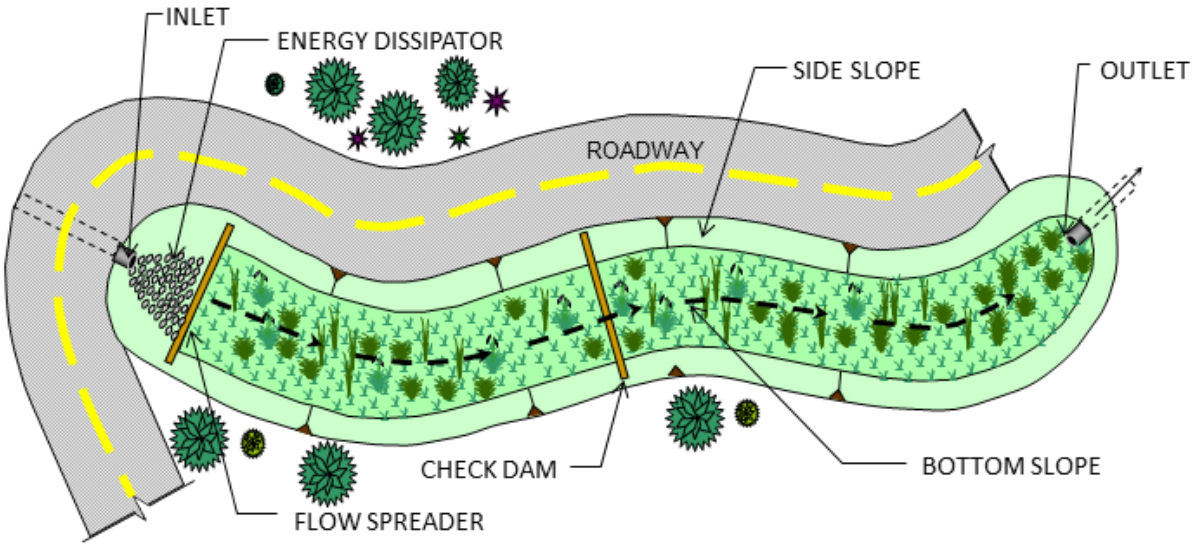
Pollutant Removal Considerations

	Phosphorus	Nitrogen	Metals	Bacteria	Oil & Grease	Organics
Partial Infiltration Configuration (with enhanced infiltration)	M	M	M	L	M	L
Standard Configuration (no enhanced infiltration)	L	L	M	L	M	L

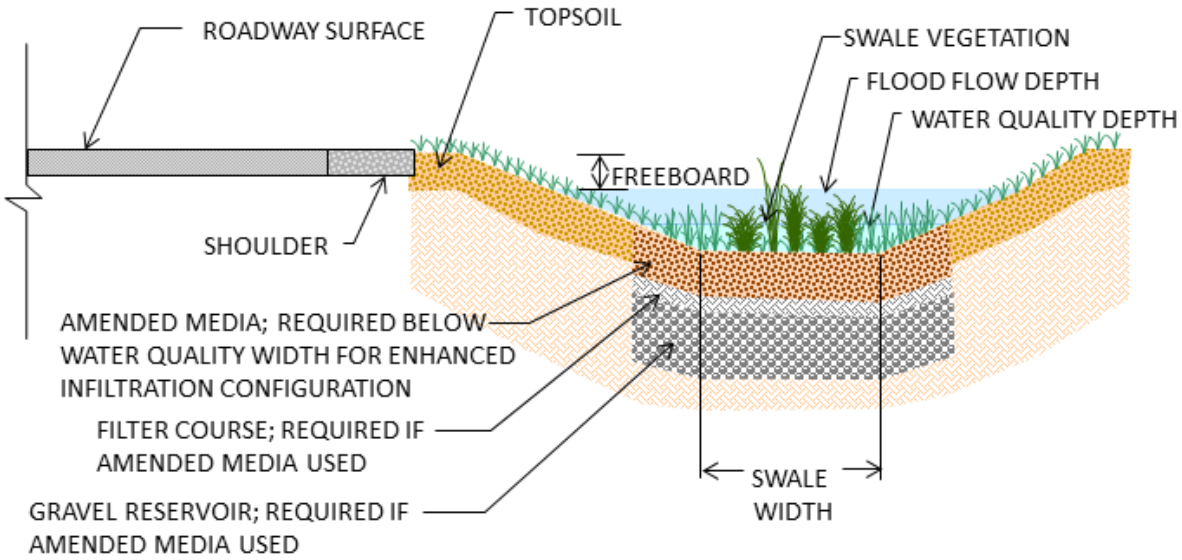
Recommended Siting Criteria

	Siting Criteria	Intent/Rationale
☐	If designed for enhanced infiltration, BMP placement adheres to geotechnical recommendations with respect to geological hazards and setbacks.	Must not negatively impact existing site geotechnical concerns.
☐	BMP is located in area of the site most suitable for partial infiltration.	To the extent practicable, BMPs must be sited to take advantage of areas where infiltration is likely to be highest.
☐	Tributary area is ≤ 5 acres, preferably ≤ 2 acre.	Larger facilities have a higher potential for scour near inflows and may increase the potential for clogging of infiltration surfaces. Additionally, they require more specific construction methods. See Section 4.4.7.

Example Schematic Design - Plan and Section View



PLAN
NOT TO SCALE



SECTION
NOT TO SCALE

Recommended BMP Component Dimensions

BMP Component	Dimension	Intent/Rationale
Freeboard	≥ 0.5 foot	Freeboard provides room for head over overflow structures and minimizes risk of uncontrolled surface discharge. Lower freeboard is allowable if there is an acceptable alternative overflow method.
Water Quality Depth (Surface Flow Depth under maximum treatment flowrate)	≤ 6 inches or ≤ 2/3rd the height of vegetation, whichever is smaller. (≥ 2 inches below shortest plant species preferred).	Flow depth must fall within the height range of the vegetation for effective water quality treatment via filtering.
Surface Flow Length	≥ 100 feet	Minimum swale length for biotreatment. Alternate length may be used if residence time is at least 10 minutes.
Finish Grade Longitudinal Slope	≤ 3% (up to 6% with check dams provided)	Reduces average velocity and associated potential for erosion and preferential flow paths.
Side Slopes	3H:1V or shallower	Gentler side slopes are safer, less prone to erosion, able to establish vegetation more quickly and easier to maintain.
Amended Soil (partial infiltration configuration)	≥ 12 inches underlain by 18 inches gravel	Supports healthy vegetation and provides sump storage for enhanced infiltration; amended soil has higher infiltration rate than top soil to promote conveyance of water into the infiltration sump.
Topsoil/Amended Soils (standard configuration)	≥ 6 inches	Supports healthy vegetation.
Swale Width	2 ≥ and ≤ 8 feet	A minimum of 2 feet minimizes erosion. A maximum of 8 feet prevents channel braiding. Swales greater than 8 feet should have a central berm divider.
Underdrain Diameter (if used)	≥ 6 inches	Facilitates simpler cleaning.
Cleanout Diameter (if underdrain used)	≥ 6 inches	Facilitates simpler cleaning.

Recommended Design Criteria and Considerations

Design Criteria	Intent/Rationale
Pretreatment	
☐ Swales do not typically require pretreatment.	
Surface Flow	
☐ Flow velocity ≤ 1 ft/s for design water quality flowrate.	Lower flow velocities provide increased pollutant removal via filtration and minimize erosion.
☐ Minimum hydraulic residence time ≥ 10 minutes.	Longer hydraulic residence time increases pollutant removal.
☐ Swale is designed to safely convey the 10-yr storm event unless a flow splitter is included to allow only the water quality event. Flow velocity for 10-yr storm event is ≤ 3 ft/s.	Planning for larger storm events lessens the risk of property damage due to flooding. If the system is online, the velocity through the system should not result in erosion.
Vegetation	
☐ An irrigation system with a connection to water supply should be provided, as needed.	Seasonal irrigation may be needed to ensure robust vegetative processes in relatively coarse-grained media material.
☐ Plant materials should be tolerant of summer drought (unless irrigated), ponding fluctuations, and saturated soil conditions for up to 48 hours; native plant species and/or hardy cultivars that are not invasive and do not require chemical fertilizers or pesticides should be used to the maximum extent feasible. See recommended plant list in **Fact Sheet MISC-4**.	Plants suited to the climate and ponding depth are more likely to survive.
☐ In right of way areas, plant selection should not impair traffic sightlines or vehicle access.	Vegetation should be compatible with operations and adjacent uses.
Soil Amendment and Gravel Reservoir (for enhanced infiltration configuration)	
☐ System should be designed serve primarily as an infiltration system during smaller storms equal to approximately one-third of the DCV or DCF as a target.	In order to be considered a biotreatment BMP, specific design provisions need to be included to promote incidental infiltration loss where feasible.
☐ Soils should be imported or amended to provide an estimated infiltration rate of at least 5 inches per hour over a depth of at least 12 inches over the entire wetted footprint of the swale.	This promotes plant growth and provides permeability for water to flow into the underlying gravel reservoir.
☐ The aggregate storage layer depth below the amended media should be at least 18 inches thick over the entire wetted footprint of the swale.	The intent of this layer is to maximize incidental volume reduction.
☐ The aggregate storage layer should be comprised of washed aggregate with a porosity of at least 40 percent.	Washing aggregate will help eliminate fines that could clog the aggregate storage layer void spaces or subgrade.

Design Criteria	Intent/Rationale
Topsoil/Amended Soils (for standard configuration)	
☐ Topsoil should be decompacted to 6 inches.	This supports healthy plant growth.
☐ Unless soils have adequate fertility, amend soil with at least 2 inches of compost mixed into the top 6 inches of in-situ soils.	This supports healthy plant growth.
Check Dams	
☐ Where slopes are 3% or steeper, check dams should be provided at necessary increments to ensure no more than 12 inches of drop between check dams. For example, at 4 percent slope, check dams would be needed every 25 feet.	Check dams prevent erosion and increase pollutant removal, volume reduction, and hydraulic residence time by lowering flow velocities and providing ponding opportunities.
Filter Course (Only Applicable When Aggregate Reservoir or Underdrain is Used)	
☐ A filter course should be used to prevent migration of fines through layers of the facility. Filter fabric is not used.	Migration of media can cause clogging of the aggregate storage layer void spaces or subgrade. Filter fabric is more likely to clog.
☐ Filter course should be washed and free of fines.	Washing aggregate will help eliminate fines that could clog the facility and impede infiltration.
☐ Filter course should adhere to guidance provided in **Fact Sheet MISC-3.**	Gradation relationship between layers determine bridging and permeability to determine if particle sizing is appropriate or if an intermediate layer is needed.
Inflow, Outlet, and Underdrain Structures (as applicable)	
☐ If slope is less than 1.0% and underlying soils do not support partial infiltration, provide an underdrain over the length of the swale.	Provides adequate drainage for flatter swales to prevent standing water. In conditions with moderately permeable underlying soils (i.e., partial infiltration conditions) an underdrain is not necessary.
☐ Design inflow and underdrains to be accessible for inspection and maintenance.	Maintenance access is essential to ensure long-term performance.
☐ Provide flow dispersion or energy dissipation approaches (e.g., riprap, level spreader, curb cut drop and apron) for piped inlets.	Minimizes erosion, scour and/or channeling.
☐ Provide an underdrain cleanout with a lockable cap every 100 feet or partial increment of 100 feet.	Properly spaced cleanouts will facilitate underdrain maintenance.
☐ Underdrain is placed 3 inches above the bottom elevation of the aggregate storage layer.	A minimal separation from subgrade or the liner lessens the risk of fines entering the underdrain and can improve hydraulic performance by allowing perforations to remain unblocked.
☐ Underdrains are made of slotted pipe per **MISC-3**.	Slotted underdrains provide greater intake capacity, clog resistant drainage, and reduced entrance velocity into the pipe, thereby reducing the chances of solids migration.

Calculations and Sizing Method

See **Appendix E** for acceptable methods for determining the required design flowrate. The Flow-Based Capture Efficiency via Nomograph Method for Sizing Treatment Control BMPs (Section E.3.7) is the most applicable method for determining the design flowrate for vegetated swales because they may only be used as treatment control BMPs. After the swale is sized using the methods in Section E.3, the user then selects the design flow depth and longitudinal slope and uses the sizing steps below to determine the required length and width of the swale.

- **Step 1: Estimate the Swale Bottom Width**

For shallow flow depths, channel side slopes can be ignored and the bottom width can be calculated using a simplified form of Manning's formula:

$b = (Q \times n_{WQ}) / (1.49 \times y^{1.67} \times s^{0.5})$

Where:

b = estimated swale bottom width, ft

Q = design flowrate, cfs

n_{WQ} = Manning's roughness coefficient for shallow flow conditions, use 0.2 unless other information is available

y = design flow depth, ft (not to exceed 4 inches or 0.33 ft)

s = longitudinal slope in flow direction, ft/ft (not to exceed 0.06)

If b is between 2 and 8 feet, proceed to step 3.

If b is less than 2 feet, increase b to 2 feet and recalculate design flow depth using the following:

$y = ((Q \times n_{WQ}) / (1.49 \times b \times s^{0.5}))^{0.6}$

If b is greater than 10 feet, one of the following steps is necessary:

- Increase design flow depth to a maximum of 4 inches or 0.33 ft, and recalculate b
- Install a divider lengthwise along swale bottom at least three-quarters of the swale length, beginning at the inlet. The swale width can be increased to 16 feet if a divider is provided.

- **Step 2: Determine Design Flow Velocity**

Calculate the design flow velocity using the following equation:

$V_{WQ} = Q / A_{WQ}$

Where:

V_{WQ} = design flow velocity, fps

Q = design flowrate, cfs

$A_{WQ} = by + Zy^2$, cross sectional area of flow at design depth

Z = side slope length per unit height

If the design flow velocity exceeds 1 foot per second, design parameters in Step 2 should be adjusted (slope, bottom width, or design flow depth) until V_{WQ} is equal or less than 1 fps.

- **Step 3: Calculate Swale Length**

Calculate the swale length needed to achieve a minimum hydraulic residence time of 10 minutes using the following equation:

$L = 60 \times t_{HR} \times V_{WQ}$

Where:

L = swale length, ft

t_{HR} = hydraulic residence time, min (minimum 10 minutes)

V_{WQ} = design flow velocity, fps

- **Step 5: If Needed, Adjust Swale Length to Site Constraints**

Note that oftentimes swale length can be accomodated by providing a meandering swale. However, if swale length is too large for the site, the length can be adjusted as follows:

- Calculate the swale treatment top area (A_{top}), based on the swale length calculated in Step 4:

$A_{TOP} = (b_i + b_{SLOPE}) \times L_i$

Where:

A_{TOP} = top area (ft^2) at the design treatment depth

b_i = bottom width (ft), calculated in Step 2

b_{SLOPE} = the additional top width (ft) above the side slope for the design water depth (for 3:1 side slopes and a 4-inch water depth, b_{slope} = 2 feet)

L_i = initial length (ft) calculated in Step 4

- Use the swale top area and a reduced swale length (L_f) to increase the bottom width, using the following equation:

$L_F = A_{TOP} / (b_F + b_{SLOPE})$

Where:

L_F = reduced swale length (ft)

b_F = increased bottom width (ft)

- Recalculate V_{WQ} according to Step 3 using the revised cross-sectional area A_{WQ} based on the increased bottom width (b_F). Revise the design as necessary if the design flow velocity exceeds 1 foot per second.
- Recalculate to ensure that the 10 minute retention time is retained.

Construction Guidance

Construction Guidance	Intent/Rationale
☐ Plans should include a construction sequence for the BMP. Revisions proposed by the contractor should be reviewed by the engineer. The construction sequence should address erosion control, utilities, BMP installation, inspections, testing and certifications, final grading, vegetation, stabilization, and post-construction monitoring.	Construction sequencing is critical to avoid issues/damage and allow appropriate inspections, testing, and certifications to be performed.
☐ If amended media is used, handle and place media in dry weather, or at least 48 hours after the end of rainfall.	Wetter soil is typically more susceptible to compaction.
☐ Avoid compaction of the base and sidewalls of facilities that are not designed as lined facilities. Alleviate compaction as needed using mechanical tilling equipment (e.g., rototiller).	Infiltration rates are typically very susceptible to compaction. Infiltration should be maximized.
☐ Keep sediment out of the facility during construction as much as practicable using sediment and erosion control measures (e.g., silt fence, filter logs, check dams).	Sediment accumulation can impair infiltration rates. If needed, remove sediment and rehabilitate underlying soil, as needed.
☐ Traffic within the BMP should be avoided unless impractical. If traffic within the system is allowed, only wide track and low-ground pressure equipment is allowed.	Compaction of the system must be avoided as much as possible.
☐ Is using media, account for settlement of media when setting finished grades and planting depths.	Media will tend to settle approximately 10 percent. Failure to account for this can result in dimensions different than intended and/or exposure of plant roots.
☐ Use staking, surveying, or other methods to confirm thickness of filter course and media layers, if applicable.	A uniform thickness of layers is important for effectiveness and to reduce preferential pathways.
☐ Establish construction phasing to allow for inspection of buried infrastructure (e.g., underdrain, filter course) before it is buried.	It is impractical to inspect buried elements once they are covered.
☐ Fully stabilize sources of sediment within the tributary area (i.e., no exposed soil) prior to placing the finished BMP into service.	Erosion and sedimentation can seriously impair the hydraulic conductivity of the media bed and require restoration and revegetation.
☐ Allow plants and mulch to stabilize for as long as practicable (preferably several months) prior to placing the finished BMP into service.	Stabilization of the system allows plants to mature and mulch to settle and “knit” before stressing the system with stormwater loading.

O&M Activities and Frequencies

Activity	Frequency
GENERAL INSPECTIONS	
Remove trash and debris	Four times per year during wet season, including inspection just before the wet season and within 24 hours after at least two storm events ≥ 0.5 inches.
Repair eroded facility areas	
Inspect and maintain access roads	
Inspect and resolve areas of standing water	
Remove minor sediment in facility bottom	
Provide vector control if needed	
Identify any needed corrective maintenance that will require site-specific planning or design	
ROUTINE MAINTENANCE	
Vegetation	
Irrigate as recommended by a landscape professional, typically for the first 3 years to establish vegetation	As needed
Remove undesirable vegetation	Four times per year during wet season, including inspection just before the wet season.
Repair areas of thin or missing vegetation	Annually
Topsoil/Amended Soils/Media Layer	
Replace top 3-6 inches of top soil or media layer and replace vegetation	Estimated every 10 years (highly site specific)
Replace full depth of top soil, media, aggregate storage (if provided) and replace vegetation	Estimated every 30 years (highly site specific)
Inflow, Underdrain and Outflow Structures	
Check energy dissipation function and add riprap	Four times per year during wet season, including inspection just before the wet season.
Inspect inlets and outlets and remove accumulated sediment	Four times per year during wet season, including inspection just before the wet season.
Flush underdrain, if included in design	As needed
Repair structural damage to inlets, outlets, and underdrain	As needed
CORRECTIVE (MAJOR) MAINTENANCE	
Prepare documentation of issues and resolutions for review by appropriate parties; modify WQMP if needed.	Before major maintenance

Activity	Frequency
Document major maintenance activities; record modified WQMP and as-built plan set if needed	After major maintenance
Take photographs before and after from the same vantage point	Before and after

BIO-3: VEGETATED FILTER STRIP

Category: Biotreatment with Partial Infiltration (Treatment Control)

Also known as:
Buffer Strip
Vegetated Buffer

Vegetated filter strips do not meet the definition of biofiltration BMPs, so they are not considered LID BMPs for the purposes of fulfilling LID requirements. They may be used as treatment control BMPs or pretreatment BMPs.



Source: Geosyntec Consultants

Vegetated filter strips are designed to treat sheet flow runoff from adjacent impervious surfaces or intensive landscaped areas such as golf courses. Filter strips decrease runoff velocity, filter out total suspended solids and associated pollutants, and provide infiltration into underlying soils, particularly for smaller storm events. While some assimilation of dissolved constituents may occur, filter strips are generally more effective in trapping sediment and particulate-bound metals, nutrients, and pesticides. Filter strips are more effective when the runoff passes through the vegetation and thatch layer in the form of shallow, uniform flow. Biological and chemical processes may help break down pesticides, absorb metals, and utilize nutrients that are trapped in the filter. These facilities may not result in retention of the full DCV, but they can be used to achieve the maximum feasible infiltration and ET while providing treatment of the remaining portion of the required treatment volume. Vegetated filter strips do not meet the required definition of biofiltration and are therefore only used for pretreatment or as a treatment control BMP.

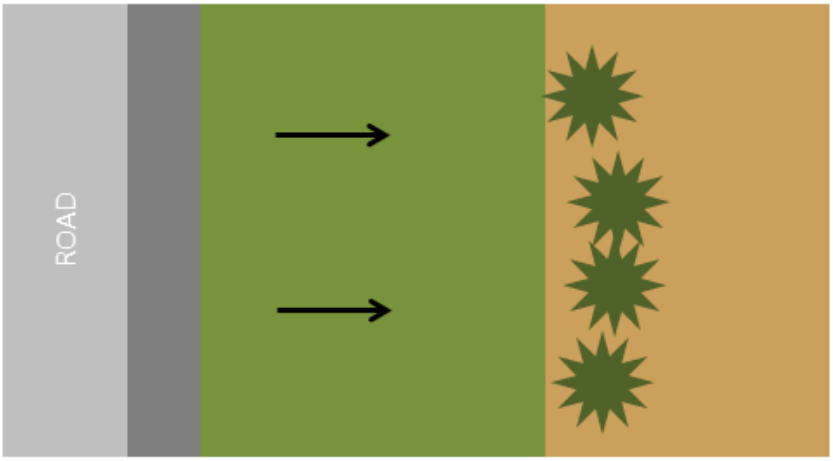
Pollutant Removal Considerations

TSS	Phosphorus	Nitrogen	Metals	Bacteria	Oil & Grease	Organics
M	M	M	M	M	M	M

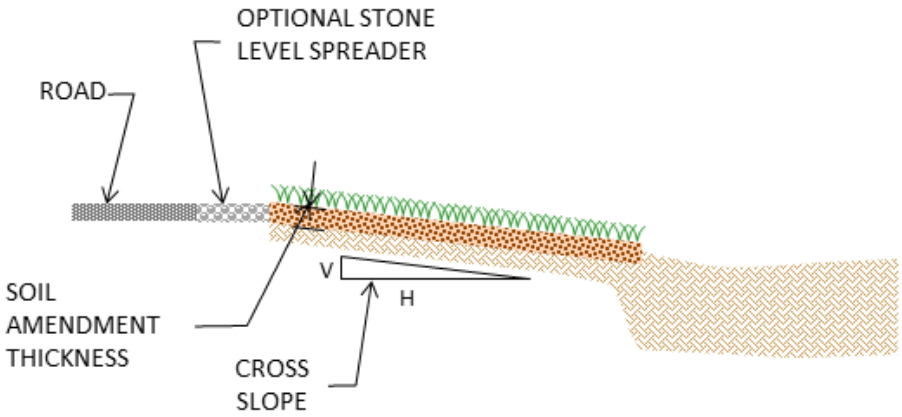
Recommended Siting Criteria

	Siting Criteria	Intent/Rationale
☐	BMP placement adheres to geotechnical recommendations with respect to geological hazards and setbacks.	Some amount of infiltration will tend to occur below a BMP; must not negatively impact existing site geotechnical concerns.
☐	BMP is located in area of the site most suitable for partial infiltration.	To the extent practicable, BMPs must be sited to take advantage of areas where infiltration is likely to be highest.
☐	BMP is adjacent to impervious surfaces.	This type of BMP only operates via sheet flow; it is not practical to disperse pipe flow onto a filter strip.
☐	Width of flow tributary to filter strip does not exceed 50 feet	It is rare for runoff to remain in sheet flow for longer than 50 feet.
☐	Site slope is ≤ 2% along edge of filter strip	Helps ensure uniform sheet flow onto the upper edge of the BMP.

Example Schematic Design - Plan and Section View



PLAN
NOT TO SCALE



SECTION
NOT TO SCALE

Recommended BMP Component Dimensions

BMP Component	Dimension	Intent/Rationale
Drop from Impervious Area	≥ 2 and ≤ 5 inches	Allows for vegetation and sediment accumulation at the edge of the strip. A beveled transition is acceptable and may be required per roadside design specifications
Surface Flow Depth	≤ 1 inch	Flow depth must be very shallow for effective treatment
Surface Flow Length	≤ 50 feet	Helps ensure even sheet flow onto BMP.
Finish Grade Longitudinal Slope (in direction of flow)	Between 1% and 6%	Controls velocities to reduce rill erosion while providing measurable slope for surface drainage.
Finish Grade Cross Slope (perpendicular to flow)	≤ 2%	Helps ensure even sheet flow onto BMP
Amended Soil Depth	≥ 12 inches	Supports healthy vegetation and enhanced volume reduction.

Recommended Design Criteria and Considerations

Design Criteria	Intent/Rationale
Surface Flow	
☐ Flow velocity ≤ 0.5 ft/s for water quality event.	Lower flow velocities provide increased pollutant removal via filtration and minimize erosion.
☐ Minimum hydraulic residence time ≥ 10 minutes.	Longer hydraulic residence time increases pollutant removal.
Vegetation	
☐ An irrigation system with a connection to water supply should be provided, as needed.	Seasonal irrigation may be needed to ensure robust vegetative processes necessary to support this BMP type. Where dense, uniform vegetation cannot be established, this BMP should not be used.
☐ Native grasses with uniform stem spacing (non-bunching) are preferred in this application.	Uniform stem spacing is necessary. Native grasses form a thatch that can be beneficial for treatment. Bunching varieties do not provide appropriate uniformity of stems.
Topsoil/Amended Soils (amendment with media is Optional)	
☐ Amend soils to 12-inch minimum depth per criteria in **Fact Sheet MISC-2**.	Provides increased porosity and permeability to support volume reduction and robust plant growth.

Calculations and Sizing Method

See **Appendix E** for acceptable methods for determining the design flowrate. The Flow-Based Capture Efficiency via Nomograph Method for Sizing Treatment Control BMPs (Section E.3.7) is the most applicable method for determining the design flowrate for vegetated filter strips because they may only be used as treatment control BMPs. In addition to the design flowrate, filter strips have other sizing aspects that must be met including the minimum filter strip width, the design flow depth, the filter strip design velocity, and the filter strip length. After determining the design flow rate, follow the steps below to determine the other sizing aspects.

- **Step 1: Calculate the Minimum Filter Strip Width**

$W_{MIN} = Q / q_{A,MIN}$

Where:

W_{MIN} = minimum width of filter strip (and tributary area), ft

Q = design flow, cfs

$q_{A,MIN}$ = minimum linear unit application rate, 0.005 cfs/ft

- **Step 2: Calculate the Design Flow Depth**

$d_F = 12 \times ((Q \times n_{WQ}) / (1.49 \times W_{TRIB} \times s^{0.5}))^{0.6}$

Where:

d_F = design flow depth, in

Q = design flow, cfs

n_{WQ} = Manning's roughness coefficient for shallow flow conditions, use 0.2 unless other information is available

W = width of strip (and tributary area), ft (should be equal or greater than W_{MIN})

s = longitudinal slope in flow direction, ft/ft (not to exceed 0.06)

- **Step 3: Calculate the Filter Strip Design Velocity**

Calculate the filter strip design velocity using the following equation:

$V_{WQ} = Q / (d_F \times W)$

Where:

V_{WQ} = filter strip design flow velocity, fps

d_F = design flow depth, in

Q = design flow, cfs

W = width of strip (and tributary area), ft

The design flow velocity should not exceed 1 foot per second. If the velocity exceeds 1 fps, adjust the strip longitudinal slope to decrease the velocity.

- **Step 4: Calculate Filter Strip Length**

Calculate the filter strip length required to achieve the required minimum residence time using the following equation:

$L = 60 \times t_{HR} \times V_{WQ}$

Where:

L = filter strip length, ft (must be 15 ft to 150 ft for biotreatment)

t_{HR} = hydraulic residence time, min (minimum 10 minutes for biotreatment)

V_{WQ} = design flow velocity, fps

Construction Guidance

Construction Guidance	Intent/Rationale
☐ Plans should include a construction sequence for the BMP. Revisions proposed by the contractor should be reviewed by the engineer. The construction sequence should address erosion control, utilities, BMP installation, inspections, final grading, vegetation, stabilization, and post-construction monitoring.	Construction sequencing is critical to avoid issues/damage and allow appropriate inspections, testing, and certifications to be performed.
☐ Conduct soil amendment in dry weather, or at least 48 hours after the end of rainfall.	Wetter soil is typically more susceptible to compaction.
☐ Avoid compaction of the filter strip.	Infiltration rates are typically very susceptible to compaction. Infiltration should be maximized.
☐ Keep sediment out of the facility during construction as much as practicable using sediment and erosion control measures (e.g., silt fence, filter logs, check dams).	Sediment accumulation can impair infiltration rates. Remove any accumulated sediment prior to amending and vegetating the system.
☐ Traffic within the BMP should be avoided unless impractical. If traffic within the system is allowed, only wide track and low-ground pressure equipment is allowed.	Compaction of the system must be avoided as much as possible.
☐ Account for settlement of amended top soil when establishing finished grades and planting depths.	Amended soils will tend to settle approximately 10 percent. Failure to account for this can result in dimensions different than intended
☐ Fully stabilize sources of sediment within the tributary area (i.e., no exposed soil) prior to placing the finished BMP into service.	Erosion and sedimentation can seriously impair the hydraulic conductivity of the media bed and require restoration and revegetation of the surface of the media bed.
☐ Allow grass to establish for as long as practicable (preferably several months) prior to placing the finished BMP into service.	Grass must be established for the system to provide treatment.

O&M Activities and Frequencies

Activity	Frequency
GENERAL INSPECTIONS	
Remove trash and debris	Four times per year during wet season, including inspection just before the wet season and within 24 hours after at least two storm events ≥ 0.5 inches.
Check for eroded facility areas or areas with sparse or dead vegetation	
Inspect for signs of concentrated flow into level spreader or into filter strip	
Identify any needed corrective maintenance that will require site-specific planning or design	
ROUTINE MAINTENANCE	
Repair eroded areas	Four times per year during wet season, including inspection just before the wet season.
Maintain level spreader by making local adjustments to elevations to improve flow distribution over filter strip	Annually
Vegetation	
Irrigate as recommended by a landscape professional, typically for the first 3 years to establish vegetation	As needed
Remove undesirable vegetation (i.e., weeds)	Four times per year during wet season, including inspection just before the wet season.
Reseed areas of thin or missing vegetation	Annually
Topsoil/Amended Soils	
Decompact/aerate to at least a 6-inch depth and reseed to maintain porosity and robust vegetation replace vegetation	Estimated every 10 to 15 years (highly site specific)
CORRECTIVE (MAJOR) MAINTENANCE	
Prepare documentation of issues and resolutions for review by appropriate parties; modify WQMP if needed.	Before major maintenance
Document major maintenance activities; record modified WQMP and as-built plan set if needed	After major maintenance
Take photographs before and after from the same vantage point	Before and after

BIO-4: DRY EXTENDED DETENTION BASIN

Category: Biotreatment (Treatment Control)

Also known as:
Dry Ponds
Detention Basins

Dry extended detention basins do not meet the definition of biofiltration BMPs, so they are not considered LID BMPs for the purposes of fulfilling LID requirements. They may be used as treatment control BMPs or pretreatment BMPs.



Source: Geosyntec Consultants

Dry extended detention basins (DEDBs) are basins that have been designed to detain storm water for an extended period to allow sedimentation. DEDBs do not have a permanent pool; they are designed to drain completely between storm events. They can also be used to provide hydromodification and/or flood control by modifying the outlet control structure and providing additional detention storage. The slopes, bottom, and forebay of DEDBs are typically vegetated. Considerable infiltration can occur in DEDBs when they are located in permeable soils and are not lined with an impermeable barrier. These facilities may not result in retention of the full DCV, but they can be used to achieve the maximum feasible infiltration and ET while providing treatment of the remaining portion of the required treatment volume. DEDBs do not meet the required definition of biofiltration and may only be used as a treatment control BMP.

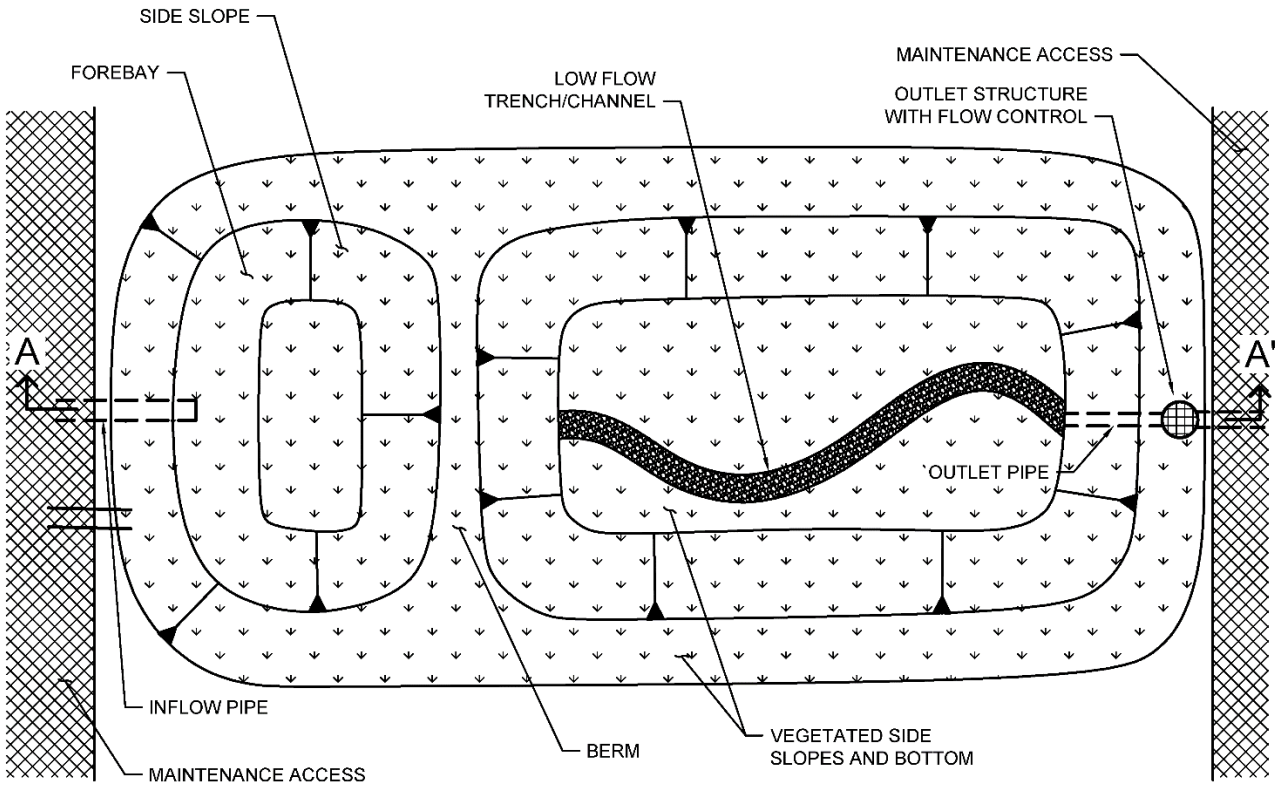
Pollutant Removal Considerations

TSS	Phosphorus	Nitrogen	Metals	Bacteria	Oil & Grease	Organics
M	M	L	M	L	H	L

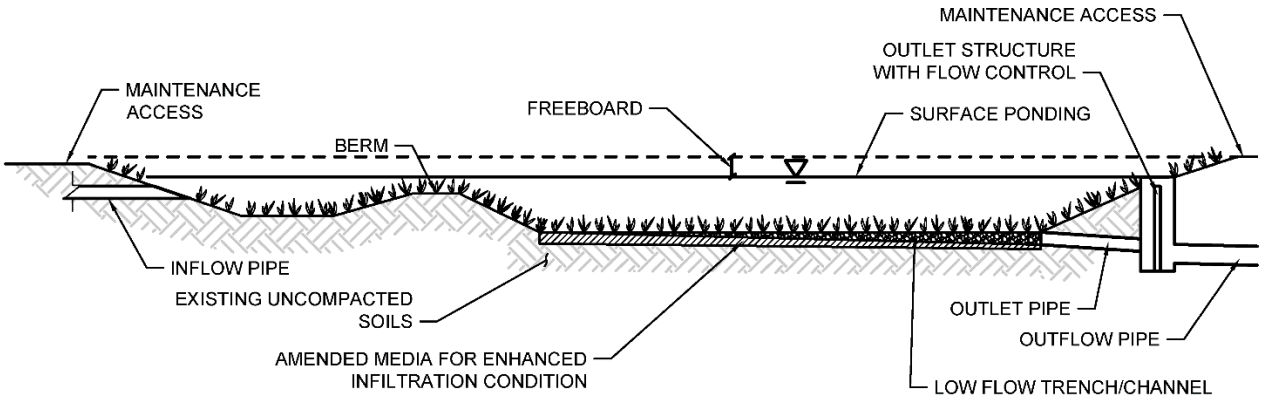
Recommended Siting Criteria

	Siting Criteria	Intent/Rationale
☐	BMP placement adheres to geotechnical recommendations with respect to geological hazards and setbacks.	Unless lined, some infiltration will occur; must not negatively impact existing site geotechnical concerns.
☐	BMP is located in area of the site most suitable for partial infiltration.	To the extent practicable, BMP must be sited to take advantage of areas where infiltration is likely to be highest.
☐	Any tributary area is acceptable	No significant scaling issues.
☐	Provide space for shallower (<4-foot depth) systems when designing for enhanced infiltration.	Facility footprint is an important factor for volume reduction.

Example Schematic Design - Plan and Section View



PLAN
NOT TO SCALE



SECTION A-A'
NOT TO SCALE

Recommended BMP Component Dimensions

BMP Component	Dimension	Intent/Rationale
Freeboard	≥ 1 foot (offline facilities) ≥ 2 foot (inline facilities)	Freeboard provides room for head over overflow structures and minimizes risk of uncontrolled surface discharge.
Surface Ponding	≤ 4 feet for enhanced infiltration ≤ 8 feet	Ponding limits are guidelines; shallower depth is encouraged to promote a greater portion of losses to infiltration.
Side Slopes	3H:1V or shallower	Gentler side slopes are safer, less prone to erosion, able to establish vegetation more quickly and easier to maintain.
Basin Length: Width Ratio	2:1 or greater is preferred	A larger length to width ratio provides a longer flow path to promote settling.
Longitudinal Basin Bottom Slope	0-2%	Flatter slopes promote ponding and settling of particles.
Low Flow Channel Slope	≥ 2%	Aids in draining dry weather flows.
Forebay Volume	10 percent of total volume	Concentrates accumulation and maintenance of coarser sediment
Forebay Depth/Berm Height	Half of Ponding Depth	Provides a dedicated volume for sediment accumulation.
Amended Media Depth	12 inches	Enhanced volume reduction
Gravel Trench for Low Flows	24-inch-deep by 24-inch wide	Provides pathway for low flows to infiltrate or be treated through the facility.

Recommended Design Criteria and Considerations

Design Criteria	Intent/Rationale
Forebay	
☐ Volume prior to overflow is ≥ 10% of facility volume.	An adequately sized forebay to trap sediment can decrease frequency of required maintenance and keep efforts more spatially isolated
Surface Ponding	
☐ Surface ponding has a 36-48 hour drawdown time.	A maximum 48-hour drawdown time is recommended for plant health and vector control. However, shorter drawdown time reduces settling efficiency.
☐ Low flow channel includes a 24-inch wide by 24-inch deep gravel trench.	Promotes infiltration of dry weather flows.
Vegetation	
☐ An irrigation system with a connection to water supply should be provided, as needed.	Seasonal irrigation may be needed to ensure robust vegetative processes in relatively coarse-grained media material.

Design Criteria	Intent/Rationale
☐ Plant materials should be tolerant of summer drought (unless irrigated), ponding fluctuations, and saturated soil conditions for up to 96 hours during back to back storms. Select from native plant species and/or hardy cultivars that are not invasive and do not require chemical fertilizers or pesticides. See recommended plant list in **Fact Sheet MISC-4**.	Plants suited to the climate and ponding depth are more likely to survive.
Soil Amendment (for enhanced infiltration configuration)	
☐ System should be designed to promote infiltration and ET losses.	In order to be considered a biotreatment BMP, specific design provisions need to be included to promote incidental infiltration loss where feasible.
☐ Soils should be imported or amended to provide an estimated infiltration rate of at least 5 inches per hour over a depth of at least 12 inches over the entire wetted footprint of the basin.	This promotes plant growth and provides permeability for water to flow into the underlying soil.
Inflow and Outflow Structures	
☐ Inlets and outlets are positioned to maximize the length of flow paths through the facility.	Facilitates increased hydraulic residence time (prevents short-circuiting of treatment).
☐ Inflow and outflow structures are accessible for inspection and maintenance.	Maintenance access is essential to ensure long-term performance.
☐ An overflow device is required at the top of the ponding depth to safely convey overflow to the downstream receiving system.	Planning for controlled overflow lessens the risk of property damage due to flooding.
☐ Design outlet structure with desired hydraulics, based on detailed design guidance acceptable to the local jurisdiction	This manual does not provide detailed design guidance for detention basin outlet structures.

Calculations and Sizing Method

See **Appendix E** for acceptable sizing methods.

Construction Guidance

Construction Guidance	Intent/Rationale
☐ Plans should include a construction sequence for the BMP. Revisions proposed by the contractor should be reviewed by the engineer. The construction sequence should address erosion control, utilities, BMP installation, inspections, final grading, vegetation, stabilization, and post-construction monitoring.	Construction sequencing is critical to avoid issues/damage and allow appropriate inspections, testing, and certifications to be performed.
☐ Excavate in dry weather, or at least 48 hours after the end of rainfall.	Wetter soil is typically more susceptible to compaction.
☐ Avoid compaction of the base and sidewalls of facilities. Alleviate compaction as needed using mechanical tilling equipment (e.g., rototiller).	Infiltration rates are typically very susceptible to compaction. Infiltration should be maximized.
☐ Keep sediment out of the facility during construction as much as practicable using sediment and erosion control measures (e.g., silt fence, filter logs, check dams).	Sediment accumulation can impair infiltration rates. Remove any sediment that accumulates in the facility during construction.
☐ Traffic within the BMP should be avoided unless impractical. If traffic within the system is allowed, only wide track and low-ground pressure equipment is allowed.	Compaction of the system must be avoided as much as possible.
☐ Fully stabilize sources of sediment within the tributary area (i.e., no exposed soil) prior to placing the finished BMP into service.	Sediment accumulation can interfere with vegetation establishment
☐ Allow plants to stabilize for as long as practicable (preferably several months) prior to placing the finished BMP into service.	Stabilization of the system allows plants to mature before stressing the system with stormwater loading.

O&M Activities and Frequencies

Activity	Frequency
GENERAL INSPECTIONS	
Remove trash and debris	Four times per year during wet season, including inspection just before the wet season and within 24 hours after at least two storm events ≥ 0.5 inches.
Areas of erosion or scour facility areas	
Areas of standing water	
Need for vegetation management	
Need for vector control efforts	
Identify any needed corrective maintenance that will require site-specific planning or design	
ROUTINE MAINTENANCE	
Repair areas of erosion, scour, or standing water	As needed
Sediment	
Remove sediment from forebay when sediment volume exceeds 25% of the sediment storage volume	As needed
Vegetation	
Irrigate as recommended by a landscape professional, typically for the first 3 years to establish vegetation	As needed
Remove undesirable vegetation	Four times per year during wet season, including inspection just before the wet season.
Reseed or replant areas of thin or missing vegetation	Annually
Inflow and Outflow Structures	
Check energy dissipation function and add riprap as needed	Four times per year during wet season, including inspection just before the wet season.
Inspect inlets and outlets and remove accumulated sediment	Four times per year during wet season, including inspection just before the wet season.
Repair structural damage to inlets and outlets	As needed
CORRECTIVE (MAJOR) MAINTENANCE	
Prepare documentation of issues and resolutions for review by appropriate parties; modify WQMP if needed.	Before major maintenance
Document major maintenance activities; record modified WQMP and as-built plan set if needed	After major maintenance
Take photographs before and after from the same vantage point	Before and after

BIO-5/BIO-7: PROPRIETARY BIOTREATMENT

Category: Biotreatment with Partial Infiltration (when accompanied by supplemental retention)

Biotreatment with No Infiltration (when used without supplemental retention)

Proprietary biotreatment BMPs are proprietary devices that are manufactured to treat stormwater. **Acceptance criteria for proprietary biotreatment BMPs are defined in Appendix J**. Proprietary BMPs that do not meet these acceptance criteria are not permitted. In addition, proprietary biotreatment BMPs must meet the definition of biofiltration in order to be used a LID biotreatment BMPs. There are two configurations of proprietary biotreatment, as explained in the following subsections.

BIO-5: Proprietary Biotreatment with Enhanced Retention Configuration

As standalone systems, proprietary biotreatment BMPs typically provide negligible volume reduction. In order to be used as a "biotreatment BMP with partial infiltration," these BMPs must be accompanied by a retention compartment. This could consist of a number of options:

- Permeable pavement upstream of the proprietary BMP
- Shallow infiltration gallery or chambers downstream of the BMP, connected to underdrains
- Proprietary biotreatment downstream of a cistern for harvest and use
- Use of adequate hydrologic source controls in the watershed to meet volume reduction targets (see Sizing section of this Fact Sheet)
- Other configurations that are determined to be appropriate to maximize the feasible volume reduction for the DMA

Guidance for retention compartments is provided in other fact sheets, such as INF-5 (Permeable Pavement) and INF-6 (Underground Infiltration).

BIO-7: Standard Configuration without Supplemental Retention

For conditions that do not require partial infiltration, volume retention is not a performance goal. Acceptable proprietary biotreatment BMPs may be used as standalone systems. Guidance related to complementary retention can be disregarded.

Pollutant Removal Considerations

BMPs that meet the acceptance criteria in Appendix J are considered to provide adequate treatment for pollutants of concern. According to these critera, there are different levels of treatment certification needed for different pollutants of concern.

Recommended Design Criteria and Considerations

	Design Criteria	Intent/Rationale
☐	Sediment sources should be controlled prior to operation of the system.	Proprietary systems are susceptible to clogging similar to other BMPs. Systems should not be used in areas that will continue to receive elevated sediment loading following construction, such as from open space area.
☐	When accompanied by infiltration compartments, the ponding should not be higher than the underdrain elevation of the proprietary BMP.	This is intended to ensure that the complementary retention compartment does not reduce the hydraulic capacity of the proprietary biotreatment BMP
☐	When accompanied by infiltration compartments, these infiltration BMPs must adhere to siting guidance found in the respective fact sheet for the BMP	Specific siting considerations apply to infiltration BMPs.
☐	Proprietary biotreatment systems typically do not require separate pretreatment	These BMPs typically include integrated mechanisms for pretreatment.
☐	Proprietary BMPs must be designed in a manner consistent with manufacturer recommendations and consistent with the design configuration that was tested as part of the BMP certification	Proprietary devices have device-specific design, installation, and maintenance details which must be followed for proper treatment results.
☐	In right of way areas, plant selection should not impair traffic sightlines or vehicle access.	Vegetation must not be prohibitive for typical vehicular movement and parking access needs.
☐	Manufacturer guidance on vegetation selection and establishment should be followed	Manufacturers have experience with plant survival in specific climates for the BMP-specific conditions.

Calculations and Sizing Method

Proprietary Biotreatment BMPs are flow-based BMPs. See **Appendix E** for acceptable sizing methods.

Supplemental retention elements (for BIO-5 configuration) should be sized for one of the following targets, where possible:

- Approximately 40 percent long term volume reduction
- Retention storage provided for approximately one-third of the DCV
- Infiltration footprint (collective of all infiltrating elements of the project design) meeting target defined in Section E.4.2.

Construction Guidance

Construction Guidance	Intent/Rationale
☐ Plans should include a construction sequence for the BMP. Revisions proposed by the contractor should be reviewed by the engineer. The construction sequence should address erosion control, utilities, BMP installation, inspections, testing and certifications, vegetation, stabilization, and post-construction monitoring.	Construction sequencing is critical to avoid issues/damage and allow appropriate inspections, testing, and certifications to be performed.
☐ Provide for inspection of buried infrastructure (e.g., underdrain, filter course) before it is buried.	It is impractical to inspect buried elements once they are covered.
☐ Fully stabilize sources of sediment within the tributary area (i.e., no exposed soil) prior to placing the finished BMP into service.	Sediment loading can seriously impair the capacity of the BMP.
☐ Allow plants and mulch to stabilize for as long as practicable (preferably several months) prior to placing the finished BMP into service.	Stabilization of the system allows plants to mature before stressing the system with stormwater loading.

O&M Activities and Frequencies

Activity	Frequency
GENERAL INSPECTIONS	
Remove trash and debris	Four times per year during wet season, including inspection just before the wet season and within 24 hours after at least two storm events ≥ 0.5 inches.
Identify excess erosion or scour	
Identify sediment accumulation that requires maintenance	
Inspect during storm event, when possible, to estimate treatment capacity and determine if premature bypass is occurring	
Evaluate plant health and need for corrective action	
Identify any needed corrective maintenance that will require site-specific planning or design	
OPERATION AND MAINTENANCE	
• O&M of proprietary BMPs must follow established manufacturer guidelines • O&M of accompanying retention BMPs should follow the guidelines established in the associated fact sheet for that BMP.	

G.6 Biotreatment BMP without Infiltration Fact Sheets (BIO)

BIO-6: BIORETENTION WITH UNDERDRAIN

Category: Biotreatment

Also known as:
Biofiltration
Planter Box

This BMP is very similar to BIO-1, but is tailored to be located in conditions that do not support a significant level of infiltration or where infiltration must be avoided.



Source: Geosyntec Consultants

Fact Sheet BIO-1 should be the primary resource for guidelines about this BMP. Fact Sheet BIO-6 does not repeat this guidance; it only presents the specific differences that should be considered in design, construction, and O&M in cases where there is not appreciable infiltration.

There are three primary options for adapting the guidance from BIO-1 to serve in conditions where no appreciable level of infiltration is feasible.

No changes to BIO-1 - Where minor incidental infiltration is permissible from the perspective of risks, but does not occur in a significant rate, it is acceptable to simply design the system following the guidance in BIO-1. Standing water in the underdrains for an extended period is an acceptable design variation known as "Internal Water Storage." This configuration improves nutrient and bacteria removal. It can also result in minor volume reduction even in very tight soils.

Add liner to BIO-1 – Where infiltration must be avoided due to risk of impacts, an impermeable liner of some sort should be used. Continuing to provide aggregate storage layer and internal water storage, as included in BIO-1 is preferred due to pollutant removal benefits.

Eliminate internal water storage – In conditions not suitable for partial infiltration and do not have nutrients as a pollutant of concern, is is acceptable to eliminate the internal water storage zone. This can reduce the thickness of the gravel storage layer compared to BIO-1. It reduces the effectiveness of the BMP to remove nutrients (from M to L) and bacteria (from H to M).

Pollutant Removal Considerations

Configuration	Sediment	Phosphorus	Nitrogen	Metals	Bacteria	Oil & Grease	Organics
With Internal Water Storage	H	M	M	H	H	M	M
Without Internal Water Storage	H	L	L	H	M	M	M

Recommended Design Criteria and Considerations (only differences from BIO-1 are listed)

Aggregate Storage Layer – Internal Water Storage Configuration Only	
☐ The aggregate storage layer depth below the underdrain invert is a minimum of 18 inches of stone.	The intent of this layer is to provide treatment processes associated with an internal water storage zone.
Underdrain Aggregate Layer –No Internal Water Storage Configuration Only	
☐ The aggregate underdrain layer must provide at least 6 inches of cover on the top and sides of the underdrain pipe and 3 inches below the pipe	The intent of this layer is to provide treatment processes associated with an internal water storage zone.
☐ Underdrains, aggregate, and filter course material maybe located in trenches rather than over the entire bottom of the BMP.	Because volume reduction and/or internal water storage is not a goal, it is not necessary to provide a storage layer.
Impermeable Liner	
☐ Liner has a minimum thickness of 30 mils.	Minimizes tearing and penetration by aggregate or other protrusions.
☐ Liner is free of holes, blisters, undispersed raw materials, contamination by foreign matter, and other defects.	Minimizes facility stormwater loss and contamination.
☐ Liner withstands the range of temperature encountered by open exposure at the site without degradation or deterioration of the lining system.	Minimizes liner deterioration.
☐ Liner, and all other parts of the lining system in contact with liquid is resistant to stormwater pollutants including small concentrations of floating hydrocarbons such as hydraulic oil, diesel fuel, and gasoline.	Minimizes liner deterioration.
☐ Liner is bedded between appropriate material at least 6 inches above and below liner, or greater subject to manufacturer recommendations.	Appropriate bedding materials should be free of sharp objects and any objects larger than 1 inch in dimension. Sand, clean soil, and/or rounded pea gravel are typically appropriate bedding materials.
Observation Port	
☐ An observation port is not necessary for BIO-6.	It is not necessary to inspect the rate of drawdown of infiltration storage.

Calculations and Sizing Method

See **Appendix E** for acceptable sizing methods. Sizing calculations should not take credit for any amount of infiltration. The internal water storage zone should be assumed to be full and not included in sizing calculations.

Construction Guidance (only differences from BIO-1 are listed)

Construction Guidance	Intent/Rationale
☐ Same as BIO-1, except it is not necessary to protect the BMP location from compaction or construction-phase sedimentation. All other provisions from BIO-1 apply.	It is not necessary preserve infiltration capacity of underlying soils.

O&M Activities and Frequencies

No differences in O&M activities compared to BIO-1.

BIO-7: PROPRIETARY BIOTREATMENT

The fact sheet for proprietary biotreatment without supplemental retention is included as part of BIO-5. This page is just a placeholder to direct users to see BIO-5.

BIO-8: WET DETENTION BASIN

Category: Biotreatment (Treatment Control)

Also known as:
Wet Ponds
Retention Ponds

Wet detention basins do not meet the definition of biofiltration BMPs, so they are not considered LID BMPs for the purposes of fulfilling LID requirements. They may be used as treatment control BMPs or pretreatment BMPs.



Source: Geosyntec Consultants

Wet detention basins are constructed, naturalistic ponds with a permanent or seasonal pool of water (also called a "wet pool" or "dead storage"). Wet detention basins can be single-celled or two-celled to include a forebay and main basin. Wet ponds must be designed with outlet control to maintain a permanent pool. Stormwater enters the wet detention basin and displaces treated stormwater from the permanent pool, which discharges to the outlet, typically located at the opposite end of the basin (and in the second cell of a two-celled system). The effectiveness of pollutant removal capabilities in wet ponds depends greatly on the hydraulic residence time in the permanent pool. Detention storage ("live storage") can be designed above the permanent pool to provide flow control. Wet detention basins typically achieve little to no volume reduction because they are either lined or in very poorly draining soils in order to maintain the permanent pool. They can, therefore, be used to achieve full treatment of the required treatment volume for DMAs in which biotreatment is not feasible. Wet detention basins do not meet the required definition of biofiltration and may only be used for pretreatment or as a treatment control BMP.

Pollutant Removal Considerations

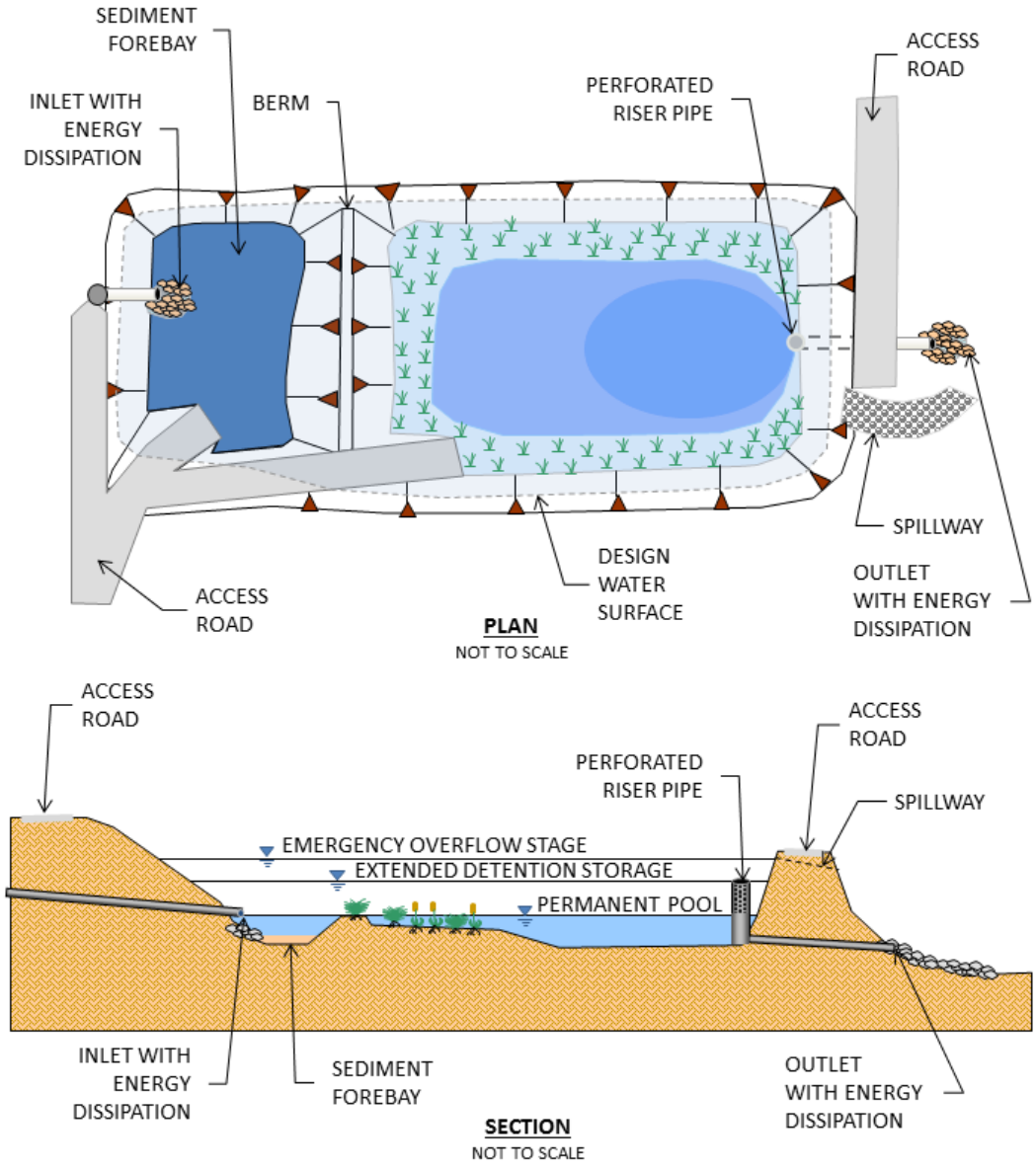
Sediment	Phosphorus	Nitrogen	Metals	Bacteria	Oil & Grease	Organics
H	M	M	H	M	M	M

Recommended Selection and Siting Criteria

Siting Criteria	Intent/Rationale
☐ Soil conditions and base inflow should support the establishment of a permanent pool for the duration of the wet season	The function of wet ponds requires that the permanent remains mostly full, at least during the wet season.
☐ Potable "make-up" water should not be required.	A design that relies on make-up water is generally not acceptable.

☐	Sediment sources are controlled prior to operation of the system.	Major sediment accumulation can interfere with operations and plant establishment
☐	Where seepage could result in risks, a liner should be used.	Continual seepage can result in significant quantities of water infiltrated.

Example Schematic Design - Section View



Recommended BMP Component Dimensions

BMP Component	Dimension	Intent/Rationale
Freeboard	≥ 1 foot (offline facilities) ≥ 2 foot (inline facilities)	Freeboard provides room for head over overflow structures and minimizes risk of uncontrolled surface discharge. Lower freeboard is allowable if there is an acceptable alternative overflow method.
Permanent Pool Depth	≥3 feet or at least half of overall depth	Allows for sediment accumulation. Providing approximately half of storage in permanent pool improves residence time.
Side Slopes	3H:1V or shallower	Gentler side slopes are safer, less prone to erosion, able to establish vegetation more quickly and easier to maintain.
Basin Length: Width Ratio	≥ 2:1 (3:1 preferred)	A larger length to width ratio provides a longer flow path to promote settling.

Recommended Design Criteria and Considerations

Design Criteria	Intent/Rationale
Forebay	
☐ If settling forebay is included (recommended), volume of forebay is ≥ 10% of facility volume.	An adequately sized forebay to trap sediment can decrease frequency of required maintenance.
Vector Management	
☐ A plan for vector management approach (e.g., mosquito) must be developed in consultation with the Orange County Mosquito and Vector Control District	This type of BMP can be a source of mosquitos if not properly designed, operated and maintained.
Extended Detention Storage (above Permanent Pool elevation)	
☐ Detention storage has a 36-48-hour drawdown time.	A 36 to 48-hour drawdown time is recommended to balance settling performance with the ability to treat back-to-back storms
Vegetation	
☐ For vegetation above the permanent pool elevation, an irrigation system with a connection to water supply should be provided, as needed.	Seasonal irrigation may be needed to ensure vegetation establishment and coverage.
☐ Vegetation should be tolerant of the conditions in the zone where it is planted. Native plant species and/or hardy cultivars that are not invasive and do not require chemical fertilizers or pesticides should be used to the maximum extent feasible.	Plants suited to the climate and ponding depth are more likely to survive.

Design Criteria	Intent/Rationale
Inflow and Outflow Structures	
☐ Inlets and outlets are positioned to maximize flow paths through the facility.	Facilitates increased hydraulic residence time (prevents short-circuiting of treatment).
☐ Inflow and outflow structures are accessible for inspection and maintenance.	Maintenance access is essential to ensure long-term performance.
☐ Outlet control structure is designed to achieve target water quality flow control using acceptable hydraulic design methods	Numerous acceptable methods are available,
☐ An overflow device is required at the top of the ponding depth to safely convey overflow to the downstream receiving system.	Planning for controlled overflow lessens the risk of property damage due to flooding.

Calculations and Sizing Method

See **Appendix E** for acceptable sizing methods. The permanent pool and extended detention storage may be counted as part of the treatment storage volume.

Construction Guidance

Construction Guidance	Intent/Rationale
☐ Plans should include a construction sequence for the BMP. Revisions proposed by the contractor should be reviewed by the engineer. The construction sequence should address erosion control, utilities, BMP installation, inspections, final grading, vegetation, stabilization, and post-construction monitoring.	Construction sequencing is critical to avoid issues/damage and allow appropriate inspections, testing, and certifications to be performed.
☐ Fully stabilize sources of sediment within the tributary area (i.e., no exposed soil) prior to placing the finished BMP into service.	Erosion and sedimentation can prematurely compromise sediment storage within the BMP.
☐ Allow plants to stabilize for as long as practicable (preferably several months) prior to placing the finished BMP into service.	Stabilization of the system allows plants to mature before stressing the system with stormwater loading.

O&M Activities and Frequencies

Activity	Frequency
GENERAL INSPECTIONS	
Identify eroded facility areas	Four times per year during wet season, including inspection just before the wet season and within 24 hours after at least two storm events ≥ 0.5 inches.
Identify needs to improve vector control if needed	
Estimate degree of sediment accumulation	
Identify areas of compromised plant health or density	
Identify any needed corrective maintenance that will require site-specific planning or design	
ROUTINE MAINTENANCE	
Sediment, Trash, and Debris	
Remove trash from facility	Each visit; as needed
Remove sediment from forebay when estimated sediment accumulation exceeds 25% of the forebay volume	As needed
Remove sediment from basin bottom when estimated sediment accumulation exceeds 10% of total volume.	As needed
Vegetation	
Irrigate as recommended by a landscape professional, typically for the first 3 years to establish vegetation	As needed
Remove undesirable vegetation	Four times per year during wet season, including inspection just before the wet season.
Reseed or replant areas of thin or missing vegetation	Annually
Remove algae mats when algae coverage is more than 20% of the water surface	As needed
Inflow and Outflow Structures	
Check energy dissipation function and add riprap, as needed	Four times per year during wet season, including inspection just before the wet season.
Inspect inlets and outlets and remove accumulated sediment	Four times per year during wet season, including inspection just before the wet season.
Repair structural damage to inlets and outlets	As needed
CORRECTIVE (MAJOR) MAINTENANCE	
Prepare documentation of issues and resolutions for review by appropriate parties; modify WQMP if needed.	Before major maintenance
Document major maintenance activities; record modified WQMP and as-built plan set if needed	After major maintenance
Take photographs before and after from the same vantage point	Before and after

BIO-9: CONSTRUCTED WETLAND

Category: Treatment Control (most configurations)

Also known as:
Stormwater Wetlands
Wetland Basins

Constructed wetlands, in most cases, do not meet the definition of biofiltration BMPs, so they are not considered LID BMPs for the purposes of fulfilling LID requirements. They may be used as treatment control BMPs. Subsurface-flow wetlands can meet the definition of biofiltration BMPs and may be used to fulfill LID requirements. These types of wetlands are not directly supported by this fact sheet but could be designed based on other design resources. They are not common in land development projects as they require a continual baseflow for proper function.



Source: Geosyntec Consultants

A constructed wetland is a system that mimics the processes within natural wetlands to provide treatment. Constructed treatment wetlands typically include components such as an inlet with energy dissipation, a sediment forebay for settling out coarse solids and to facilitate maintenance, shallow sections (1 to 2 feet deep) planted with emergent vegetation, deeper areas or micro pools (3 to 5 feet deep), and an outlet structure designed to maintain a permanent pool. The interactions between the incoming stormwater runoff, aquatic vegetation, wetland soils, and the associated physical, chemical, and biological unit processes are a fundamental part of constructed wetlands. Constructed wetlands can be used to treat the required treatment volume. Constructed wetlands that are not subsurface-flow wetlands do not meet the required definition of biofiltration and may only be used as a treatment control BMPs.

Pollutant Removal Considerations

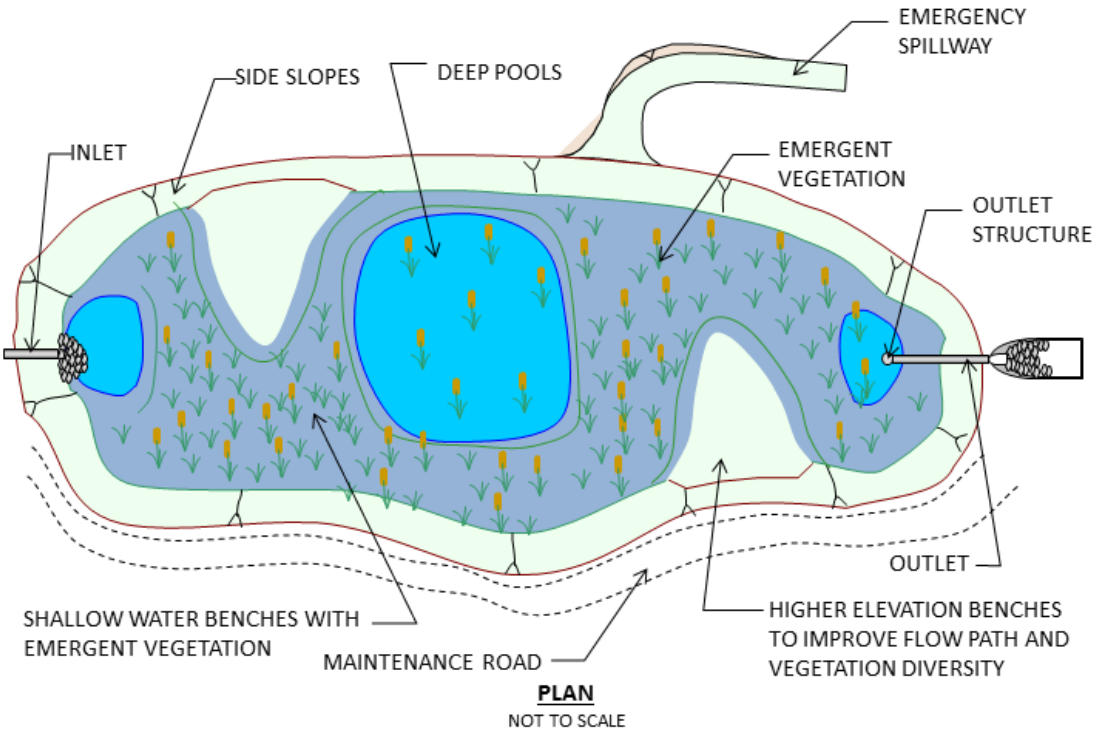
Sediment	Phosphorus	Nitrogen	Metals	Bacteria	Oil & Grease	Organics
H	M	H	H	H	M	M

Recommended Siting Criteria

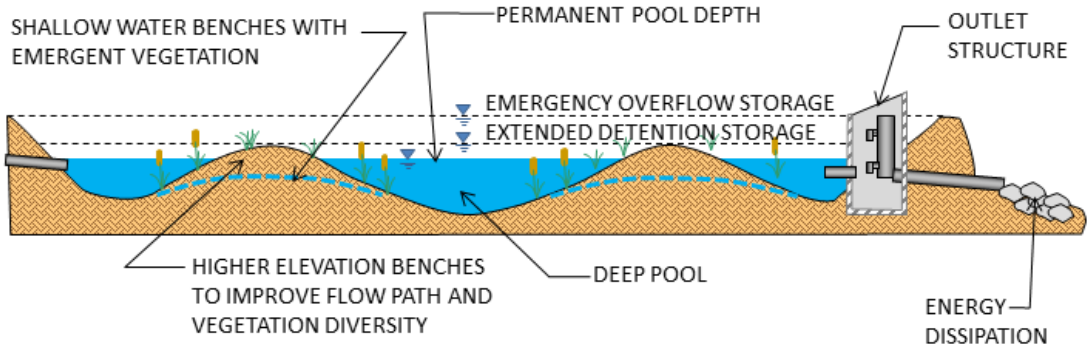
Siting Criteria	Intent/Rationale
☐ Soil conditions and base inflow should support the establishment of a permanent pool year-round.	The function of constructed wetlands requires that the permanent remains mostly full. It is possible that wetlands could be allowed to go seasonally dry, but this is not preferred.
☐ Potable "make-up" water should not be required.	A design that relies on make-up water is generally not acceptable.
☐ Sediment sources are controlled prior to operation of the system.	Major sediment accumulation can interfere with operations and plant establishment

☐	Where seepage could result in risks, a liner should be used.	Continual seepage can result in significant quantities of water infiltrated below normally-wet facilities.

Example Schematic Design – Plan and Section View



PLAN
NOT TO SCALE



SECTION
NOT TO SCALE

Recommended BMP Component Dimensions

BMP Component	Dimension	Intent/Rationale
Freeboard	≥ 1 foot (offline facilities) ≥ 2 foot (inline facilities)	Freeboard provides room for head over overflow structures and minimizes risk of uncontrolled surface discharge. Lower freeboard is allowable if there is an acceptable alternative overflow method.
Permanent Pool Depth	Vary between 4 to 6 feet for deeper pools and 2 to 4 feet for shallower areas	The intent is to provide a mix of emergent vegetation and deep water areas for varied treatment processes.
Side Slopes	3H:1V or shallower	Gentler side slopes are safer, less prone to erosion, able to establish vegetation more quickly and easier to maintain.
Basin Length: Width Ratio	≥ 2:1 (3:1 preferred)	A larger length to width ratio provides a longer flow path to promote settling and allow time for natural treatment processes to remove pollutants prior to discharge. Berms can also be used to increase flow path length.

Recommended Design Criteria and Considerations

Design Criteria	Intent/Rationale
Forebay	
☐ A deeper pool near the inlet can serve as a forebay and energy dissipation	This helps concentrate sediment removal efforts in a specific location.
Vector Management	
☐ A plan for vector management approach (e.g., mosquito) must be developed in consultation with the Orange County Mosquito and Vector Control District	This type of BMP can be a source of mosquitos if not properly designed, operated and maintained.
Permanent Pool	
☐ A natural shape and range of alternating, intermixed, irregular depths is recommended.	Enhances diversity of wetland vegetation and redox conditions which enhances the subsequent treatment capabilities.
☐ A wetland scientist or other appropriate discipline should review the design of the constructed wetland.	Wetlands are complex and require specialized experience to support design.
☐ A source of water during dry weather to sustain the wetland is necessary.	Sustained wetland vegetation and treatment are dependent on a continuous water source.
Extended Detention Storage (above Permanent Pool elevation)	
☐ If detention storage is provided, this storage has a 36-48-hour drawdown time.	A 36 to 48-hour drawdown time is recommended to balance settling performance with the ability to treat back-to-back storms

Design Criteria	Intent/Rationale
Vegetation	
☐ For vegetation above the permanent pool elevation, an irrigation system with a connection to water supply should be provided, as needed.	Seasonal irrigation may be needed to ensure robust vegetative processes in relatively coarse grained media material.
☐ Wetland plantings should be selected by a wetland scientist or other appropriate discipline, specific to each zone of the wetland. Plants should be native or non-invasive.	Plants suited to the climate and ponding depth are more likely to survive.
Inflow and Outflow Structures	
☐ Inlets and outlets are positioned to maximize flow paths through the facility.	Facilitates increased hydraulic residence time (prevents short-circuiting of treatment).
☐ Inflow and outflow structures are accessible for inspection and maintenance.	Maintenance access is essential to ensure long-term performance.
☐ An overflow device is required at the top of the ponding depth to safely convey overflow to the downstream receiving system.	Planning for controlled overflow lessens the risk of property damage due to flooding.

Calculations and Sizing Method

See **Appendix E** for acceptable sizing methods. The permanent pool and extended detention storage may be counted as part of the treatment storage volume.

Construction Guidance

Construction Guidance	Intent/Rationale
☐ Plans should include a construction sequence for the BMP. Revisions proposed by the contractor should be reviewed by the engineer. The construction sequence should address erosion control, utilities, BMP installation, inspections, final grading, vegetation, stabilization, and post-construction monitoring.	Construction sequencing is critical to avoid issues/damage and allow appropriate inspections, testing, and certifications to be performed.
☐ Conduct earthwork in dry weather, or at least 48 hours after the end of rainfall.	Wetter soil is typically more susceptible to compaction, which can negatively impact plant establishment
☐ Fully stabilize sources of sediment within the tributary area (i.e., no exposed soil) prior to placing the finished BMP into service.	Erosion and sedimentation can sacrifice sediment storage within the BMP.
☐ Allow plants to stabilize for as long as practicable (preferably several months to a year) prior to placing the finished BMP into service.	Stabilization of the system allows plants to establish before stressing the system with stormwater loading.

O&M Activities and Frequencies

Activity	Frequency
GENERAL INSPECTIONS	
Identify eroded facility areas	Four times per year during wet season, including inspection just before the wet season and within 24 hours after at least two storm events ≥ 0.5 inches.
Identify needs to improve vector control if needed	
Estimate degree of sediment accumulation	
Identify areas of compromised plant health or density	
Identify any needed corrective maintenance that will require site-specific planning or design	
ROUTINE MAINTENANCE	
Sediment, Trash, and Debris	
Remove trash from facility	Each visit; as needed
Remove sediment from forebay when estimated sediment accumulation exceeds 25% of the forebay volume	As needed
Remove sediment from basin bottom when estimated sediment accumulation exceeds 10% of total volume.	As needed
Vegetation	
Irrigate as recommended by a landscape professional, typically for the first 3 years to establish vegetation	As needed
Remove undesirable vegetation	Four times per year during wet season, including inspection just before the wet season.
Replant or reseed areas of thin or missing vegetation	Annually
Remove algae mats when algae coverage is more than 20% of the water surface	As needed
Inflow and Outflow Structures	
Check energy dissipation function and add riprap	Four times per year during wet season, including inspection just before the wet season.
Inspect inlets and outlets and remove accumulated sediment	Four times per year during wet season, including inspection just before the wet season.
Repair structural damage to inlets and outlets	As needed
CORRECTIVE (MAJOR) MAINTENANCE	
Prepare documentation of issues and resolutions for review by appropriate parties; modify WQMP if needed.	Before major maintenance
Document major maintenance activities; record modified WQMP and as-built plan set if needed	After major maintenance
Take photographs before and after from the same vantage point	Before and after

BIO-10: BIOTREATMENT BMPS WITH IMPERVIOUS LINER

Any of the biotreatment BMPs which include partial infiltration (BIO-1 through BIO-5) can be retrofitted for a No Infiltration condition by including an impervious liner below the BMP to prevent infiltration. Any biotreatment BMP must still meet the definition of biofiltration BMP to be used to fulfill LID requirements.

G.7 Treatment Control BMP Fact Sheets (TRT)

TRT-1: SAND FILTER

Category: Treatment Control BMP

Also known as:
Media Bed Filter



Source: CASQA Stormwater BMP Handbook

A sand filter operates by filtering stormwater through a constructed sand bed with an underdrain system. Runoff enters the filter and spreads over the surface. Sand filter beds can be enclosed within concrete or eathen containment. As flows increase, water backs up on the surface of the filter where it is held until it can percolate through the sand. The treatment pathway is downward (vertical) through the media to an engineered underdrain system that is connected to the downstream storm drain system. As stormwater passes through the sand, pollutants are trapped on the surface of the filter, in the small pore spaces between sand grains, or are adsorbed to the sand surface. Because a sand filter lacks vegetation and the assoicated biologial processes and provides little to no volume reduction, it is a treatment control BMP, not an LID BMP. Treatment control BMPs can be used as pretreatment for other BMPs or to fulfill pollutant removal requirements, but cannot be used as standalone BMPs to fulfill LID requirements. See Section 3 of the Model WQMP for details.

Sand filters have limited role in WQMPs for typical sites. A detailed fact sheet is not provided. Other design references may be used to support sand filter design should a project determine that a sand filter is appropriate.

Pollutant Removal Considerations

Sediment	Phosphorus	Nitrogen	Metals	Bacteria	Oil & Grease	Organics
H	M	M	M	M	M	M

TRT-2: PROPRIETARY TREATMENT CONTROL BMPS

Category: Treatment Control BMP

Proprietary treatment controls BMPs are proprietary devices that are manufactured to treat stormwater. They do not meet the criteria to be biotreatment. These BMPs can take many different forms depending on the manufacturer, but usually include filtration through engineered, proprietary media mixes and/or filtration through cartridge filters. **Acceptance criteria for proprietary treatment control BMPs are defined in Appendix J**. Proprietary BMPs that do not meet these acceptance criteria are not permitted.

Treatment control BMPs can be used to fulfill pollutant removal requirements and can be used as pretreatment for LID BMPs, but cannot, alone, be used to meet LID requirements. Section 3 of the Model WQMPs provides further details.

Because there are so many different potential types of proprietary treatment control BMPs, this fact sheet provides only general guidance. Specific guidance including pollutant removal, design considerations, construction guidance, and O&M activities is provided by the manufacturer.

Pollutant Removal Considerations

BMPs that meet the acceptance criteria in Appendix J are considered to provide adequate treatment for pollutants of concern. According to these critera, there are different levels of treatment certification needed for different pollutants of concern.

Recommended Design Criteria and Considerations

	Design Criteria	Intent/Rationale
☐	Sediment sources should be controlled prior to operation of the system.	Proprietary systems are susceptible to clogging similar to other BMPs. Systems should not be used in areas that will continue to receive elevated sediment loading following construction, such as from open space area.
☐	Proprietary treatment control systems typically do not require separate pretreatment	These BMPs typically include integrated mechanisms for pretreatment.
☐	Proprietary treatment control BMPs must be designed in a manner consistent with manufacturer recommendations and consistent with the design configuration that was tested as part of the BMP certification	Proprietary devices have device-specific design, installation, and maintenance details which must be followed for proper treatment results.

Calculations and Sizing Method

Proprietary Treatment Control BMPs are flow-based BMPs with specific sizing requirements separate from biofiltration BMPs. See **Appendix E** for acceptable sizing methods.

Construction Guidance

Construction Guidance	Intent/Rationale
☐ Plans should include a construction sequence for the BMP. Revisions proposed by the contractor should be reviewed by the engineer. The construction sequence should address erosion control, utilities, BMP installation, inspections, testing and certifications, stabilization, and post-construction monitoring.	Construction sequencing is critical to avoid issues/damage and allow appropriate inspections, testing, and certifications to be performed.
☐ Provide for inspection of buried infrastructure (e.g., underdrain, filter course) before it is buried.	It is impractical to inspect buried elements once they are covered.
☐ Fully stabilize sources of sediment within the tributary area (i.e., no exposed soil) prior to placing the finished BMP into service.	Sediment loading can seriously impair the capacity of the BMP.

O&M Activities and Frequencies

Activity	Frequency
GENERAL INSPECTIONS	
Remove trash and debris	Four times per year during wet season, including inspection just before the wet season and within 24 hours after at least two storm events ≥ 0.5 inches
Identify excess erosion or scour	
Identify sediment accumulation that requires maintenance	
Inspect during storm event, when possible, to estimate treatment capacity and determine if premature bypass is occurring	
Identify any needed corrective maintenance that will require site-specific planning or design	
OPERATION AND MAINTENANCE	
O&M of proprietary treatment control BMPs must follow established manufacturer guidelines	

APPENDIX H. TECHNICAL BASIS FOR GREEN ROOF DESIGN CRITERIA

The purpose of this appendix is to present minimum criteria for green roofs (roofs with growing media and vegetation) to be considered "self-retaining" for new development and significant redevelopment projects in Orange County. Self-retaining areas are designed to retain the DCV and no further management of these areas is required to meet LID and treatment control performance criteria. This category also includes brown roofs, which are designed with vegetation intended to go seasonally dormant during dry periods. This document describes the functional definition of "self-retaining" that has been applied to green roofs, presents an overview of the analytical methods used to evaluate performance of a range of design criteria, and presents the results of this analysis in terms of the minimum design criteria for green roofs to be considered self-retaining.

H.1 Functional Definition of "Self-Retaining" for Green roofs

HSCs are group of low-tech stormwater management measures that reduce stormwater runoff volume through landscape dispersion and interception of stormwater. As described above, if an HSC is to be considered "self-retaining," it should fully retain the volume from the LID design storm event.

Green roofs are a form of HSC. These systems reduce stormwater runoff volume by retaining a portion of rainfall in soil pores and surface and plant depression storage during storm events and making it available for subsequent ET. Green roofs also provide biotreatment/ biofiltration of water draining through and over roofs, removing pollutants deposited from the atmosphere or from adjacent transportation land uses. Finally, green roofs can have additional benefits beyond stormwater management, including reductions in building heating and cooling costs and reductions in urban heat island effects. As such, green roofs should be encouraged where they can provide appreciable benefit for stormwater management. They do require irrigation, so their effects on water demand should be considered. In addition, green roofs may use reclaimed water for irrigation and measures may be required to mitigate the risk of discharges leaving the site. Green roofs are considered to be self-retaining on the basis that they provide the maximum feasible area for ET and provide biotreatment for the remaining portion of the DCV. Ground-level LID BMPs must still be provided for ground level drainage areas, where feasible, and optionally can be sized to provide additional volume reduction and biotreatment of runoff from green roofs.

The volume reduction potential of green roofs is relatively limited in the southern California climate because of typical patterns of precipitation and ET: during winter months when the majority of rainfall occurs, and particularly during the typical short periods of back-to-back rainfall events, ET rates are relatively low, and pore space is recovered relatively slowly. As

such, it is not generally possible for green roofs to provide reliable reduction of the entire DCV within the timeframe criteria applied to other HSCs. To recognize this limitation and still encourage the use of these system, a green roof would be considered to be "self-retaining" (i.e., requiring no other stormwater mitigation measures for the DCV) if the roof retains at least 40 percent of average long term precipitation volume and biotreats the remaining volume.

H.2 Analysis Inputs

To determine the minimum design criteria for a green roof to be considered self-retaining, a simple modeling analysis of precipitation, ET patterns, and green roof design parameters was conducted. This analysis included the following inputs:

- **60 year of hourly precipitation data** from the NCDC Los Angeles International Airport (LAX) climate station (COOP ID: 045114)[10]. The average annual precipitation at LAX is 12 inches, which is approximately the same as observed over much of Orange County, therefore this analysis is applicable to Orange County.
- **Monthly normal reference ET data** from the NCDC Cooperative Summary of the Day at LAX (COOP ID: 045114) (See note **10**).
- **Ranges of green roof extensiveness.** Extensiveness is defined as the ratio of the area covered by green roof to the area tributary to the roof (including the roof itself). Extensiveness has a maximum of 1.0. For the study, extensiveness varied from 0.5 (half the roof occupied by green roof with the remaining area draining to the green roof) to 1.0 (the full roof covered by the green roof, or the green roof portion not receiving any "run-on" from other areas).
- **Ranges of landscape coefficients.** The landscape coefficient (K_L) is a multiplier on the ET rate that accounts for the plant species, micro climate (exposure, etc.), and the density of vegetative cover. For the study, landscape coefficients of 0.5 and 0.75 were evaluated, representing low water use species and moderate water use species, respectively. Landscape coefficients are generally believed to be higher on roof tops than for ground-level landscaping because of high exposure to sun and wind. It is not recommended that high water use species be used in green roofs because of the high irrigation demand exerted during summer months and winter dry periods.
- **Ranges of soil moisture retention depth.** Green roof moisture retention depth is the equivalent depth of water that a green roof can hold long enough for ET to have an appreciable effect. For engineered extensive or intensive roofs, this is defined as the field capacity (FC, the volumetric water content retained in soil after a prolonged period of

[10] This analysis was prepared from data originally developed for another Geosyntec project; therefore different input data sources have been used than were used for other analyses described in this TGD. The input data used for this analysis is believed to be representative of Orange County and differences are very likely within the range of model sensitivity/uncertainty.

draining) minus the wilting point (WP, the lowest volumetric water content that can be achieved via plant transpiration processes). This is generally 15 to 20 percent of the actual thickness of the green roof, depending on the characteristics of the growing media. Some proprietary green roof systems utilized specialized light weight media with enhanced soil moisture retention properties or synthetic materials such as plastic cup layers and wicking materials. These systems are generally specified in terms of the effective depth of water they retain (i.e., the soil moisture retention depth). Soil moisture retention depth was varied from 0 up to 4 inches for this study, representing simple green roofs up to approximately 30 inches deep.

H.3 Analysis Methods

For the purpose of this analysis, Geosyntec developed a model written in VBA (Excel) that incorporates the inputs described above on an hourly basis and tracks the transient storage contained in soil moisture storage. The model can best be thought of as physically representing a bucket of water, where the water level in the bucket corresponds to the amount of moisture held in the green roof soil. Precipitation is applied over the roof and other areas tributary to the roof at hourly time steps corresponding to historical records. When the capacity of the soil moisture layer is exceeded, runoff occurs. During and between events, the monthly normal ET rate is applied to the stored water to recover the storage in the soil moisture layer (i.e., empty the bucket). The precipitation and runoff is tracked and totaled for the model run, yielding the average fraction volume removed.

H.4 Results

Results are presented in terms of the soil moisture retention depth required to achieve at least 40 percent reduction in volume. Results are presented in Table H-1. Graphical output of model results is shown in Figure H-1 and **Figure H-2**, and are expressed in terms of landscape coefficient. The landscape coefficient describes the fraction of reference ET that can be assumed to be evapotranspired for a given plant palette. The higher the landscape coefficient, the shallower the depth of the green roof needs to be to achieve 40 percent retention. This would be expected, since water lost to ET is retained (does not run off) and higher landscape coefficient increases the rate of ET. Likewise increasing the extensiveness of a roof has the same effect, since larger green roof surface area per unit of stored volume yields faster moisture recovery rates.

It should be noted that when designing a green roof, consideration should be given to summer irrigation demands as well as wet season performance. While a higher landscape coefficient and more extensive area would theoretically increase wet season performance, this would also tend to increase irrigation demand during the dry season and during dry periods of the wet season.

Table H-1: Green Roof Moisture Retention Depth Required for 40 Percent Volume Reduction, Los Angeles/Orange County

Landscape Coefficient (K_L) = 0.5						
Extensiveness	0.5	0.6	0.7	0.8	0.9	1.0
Minimum Required Moisture Retention Depth, inches	1.3	1.05	0.9	0.8	0.7	0.6
Typical Soil Depth Required to Provide Minimum Moisture Retention Depth(FC - WP = 0.15)	8.7	7.0	6.0	5.3	4.7	4.0
Landscape Coefficient (K_L) = 0.75						
Extensiveness	0.5	0.6	0.7	0.8	0.9	1.0
Minimum Required Moisture Retention Depth, inches	0.9	0.75	0.65	0.55	0.5	0.45
Typical Soil Depth Required to Provide Minimum Moisture Retention Depth(FC - WP = 0.15)	6.0	5.0	4.3	3.7	3.3	3.0

K_L = Landscape Coefficient; WP = soil wilting point; FC = soil field capacity

Figure H-1: Green Roof Performance Relationships for Los Angeles and Orange County, Landscape Coefficient (KL) = 0.5 (Low water use plant palette)

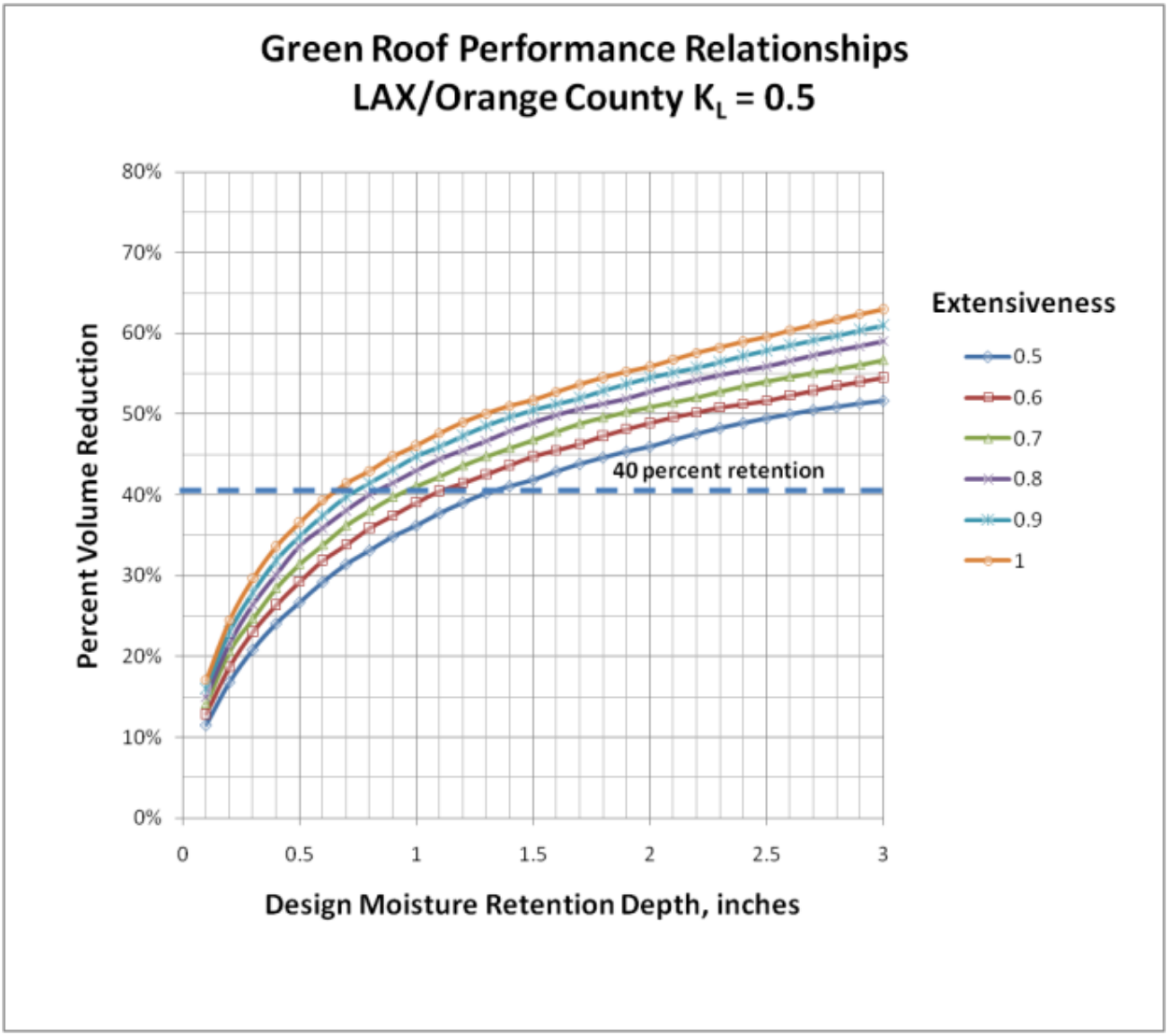
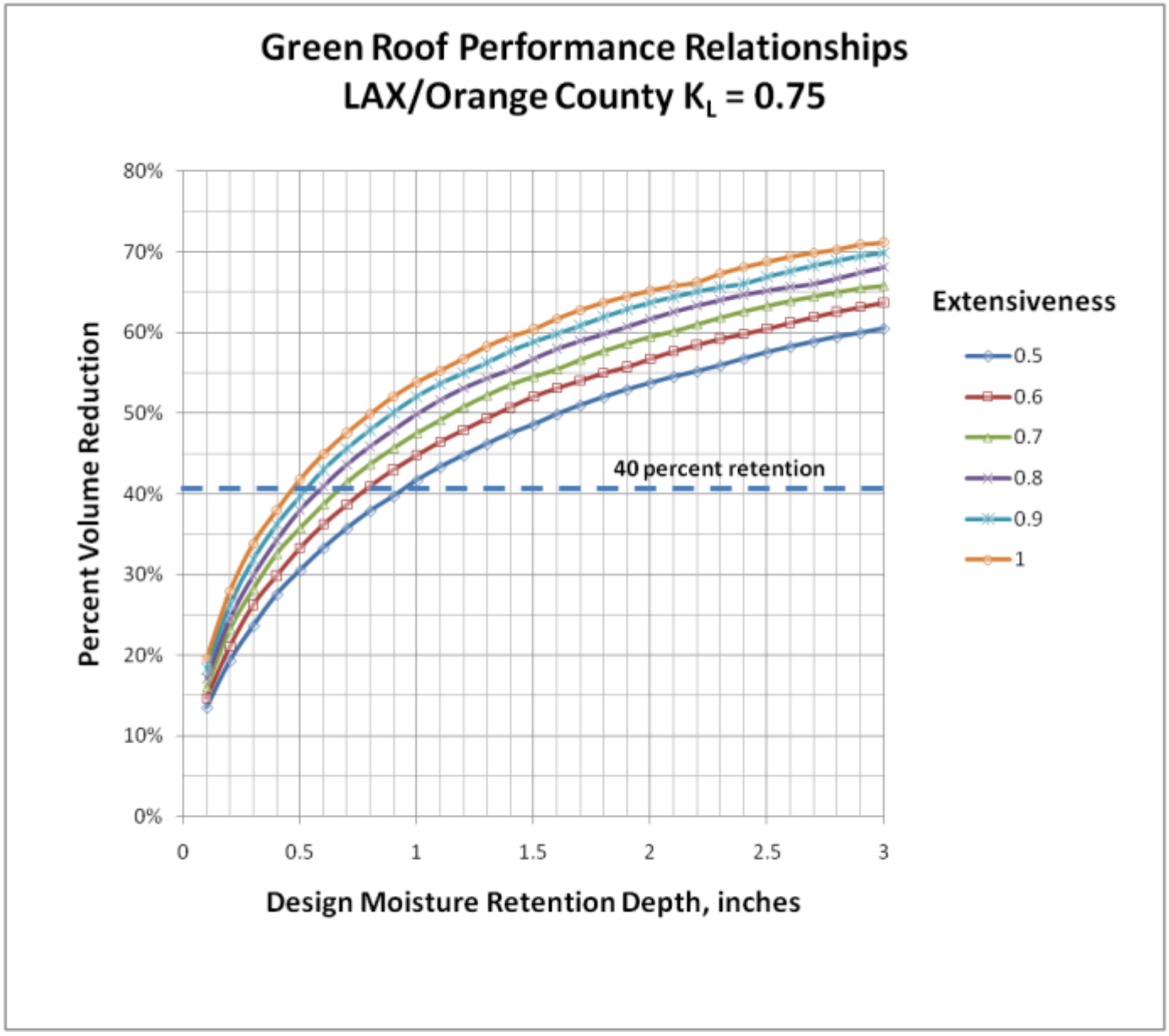


Figure H-2: Green Roof Performance Relationships for Los Angeles and Orange County, Landscape Coefficient (K_L) = 0.75 (Moderate water use plant palette)



APPENDIX I. GUIDELINES FOR USE OF DRY WELLS IN STORMWATER MANAGEMENT APPLICATIONS

I.1 Introduction

I.1.1 Purpose

A dry well is a type of stormwater management best management practice (BMP). Most stormwater dry wells are also categorized as a type of regulated injection well, which results in certain limitations and requirements related to their use. Existing federal, state and local standards related to injection wells do not distinguish between dry wells serving as stormwater management features from other types of injection well. This creates certain contradictory requirements in existing statutes related to dry well design and operation. However, this is not interpreted to preclude their use.

The purpose of this document is to provide guidelines for use of dry wells as a stormwater BMP for land development projects and stormwater retrofits in Orange County, California in the areas covered by the South Orange County MS4 Permit.

I.1.2 Description of Dry Wells as Stormwater Management BMPs

Dry wells consist of an excavated pit, typically lined with a perforated casing and filled with stone, that receives gravity drainage from stormwater piping. During precipitation, the void space in the stone serves as a storage reservoir to detain and equalize stormwater inflows. Stormwater infiltrates from the system into the surrounding soils through bottom and walls of the facilities. As such the system has dynamic storage and loss mechanisms that vary with storm size and intensity. There is no specific ratio of infiltration loss rate versus storage volume that defines a dry well, however volumes tend to be relatively small compared to loss rates and system tend to operate mostly like a "flow-based" BMP. When the storage volume is full and inflow rates exceed infiltration loss rates, the system bypasses water to the downstream conveyance system. A pretreatment and/or isolation system can be an integral element of a dry well design or can be provided separately via an upstream treatment system. Dry wells can be used in combination with other stormwater management approaches, such as being connected to the underdrain discharge of a bioretention area to improve retention of stormwater. Dry wells can be designed to provide infiltration into near-surface soils, or can be designed to infiltrate into deeper soil strata. By definition, the bottom of a dry well is located above the water table. Figure I-1 illustrates the basic elements of a dry well. Actual designs vary and do not necessarily include all elements.

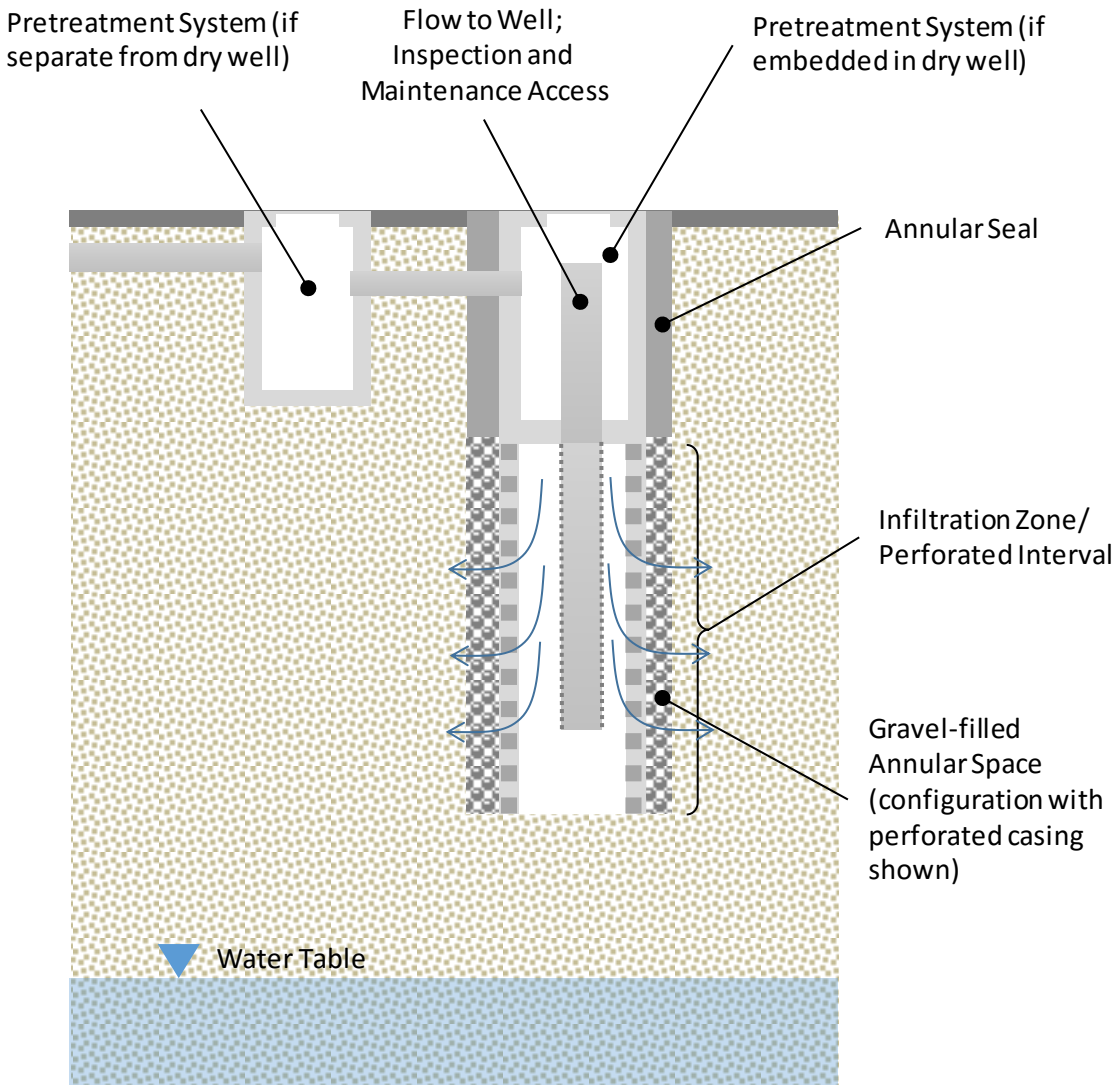


Figure I-1. Conceptual Diagram of Dry Well Components

I.1.3 Regulatory Setting and Definition

Dry wells for stormwater management are subject to federal, state, and local requirements, including:

- U.S. Environmental Protection Agency (US EPA) Underground Injection Control (UIC) regulations
- California Department of Water Resources (CA DWR) Well Standards (Bulletin 74-81)
- Orange County Well Ordinance (No 2607, Article 4-5-14 through 4-5-31 of Orange County Code)
- South Orange County MS4 Permits and associated implementing documents including the Model Water Quality Management Plan and the Technical Guidance Document.

I.1.3.1 USEPA UIC Definitions and Regulations

Dry wells for stormwater drainage are identified by USEPA as a subtype of Class V injection wells. In order to be classified as Class V injection well, the well must: (1) serve lots other than an individual single-family homes, and (2) the system must be defined as a "well" per the Code of Federal Requirements (CFR). BMPs that do not meet these definitions are not subject to USEPA UIC requirements.

> *Well means: A bored, drilled, or driven shaft whose depth is greater than the largest surface dimension; or, a dug hole whose depth is greater than the largest surface dimension; or, an improved sinkhole; or, a subsurface fluid distribution system. (40 CFR 144.12)*
>
> *A subsurface fluid distribution system means an assemblage of perforated pipes, drain tiles, or other similar mechanisms intended to distribute fluids below the surface of the ground. (40 CFR 144.3)*

The US EPA has set forth the following minimum requirements for Class V wells:

- Register injection wells at www.epa.gov/region09/water/groundwater/injection-wells-register.html
- Operate injection wells in a way that will not endanger underground sources of drinking water.
- Abandoned Class V wells should be properly destroyed, with notification to the US EPA, to prevent movement of contaminated fluids into underground sources of drinking water.

The US EPA has no design requirements for dry wells; that responsibility is left to local authorities.

I.1.3.2 California Well Standards (Bulletin 74-81)

The DWR well water regulations (Bulletin 74-81) can be interpreted to have applicability to stormwater infiltration through dry wells, however standards specific to stormwater infiltration are not contained in these regulations. Bulletin 74-81 includes specific designs standards for well construction, but does not specifically describe standards applicable for dry well construction. General water well design standards are specifically intended to prevent surface water from entering wells, which is essentially the process that dry wells are designed to perform. Therefore, there unavoidable contradictions in applying Bulletin 74-81 to dry wells. Bulletin 74-81 specifically notes (Chapter 2, Section 5):

> "Special standards are necessary for the construction of recharge or injection wells, horizontal wells and other unusual types of wells. Design of these wells is subject to the approval of the enforcing agency."

Therefore, application of California Well Standards to stormwater dry wells requires discretion of the Orange County Health Officer.

I.1.3.3 Regional Water Quality Control Boards - MS4 Permits

The Regional Water Quality Control Boards have authority to prescribe requirements related to discharge to waters of the state, including groundwater. The South Orange County MS4 Permits contain specific criteria related to protection of groundwater quality from impacts associated with stormwater infiltration. These criteria are implemented at a local level through the Model WQMP and TGD and local implementing ordinances.

I.1.3.4 Orange County Well Ordinance

The Orange County Well Ordinance (County Ordinance No. 2607) implements the California Well Standards at a local level. This ordinance requires that a permit be obtained prior to the construction or destruction of any well. In unincorporated Orange County and all South Orange County cities except San Clemente, the Orange County Health Officer is responsible for enforcement of the well ordinance. In San Clemente, well ordinances are enforced by city personnel.

The Ordinance establishes the Well Standards Advisory Board with specific composition and responsibilities. Among these responsibilities, Well Standards Advisory Board may determine the types of wells covered by the Ordinance, provide advice and concurrence with local modifications of the standards described in DWR Bulletin 74, hear testimony related to public nuisances or permitting issues, and other responsibilities.

The Well Standards Advisory Board has directed the County of Orange to prepare the guidelines contained in this Appendix as part of TGD to clarify design standards and review process for the use of dry wells in stormwater management applications.

I.1.4 Intended Applicability of these Guidelines

These guidelines are specifically intended to apply to vertical drilled or dug stormwater dry wells that receive municipals stormwater runoff and are classified as Class V injection wells. Specifically, these guidelines apply where the depth of the well is deeper than the longest plan view surface dimensions. These guidelines are not intended to be used in conformance with individual or general NPDES permits (e.g., industrial general permit, individual NPDES permit) besides the MS4 Permits.

These guidelines are not intended to apply to BMPs that are more appropriately classified as INF-1 (Infiltration Basin), INF-2 (Infiltration Trenches), INF-3 (Bioretention without Underdrains), INF-5 (Permeable Pavement) or INF-6 (engineered infiltration chambers or gravel infiltration beds). The current framework for project development and approval that is provided in the Model WQMP and TGD is adequate to guide the design and construction of these facilities in a manner protective of groundwater quality.

I.2 Underlying Performance Standards

Stormwater dry wells must be designed, constructed, and maintained to meet he following performance standards:

- Dry wells may only be used in cases where the combination of drainage area conditions and pretreatment results in a low level of potential for long term clogging.
- Dry wells must provide verified (full scale-tested) and sustained infiltration capacity equal to or exceeding the required stormwater management design capacity.
- Dry wells must be sited, designed and operated only in ways that:
    - Pose no significant risk of contamination of groundwater from contaminants in stormwater.
    - Have no reasonable potential for contaminant spills to enter dry wells.
    - Pose no significant risk of mobilizing or moving existing sources of contamination in soil or groundwater.
    - Pose no significant risk of damage to on-site or off-site infrastructure related to change in water table or soil moisture (e.g., geotechnical issues).
- Dry wells must be designed to allow inspection of infiltration capacity and identification of the presence of conditions of nuisance or contamination.

Guidelines for selection, siting, design and construction to satisfy these performance standards are described in the following sections. Minor variations from these standards that are

demonstrated by the project applicant provide equivalent performance relative to each of these performance standards may be acceptable.

I.3 Guidelines for Selection and Siting of Dry Wells as Stormwater BMPs

This section provides guidelines for how dry wells should be considered during the phase of the project in which overall site conditions are investigated and BMPs are selected.

I.3.1 Feasibility Criteria

The location of the proposed dry well must be categorized as feasible for full infiltration based on the criteria described in Section 4.2 and the appendices referenced from this section. Feasibility categorization must consider infiltration rate, groundwater elevation, potential for groundwater-related issues, and potential for geotechnical issues.

In addition, the following criteria apply specifically to evaluating the feasibility of dry wells as full infiltration BMPs:

- The drainage area shall not contain any of the following land uses:
  - Roads greater than 25,000 ADT
  - Heavy and light industrial pollutant source areas
  - Truck routes that include truck traffic from industrial sites or industrial portions of the site
  - Automotive repair shops
  - Car washes
  - Fleet storage areas
  - Nurseries, agriculture, and heavily managed landscape area with extensive use of fertilizer
  - Fueling stations
- No deviation from a minimum 10-foot separation to seasonally high mounded groundwater shall be allowed under any condition.
- Where depth to first groundwater is 15 feet or less below the bottom of the dry well, an analysis of potential groundwater mounding shall be conducted.
- Where dry wells exceed 25 feet in depth, the minimum separation to seasonally high groundwater shall be 15 feet to account for greater uncertainty in groundwater table and subsurface conditions.

Consultation with the applicable groundwater management agency (usually San Juan Basin Authority) is mandatory for dry wells. This will be facilitated by the reviewing agency as part of the Project WQMP review process.

I.3.2 BMP Selection Hierarchy

Dry wells are categorized as full infiltration BMPs, which is the highest priority LID BMP category. However, within the full infiltration BMP category, other BMP types should be first evaluated for feasibility, including:

- Hydrologic source control BMPs
- Bioretention without underdrains
- Permeable pavement
- Infiltration basins

These BMPs should be evaluated as a higher priority because of the following preferred attributes of these BMPs in comparison to dry wells:

- Deficiencies in operational conditions (e.g., infiltration loss rate) and/or the presence of contamination of the system can be more readily observed and can be abated without requiring as significant of reconstruction efforts.
- These BMP types more often infiltrate into soils that are within the surface horizon, typically providing greater pollutant attenuation capacity than subsurface soil horizons.
- Soil conditions can be determined with greater certainty in near-surface horizons than deeper subsurface horizons due to the wider range of investigation methods available.
- These BMP types tend to be less susceptible to long term clogging for various reasons:
    - A layer of amended media, mulch, and/or sacrificial sand layer combined with the presence of vegetation tends to reduce the susceptibility to clogging in bioretention and infiltration basins
    - A relatively large effective footprint area (compared to tributary area) reduces susceptibility of clogging (applies primarily to HSCs and permeable pavement)
- Adaptation of BMP designs can be made within the same BMP footprint if actual infiltration conditions are different than estimated. It is acknowledged that dry wells can also provide adaptability in design by drilling deeper systems or adding additional wells.
- These BMP types do not trigger well requirements, registration, and associated administrative burdens on the County and/or Copermittees.

Where the preferred infiltration BMPs listed above are not appropriate for a site, dry wells should be considered at a similar level of priority as the following BMPs:

- Underground infiltration chambers
- Infiltration trenches

This priority is intended to guide BMP consideration, but is not a specific MS4 Permit requirement and reviewer discretion on a case-by-case basis is appropriate.

I.4 Design and Construction Standards

This section provides guidelines for sizing and design of dry wells to support the development of specific design and construction plans.

I.4.1 Determining Required Design Capacity

The following criteria apply to determining the required design flowrate or volume of dry wells to satisfy stormwater management criteria:

- Dry wells shall be sized using either volume-based or flow-based methods to result in capture and infiltration of 80 percent of average annual runoff volume. Applicable methods include:
    - Appendix E.3.1: Simple DCV Method. The DCV is provided in detention storage and drained by the dry wells within 48 hours
    - Appendix E.3.2: Volume-based Capture Efficiency by Nomograph Method. The combination of storage volume and drawdown rate results in 80 percent capture of long term runoff.
    - Appendix E.3.7: Flow-based Capture Efficiency by Nomograph Method. Dry wells are sized as a flow-based BMP with a pretreatment and infiltration discharge rate adequate to capture 80 percent of average annual runoff.

  Minor adaptations of the sizing methods and worksheets in these appendices can be used for dry wells.
- Where dry wells will also be used as part of meeting hydromodification criteria (hydrologic conditions of concern), larger sizing or alternative analysis methods may be needed.
    - Model the dry well in the South Orange County Hydrology Model to evaluate conformance to flow duration control criteria.
- In any case, pretreatment shall be sized to treat the maximum flowrate that can enter the dry well such that no influent may ever enter the dry well without effective Pretreatment.
- An off-line configuration or system within internal bypass for flows above design flows is strongly encouraged.

I.4.2 Determining Rated Design Capacity

The following criteria apply to investigating the rate of infiltration and the associated capacity of dry wells as part of developing final designs. This may require additional investigation beyond what was needed in BMP selection and feasibility screening.

- The design infiltration rate used in sizing calculations must be determined based on infiltration testing at the location of each dry well. [Note: If an infiltration test is to continue more than 24 hours for "open" boreholes or test casing wells, then a well construction permit application is required for testing.]

- Borehole tests (Constant Head Well Permeameter[11], USBR 7300-83, or approved equivalent) are the preferred method to investigate infiltration rates for dry well sizing as the have a similar geometry to the final proposed dry well. Acceptable borehole tests are also identified in Appendix D.
- Borehole tests shall have a screened interval reasonably consistent with the proposed screened interval of the dry well (although it is recognized that minor differences may occur between testing and design).
- Borings must be logged and interpreted to at least 15 feet below the bottom elevation of the dry well to determine if borehole testing is representative of performance under full scale conditions.
- For cylindrical dry well applications, results of borehole tests (i.e., loss rate per unit area of wall) can be scaled up to the proposed wall area of the dry well. It is a more direct method of interpretation rather than converting results to a 1-dimensional infiltration rate and then applying this rate back to the three-dimensional dry well case.
- Where dry wells will be spaced closer than 20 feet on-center, an analysis of potential interaction between infiltration processes in adjacent dry wells shall be conducted and an appropriate reduction in effective capacity shall be incorporated into sizing. Alternatively, simultaneous full scale testing can be conducted or an additional factor of safety of 1.5x may be included in design calculations.
- A minimum factor of safety of 2.0 shall be applied to dry well capacity when converting from borehole measurements to dry well capacity. This factor of safety, or a higher factor of safety at the discretion of the reviewer, shall be applied to account for uncertainty and long term clogging.
- Scaling from borehole to full-scale capacity is uncertain. One of two approaches should be applied to account for uncertainty in scaling of borehole tests to full-scale capacity:
    - Plans and specifications may require full scale infiltration testing of the system upon completion of the well. This would include filling the constructed dry well and monitoring the discharge rte. The plans and specifications shall define a contingency plan for adapting final design based on the results of testing, including the ability to provide at least 50 percent additional capacity, either in the form of deeper dry wells or additional dry wells. The full scale tested capacity should demonstrate at least a 2.0 factor of safety on the long term design infiltration discharge rate.
    - In lieu of full scale verification, an additional 1.5x factor of safety in dry well capacity (depth of well or number of wells) may be used. This should be applied as an additional factor of safety over and above the prudent fact of safety calculated per Appendix D.

[11] Reynolds, W.D., 2008. Saturated hydraulic properties: well permeameter, in: Carter, M.R. and Gregorich, E.G. (Eds.), Soil Sampling and Methods of Analysis (2nd ed.). Canadian Society of Soil Science. CRC Press, Boca Raton, FL., USA, pp. 1025-1042.

I.4.3 Pretreatment and Spill Isolation

The following criteria apply to pretreatment of stormwater entering dry wells and the ability to isolate the system in the event of a contaminant spill:

- Pretreatment must be provided for all stormwater that is allowed to enter the dry well to address pollutants such as, but not limited to, sediment, metals, pesticides, hazardous materials, and hydrocarbons.
- Pretreatment must be selected based on the land use and land cover tributary to the system, as described in Table I-1.
- The design must include a method of hydraulically isolating the system from a spill within its drainage area. This method be able to be activated as part of emergency response by a single person without confined space entry. This does not apply to systems that receive only residential roof runoff.
- It is not practical to pre-treat for dissolved nutrients, salts, mobile organic contaminants, or other dissolved and mobile contaminants; appropriate siting based on source areas as described in Section I.3 along with the ability to isolate the system in the event of a spill limits the potential for impacts from these types of pollutants.

Table I-1: Identification of Pretreatment Requirements Based on Tributary Land Use/Land Cover

Tributary Land Use/Land Cover	Target Pollutants for Pretreatment	Appropriate Pretreatment BMP Category
Rooftops	Roof material shedding Aerial deposited particulates and pollutants	Grit trap/settling chamber
Sidewalks, paths Other lightly used impervious areas Low-use paved parking lot	Road/vehicular particulates Hydrocarbons Minor landscaping sediment and debris Trash	Grit trap/settling chamber plus hydrocarbon removal system
Medium-use paved parking Neighborhood residential streets (includes single family detached, attached, and multi-family residential, including associated parking areas)	Road/vehicular particulates Hydrocarbons Minor landscaping sediment and debris Trash Elevated clogging risk Minor risk of spilled pollutants	Approved proprietary BMP with Pretreatment certification and isolation system
High-use Parking Lots (typically in commercial and institutional land uses)	Road/vehicular particulates Hydrocarbons Metals Elevated hydrocarbon spill potential	Full biotreatment or treatment control (e.g., approved proprietary biofiltration system, bioretention with underdrains connected to dry well)

Collector, arterial, and commercial roads not exceeding AADT feasibility limits	Elevated clogging risk Trash	

I.4.4 Design Details

The following design requirements and guidelines apply to dry wells for stormwater management applications:

- Pretreatment and dry well structures must be in locations that are readily accessible for inspection and maintenance.
- Pretreatment structures must allow access for removal of sediment via a vacuum truck.
- Inspection ports at least 6 inches in diameter must be provided that enable the rate of stormwater drawdown in the dry well portion of the system to be determined.
- Dry wells must be designed for the appropriate structural loading associated with the location where they are sited (e.g., H20 loading) adhering to standard civil engineering practice for buried drainage structures.
- The interior space within a dry well may be backfilled with gravel or left open.
- Dry wells must include a minimum 5 feet deep annular well seal (measured from ground surface) with an approved seal material to avoid water entering the well that is not pre-treated. The appropriate well seal material for dry wells is a concrete slurry meeting the following criteria:
    - 5 sacks of Portland cement per cubic yard (Class B concrete)
    - The size of any aggregate must be less than 1/5 the radial thickness of the annular seal. Aggregate must meet ASTM C33 "Standard Specification for Concrete Aggregate".
    - Cement or concrete must be from "Ready-Mix" Company with weight slip or mixed on-site from original manufacturer's packaging.
    - Cement must meet ASTM C150, "Standard Specification for Portland Cement"
    - Reduced specifications for annular seal may be approved at the discretion of the well permitting agency if there is limited structural load and risk of direct inflow to the system.
- If a perforated casing is used, the perforated interval (the depth range over which infiltration occurs) should be encased by 1 foot of coarse round river rock on sides and bottom of facility. This exceeds the 2-inch minimum that is specified in the California Well Standards.
- A perforated concrete casing is not required within the infiltration zone. This zone may be occupied solely by aggregate backfill. In any case, the design shall prevent the walls of the well from sloughing.
- Aggregate used to fill the annular space or void space shall be washed and free of fines and deleterious material.

- There is not a maximum depth of dry wells, however as dry wells increase in depth, there is increasing complexity associated with:
    - Characterizing subsurface conditions
    - Verifying construction per design
    - Inspecting operations
    - Rehabilitating the system in the event of failure or diminished performance.

  The reviewer has the discretion to request information from the project applicant to ensure each of these issues is addressed in the proposed design, O&M plan, and maintenance funding mechanism.
- All well drilling contractors must possess a current C-57 contractor's license.
- Construction phasing and specifications must avoid compaction of dry well surfaces;
- Full scale testing must be conducted following the completion of activities that may compact dry well surfaces.
- Dry wells must not receive any runoff from the site during the construction phase.

I.5 Project Development Process

There are three primary phases of project development:

- Planning and discretionary approval phase
- Design and ministerial approval phase
- Construction and verification

The following subsections identify the plan development, permitting, and registration activities that apply at each phase.

I.5.1 Planning Phase/Conceptual WQMP

The project applicant should conduct site and watershed characterization, BMP selection and conceptual site and drainage designs as with any Project WQMP and prepare a Conceptual/Preliminary WQMP per standard processes applicable within the local jurisdiction

If dry wells are selected and proposed for the project, then the following additional steps are required as part of preparation and approval of the Conceptual/Preliminary WQMP:

- Register the proposed well(s) with USEPA Region 9: https://www.epa.gov/uic/forms/underground-injection-wells-registration
- Retain proof of registration and include with the Conceptual/Preliminary WQMP and Application for Well Construction Permit.
- Prepare an Application for Well Construction Permit with the appropriate agency. The following entities are responsible for well construction permitting:

    - Orange County Health Care Agency - http://ochealthinfo.com/eh/water/well (all projects, except those located in San Clemente)
    - City of San Clemente - http://san-clemente.org/department-services/engineering-services/permits-2486
- Attach additional information from the Conceptual WQMP needed to facilitate review of the Application for Well Construction Permit, including:
    - Tributary land use activities
    - Results of infiltration feasibility screening related to groundwater quality and soil contamination issues
    - Results of infiltration testing
    - Description of proposed dry well and pretreatment approach

The applicable well permitting agency should review the Application for Well Construction Permit and accompanying information. The well permitting agency may take one of three actions:

- Reject the use of stormwater dry wells and provide the basis.
- Provide a letter of conceptual acceptance and require additional information to support design level review.
- Issue the Well Construction Permit.

The project applicant should attach documentation to the Conceptual/Preliminary WQMP documenting review by the well permitting agency.

The agency responsible for WQMP review shall provide an opportunity for consultation by the applicable water agency (San Juan Basin Authority) as part of the Conceptual/Preliminary WQMP review process. See Appendix C.9 for guidance on this consultation process.

I.5.2 Design Phase/Final WQMP

If dry wells are included in the approved Conceptual/Preliminary WQMP, then the following additional steps are needed for dry well approvals during the design phase:

- Update the Application for Well Construction Permit and supporting information, if needed, based on design phase investigation activities or design refinements. It is possible that design details would be included at this phase what were not included at the conceptual phase.
- Satisfy any conditions of approval that were issued as part of the Conceptual/Preliminary WQMP approval or project permitting process that relate to dry wells.
- Identify the design adaptations that apply to the project construction plans that are contingent on full-scale measured infiltration capacity testing to be obtained as part of well construction and verification. The construction plans always need to have

contingency provisions allowing the plans to be adapted to provide up to 50 percent more dry well capacity than designed.

If a Well Construction Permit was not issues as part of the Conceptual/Preliminary WQMP, the applicable well permitting agency should review the Application for Well Construction Permit and accompanying information. When the final dry well plans are deemed acceptable to the well permitting agency, the Well Construction Permit should be issued.

The Well Construction Permit should be attached to the Final Project WQMP. The agency reviewing the Final Project WQMP shall check that this is included in any projects that propose stormwater dry wells.

I.5.3 Construction and Verification Phase

The following criteria apply during the construction, verification, and project permit closeout phase.

- Utilize only C-57 licensed contractors for well construction
- Complete full-scale infiltration testing of constructed wells at the time they are completed; activate contingency plans (i.e., greater or fewer wells) depending on results of testing
- Amend the WQMP, if needed, if the number or design of wells changed as a result of full-scale testing of wells and associate contingency designs were activated.
- Prepare Well Completion Report
  http://www.water.ca.gov/groundwater/wells/well_completion_reports.cfm
  - Send completed Well Completion Report form via mail to:

    California Department of Water Resources
    Southern Region
    770 Fairmont Ave., Suite 102
    Glendale, CA 91203-1035

  - Additionally, within 60 days of the date of completion, a copy of the DWR well completion report must be submitted to the well permitting agency for any well that is constructed.
- Update USEPA Class V UIC registration to change the status of the well to completed.

Additionally, decommissioning of any well requires a permit from the applicable local agency, requires reporting to the stated DWR, and requires update to the USEPA UIC registration.

APPENDIX J. PROPRIETARY BMP ACCEPTANCE PROCESS

J.1 Introduction

In the preparation of a Project WQMP, the preparer may determine that the use of a certified proprietary BMP is appropriate. There are three potential roles that proprietary treatment BMPs may serve as part of a Project WQMP:

- Pretreatment
- Biotreatment, under certain conditions
- Treatment control, under certain conditions

Section 2.5 and Section 4 of the TGD support the determination of when it is appropriate to use a certified proprietary BMP in any form. This appendix is intended to describe the criteria for determining that a certain type of proprietary has the certifications needed to be used in the intended role.

Acceptance should be evaluated by the reviewing agency on a case by case basis for each priority project. Past approvals of a BMP technology for other projects or in other jurisdictions does not provide basis for automatic acceptance or waiver of project-specific review.

J.2 Acceptance Process

The acceptance process for proprietary BMPs is as follows:

1. The Project WQMP must provide adequate demonstration that it is appropriate to use a proprietary BMP in the intended role. This shall be done per the BMP selection and design process described in Section 2.5 and Section 4. For example, in a case where it is feasible to provide full or partial infiltration and the project does not have a demonstrated space constraint justifying the use of a compact system, it is not acceptable to use a proprietary biotreatment BMP system unless it is complemented with an infiltration system.
2. The selected proprietary BMP must have adequate certifications or field-scale third party performance demonstration to serve the intended role. The acceptance process relies primarily on third-party assessments of performance and certification standards. The performance standards for determining adequacy are based on the Washington State Technology Acceptance Protocol-Ecology (WA TAPE). Only BMPs with General Use Level Designation (GULD), or equivalent, for a treatment category that is appropriate for the identified BMP role will be considered valid. Section J.3 identifies the treatment performance category that is valid in each role. The treatment performance standards associated with each performance category are documented in J.4. Where field-scale data reviewed by a recognized third party testing or verification agency

demonstrates performance equivalent to the WA TAPE standards, then this may be acceptable at the discretion of the reviewing agency. The Technology Acceptance Reciprocity Partnership (TARP) or New Jersey Corporation for Advance Testing (NJCAT) programs may serve this role.

3. The BMP must be used in a manner consistent with manufacturer guidelines and conditions of its third-party certification. Practically, what this means is that the BMP is used in the same way in which it was tested and certified. For example, it is not acceptable for a BMP of a given size to be certified/verified with a 100 gallon per minute treatment rate and be applied at a 150 gallon per minute treatment rate in a design. Certifications or verifications issued by the Washington Technology Acceptance Protocol-Ecology program and the Technology Acceptance Reciprocity Partnership or New Jersey Corporation for Advance Testing programs are typically accompanied by a set of guidelines regarding appropriate design and maintenance conditions that would be consistent with the certification/verification. It is common for these approvals to specify the specific model of BMP, design capacity for given unit sizes, type of media that is the basis for approval, and/or other parameter. The applicant must demonstrate conclusively that the proposed application of the BMP is consistent with these criteria.
4. The acceptability of any proprietary BMP is ultimately at the discretion of the reviewing agency. In addition to demonstrated performance, the reviewing agency may consider other factors such as the ability to inspect the BMP and determine the need for maintenance, the ability to maintain the system with available equipment and staff, the ability to procure a replacement BMP in a similar footprint should a vendor no longer be in business at the time of required replacement, relevant local experience with operation and maintenance of the BMP, and other potential factors. In the event that a proprietary BMP is rejected, the basis for rejection should be provided to the applicant.

The basis and acceptability for the use of proprietary BMPs must be documented in the Project WQMP.

J.3 Acceptable Certifications Based on BMP Role

J.3.1 Proprietary Pretreatment BMPs

Within this TGD, two levels of proprietary BMP certification apply.

- Standard Pretreatment: Any BMP with a GULD approval for "pretreatment" via the WA TAPE program, or demonstrated equivalent performance via a third party review agency, may be used to provide a standard level of pretreatment.

- Advanced Pretreatment (Basic Treatment): Any BMP with a GULD approval for "basic treatment" via the WA TAPE program, or demonstrated equivalent performance via a third party review agency, may be used to provide a standard level of pretreatment.

The level of pretreatment should be selected based on clogging risk and contamination risk, as discussed in Section 4.4.2 of the TGD, Fact Sheet MISC-5 and Appendix C.

J.3.2 Proprietary Biotreatment BMPs

Proprietary biotreatment BMPs must be selected based on their ability to effectively remove pollutants of concern. Table J-1 identifies the WA TAPE treatment levels, or equivalent, that are appropriate for each category of pollutant of concern.

Additionally, to be considered biofiltration, the BMP needs to provide features such as media and plants, that meet the applicable definitions that apply in each region. No system is perfectly sterile (i.e., some form of biology is present in any BMP), however system such as cartridge media filters and hydrodynamic separators do not meet the definition of a biotreatment or biofiltration BMP, and many biotreatment BMPs do not meet the definition of a biofiltration BMP. In order to be used to fulfill LID requirements, a biotreatment BMP must meet the definition of a biofiltration BMP. Additionally, the BMP needs to meet one of the applicable sizing standards for biofiltration.

Table J-1. Acceptable WA TAPE Certifications, or Equivalent, for Polltuants of Concern

Project Pollutant of Concern	Acceptable Technology Acceptance Protocol-Ecology Certification, or Equivalent
Trash	Pretreatment, Basic Treatment, Phosphorus Treatment, or Enhanced Treatment
Sediments	Basic Treatment, Phosphorus Treatment, or Enhanced Treatment
Oil and Grease	Basic Treatment, Oil Treatment, Phosphorus Treatment, or Enhanced Treatment
Nutrients	Phosphorus Treatment[1]
Metals	Enhanced Treatment
Pesticides	Basic Treatment (including filtration)[2] Phosphorus Treatment, or Enhanced Treatment
Organics	Basic Treatment (including filtration)[2] Phosphorus Treatment, or Enhanced Treatment
Bacteria and Viruses	Basic Treatment (including bacteria removal processes)[3] , Phosphorus Treatment, or Enhanced Treatment

1 – There is no Technology Acceptance Protocol-Ecology equivalent for nitrogen compounds; however systems that are designed to retain phosphorus (as well as meet basic treatment designation), generally also provide treatment of nitrogen compounds. Where nitrogen is a pollutant of concern, relative performance of available certified systems for nitrogen removal should be considered in BMP selection.
2 – Pesticides, organics, and oxygen demanding substances are typically addressed by particle filtration; if a system with Basic treatment certification does not provide filtration, it is not acceptable for pesticides, organics or oxygen demanding substances.

3 – There is no Technology Acceptance Protocol-Ecology equivalent for pathogens (viruses and bacteria), and testing data are limited because of typical sample hold times. Systems with Basic Treatment certification must also include one or more significant bacteria removal process such as media filtration, physical sorption, predation, reduced redox conditions, and/or solar inactivation.

J.3.3 Proprietary Treatment Control BMPs

Proprietary treatment control BMPs must be selected based on their ability to effectively remove pollutants of concern. Table J-1 identifies the WA TAPE treatment levels, or equivalent, that are appropriate for each category of pollutant of concern. These BMPs do not need to meet the definition of biofiltration. Biotreatment BMPs that do not meet the definition of biofiltration BMPs are considered treatment control BMPs. They must be sized per applicable sizing standards for treatment control.

J.4 TAPE Performance Standards

Table J-2 describes the underlying performance standards for each category of WA TAPE approval. Where a different source of third-party data is considered, it should be evaluated against these standards and be based on a similarly-rigorous testing and statistical analysis protocol to the WA TAPE program.

Table J-2. Performance Standards for WA TAPE Performance Categories

Performance Goal	Influent Range	Criteria
Basic Treatment	20 – 100 mg/L TSS	Effluent goal ≤ 20 mg/L TSS
	100 – 200 mg/L TSS	≥ 80% TSS removal
	>200 mg/L TSS	> 80% TSS removal
Enhanced (Dissolved Metals) Treatment	Dissolved copper 0.005 – 0.02 mg/L	Must meet basic treatment goal and better than basic treatment currently defined as >30% dissolved copper removal
	Dissolved zinc 0.02 – 0.3 mg/L	Must meet basic treatment goal and better than basic treatment currently defined as >60% dissolved zinc removal
Phosphorous Treatment	Total phosphorous 0.1 – 0.5 mg/L	Must meet basic treatment goal and exhibit ≥50% total phosphorous removal
Oil Treatment	Total petroleum hydrocarbon > 10 mg/L	No ongoing or recurring visible sheen in effluent. Daily average effluent Total petroleum hydrocarbon concentration < 10 mg/L Maximum effluent Total petroleum hydrocarbon concentration for a 15 mg/L for a discrete (grab) sample
Pretreatment	50 – 100 mg/L TSS	≤ 50 mg/L TSS
	≥ 200 mg/L TSS	≥ 50% TSS removal

APPENDIX K. APPROVED METHODS FOR QUANTIFYING AND MITIGATING HCOCS IN NORTH ORANGE COUNTY [PLACEHOLDER]

[Placeholder for future addition after adoption of the 5th Term NOC MS4 Permit]

APPENDIX L. ADDITIONAL GUIDANCE ON HYDROMODIFICATION MANAGEMENT IN SOUTH ORANGE COUNTY [PLACEHOLDER]

[See the South Orange County HMP for guidance. No other guidance is provided at this time.]

.

APPENDIX M. WORKSHEETS

This section provides hyperlinks to each of the worksheets embedded in text of theses TGD Appendices.

To be completed prior to publication.

APPENDIX N. EXHIBITS

This appendix includes exhibits relevant to South Orange County.

Some exhibits are excerpts from the Watershed Management Area Analysis which is part of the Water Quality Improvement Plan.

N.1 Rainfall Zones Map

Figure N-1: Orange County Rainfall Zones Map

Exhibit on following page

N.2 Infiltration Feasibility Constraints Maps

Figure N-2: Infiltration Feasibility Constraints Maps

Exhibits start on following page

8.0 CONSTRUCTION COMPONENT

8.1 INTRODUCTION

Construction and grading activities are a potential source of pollutants in all phases of execution. Consequently, effective management of construction projects occurs throughout the City of Laguna Niguel by implementing ordinances, performing inspections, requiring BMPs and undertaking enforcement actions. Local regulatory oversight of construction therefore directly supports both the principal requirements of the Fifth Term Permit and effectively addresses two of the HPWQCs identified in the WQIP, specifically, unnatural water balance in dry weather and pathogen health risk.

8.2 INVENTORY OF CONSTRUCTION PROJECTS

Watershed-based inventories of all construction projects are maintained in compliance with Provision E.4. Construction projects include those covered by a State Construction General Permit, City Grading Permit, City Building Permit, or Public Works activities that result in the disturbance of soil such as soil movement, grading excavation, clearing, road construction, structure construction, or structure demolition; and projects involving uncovered storage of materials and wastes such as dirt, sand or fertilizer; or exterior mixing of cementaceous products such as concrete, mortar or stucco.

The inventories do not include building permits for electrical, mechanical and interior plumbing work, wall signs, temporary mobile homes and trailers, temporary power poles, changes of use in existing buildings, and interior tenant improvements and remodels.

8.3 PROJECT REVIEW AND APPROVAL

In compliance with Provision E.4, prior to approval and issuance of grading or building permits, all proposed construction projects shall comply with the following:

- Project applicants shall submit and obtain City approval of an erosion and sediment control plan (or equivalent construction BMP plan) that complies with the City's runoff water quality control ordinance, grading ordinance, and the Fifth Term Permit.
- Project applicants shall provide written consent to implement appropriate construction BMPs and other measures necessary to ensure compliance with applicable water quality standards.
- As applicable, project applicants shall provide evidence of existing coverage under the State Construction General Permit.

8.4 CONSTRUCTION BMPS

In compliance with Provision E.4, all private and Public Works construction projects, regardless of size, are required, at a minimum, to implement and be protected by an effective combination of erosion and sediment controls and waste and materials management BMPs.

8.4.1 Minimum Performance Requirements

All construction projects shall comply with the minimum performance requirements summarized in Table 8.1. These minimum performance requirements are conveyed to construction contractors as part of the permit conditions and plan notes. For projects necessitating pre-construction meetings, the requirements are also reviewed by the City inspector and/or project manager prior to commencement of work.

Table 8.1
Minimum Performance Requirements for All Construction Projects

CATEGORY	MINIMUM REQUIREMENTS
Management Measures	1. Pollution prevention, where appropriate 2. Development and implementation of a project-specific runoff management plan 3. Minimization of areas that are cleared and graded to only the portion of the site that is necessary for construction 4. Minimization of exposure time of disturbed soil areas 5. Minimization of grading during the wet season and correlation of grading with seasonal dry weather periods to the extent feasible 6. Limitation of grading to a maximum disturbed area as determined by the City before either temporary or permanent erosion controls are implemented to prevent storm water pollution. The City has the option of temporarily increasing the size of disturbed soil areas by a set amount beyond the maximum, if the individual site is in compliance with applicable water quality regulations and the site has adequate control practices implemented to prevent discharge of pollutants to the City's storm drain system 7. Temporary stabilization and reseeding of disturbed soil areas as rapidly as feasible 8. Wind erosion controls 9. Tracking controls 10. Non-stormwater management measures to prevent illicit discharges and control runoff pollution sources 11. Waste Management measures 12. Preservation of natural hydrologic features where feasible 13. Preservation of riparian buffers and corridors where feasible 14. Evaluation and maintenance of all BMPs, until removed 15. Rentention, reduction, and proper management of all stormwater pollutant discharges on site to the maximum extent practicable (MEP) standard

CATEGORY	MINIMUM REQUIREMENTS
Erosion and Sediment Controls	1. Erosion prevention is to be used as the most important measure for keeping sediment on-site during construction 2. Sediment controls are to be used as a supplement to erosion prevention for keeping sediment on-site during construction 3. Slope stabilization must be used on all active slopes during rain events regardless of the season and on all inactive slopes during the rainy season and during rain events in the dry season 4. Permanent revegetation or landscaping as early as feasible
Enhanced Measures (Applicable only to sites tributary to a CWA section 303(d) water body segment impaired for sediment or turbidity, and/or within or directly adjacent to, or discharging directly to, a receiving water within an ESA)	Advanced sediment treatment (AST) shall be required at construction sites, or portions thereof, that the City determines to be an exceptional threat to water quality. Such determinations, shall be based on consideration of the following factors: 1. Soil erosion potential or soil type 2. The site's slope 3. Project size and type 4. Sensitivity of receiving waters bodies 5. Proximity of receiving water bodies 6. Non-stormwater discharges 7. Ineffectiveness of other BMPs 8. Proximity and sensitivity of aquatic threatened and endangered species of concern 9. Known effects of AST chemicals 10. Any other relevant factors

8.4.2 Designated Construction BMPs

Table 8.2 lists the construction BMPs designated for use with the LIP. Detailed construction BMP fact sheets are included as **Exhibit 8.I**.

Table 8.2
Construction BMPs

CATEGORY	BMP #	BMP NAME
Erosion Control BMPs	EC-1	Scheduling
	EC-2	Preservation of Existing Vegetation
	EC-3	Hydraulic Mulch
	EC-4	Hydroseeding
	EC-5	Soil Binders
	EC-6	Straw Mulch
	EC-7	Geotextiles and Mats
	EC-8	Wood Mulching
	EC-9	Earth Dikes and Drainage Swales
	EC-10	Velocity Dissipation Devices
	EC-11	Slope Drains
	EC-12	Streambank Stabilization
	EC-13	Reserved
	EC-14	Compost Blanket
	EC-15	Soil Preparation/Roughening
	EC-16	Non-Vegitative Stabilization

Sediment Control BMPs	SE-1	Silt Fence
	SE-2	Sediment Basin
	SE-3	Sediment Trap
	SE-4	Check Dam
	SE-5	Fiber Rolls
	SE-6	Gravel Bag Berm
	SE-7	Street Sweeping and Vacuuming
	SE-8	Sandbag Barrier
	SE-9	Straw Bale Barrier
	SE-10	Storm Drain Inlet Protection
	SE-11	Active Treatment Systems
	SE-12	Temporary Silt Dike
	SE-13	Compost Socks and Berms
	SE-14	Biofilter Bags
Wind Erosion Control BMPs	WE-1	Wind Erosion Control
Tracking Control BMPs	TC-1	Stabilized Construction Entrance/Exit
	TC-2	Stabilized Construction Roadway
	TC-3	Entrance/Outlet Tire Wash
Non-Stormwater Control BMPs	NS-1	Water Conservation Practices
	NS-2	Dewatering Operations
	NS-3	Paving and Grinding Operations
	NS-4	Temporary Stream Crossing
	NS-5	Clear Water Diversion
	NS-6	Illicit Connection/Illegal Discharge
	NS-7	Potable Water/Irrigation
	NS-8	Vehicle and Equipment Cleaning
	NS-9	Vehicle and Equipment Fueling
	NS-10	Vehicle and Equipment Maintenance
	NS-11	Pile Driving Operations
	NS-12	Concrete Curing
	NS-13	Concrete Finishing
	NS-14	Material Over Water
	NS-15	Demolition Adjacent to Water
	NS-16	Temporary Batch Plants
Waste Management & Materials Pollution Control BMPs	WM-1	Material Delivery and Storage
	WM-2	Material Use
	WM-3	Stockpile Management
	WM-4	Spill Prevention and Control
	WM-5	Solid Waste Management
	WM-6	Hazardous Waste Management
	WM-7	Contaminated Soil Management
	WM-8	Concrete Waste Management
	WM-9	Sanitary/Septic Waste Management
	WM-10	Liquid Waste Management

8.5 CITY INSPECTION AND REPORTING

In compliance with Provision E.4 of the Fifth Term Permit, construction projects are subject to City inspection to verify compliance with City permits, ordinances, and contract documents (for Public Works projects). Construction sites are inspected, according to the established frequencies, until the construction activity is complete. The City's construction site inspection checklist is included as **Exhibit 8.II**.

8.5.1 Minimum Inspection Frequencies

In setting construction project inspection frequencies, the City considers the nature and size of the construction activity, topography, and the soil characteristics and receiving water quality. At a minimum, construction sites are subject to City inspection as shown in Table 8.3.

Table 8.3
Construction Site Inspection Frequency

CONSTRUCTION ACTIVITY	RAINY SEASON (OCTOBER 1 – APRIL 30)	DRY SEASON (MAY 1 – SEPTEMBER 30)
Sites 30 acres or more with rough grading or active slopes	Every 2 weeks	Annually in August or September
Sites 1 acre or more, tributary to a CWA section 303(d) water body segment impaired for sediment, and/or within or directly adjacent to, or discharging directly to, a receiving water within an ESA	Every 2 weeks	Annually in August or September
Other sites determined to be a significant threat to water quality*	Every 2 weeks	As needed
All other sites 1 acre or more but not meeting the above criteria	Monthly	As needed
Sites less than 1 acre	As needed	As needed

* Evaluation of significant threats to water quality includes consideration of the following factors: 1) soil erosion potential; 2) site slope; 3) project size and type; 4) sensitivity of receiving water bodies; 5) proximity to receiving water bodies; 6) non-stormwater discharges; 7) past record of non-compliance by the operators of the construction site; 8) WQIP HPWQCs; and 9) any other relevant factors.

8.5.2 Enforcement Actions

Enforcement of construction projects will be undertaken by the City of Laguna Niguel's inspectors and/or other staff who possess internal enforcement authority through established policies and procedures. Threat to water quality will be assessed by inspectors for construction site runoff that will not be reasonably controlled by the BMPs in place or if a failure of BMPs is resulting in the release of sediments or other pollutants. Violations observed will be documented by the inspectors.

If a significant and/or immediate threat to water quality is observed by an inspector, action will be taken to require the developer/contractor to immediately cease the discharge. Consistent with the City's Enforcement Response Plan (see Exhibit 4.III). Table 8.4 outlines the City of Laguna Niguel's enforcement steps that will be taken by inspectors for private construction projects and for public works construction projects. Depending on the violation, the inspector may choose to utilize contract language, a local permit, the grading ordinance or the water quality ordinance as the basis for enforcement.

Table 8.4
Enforcement Actions for Construction Projects

PRIVATE CONSTRUCTION PROJECTS	PUBLIC WORKS CONSTRUCTION PROJECTS
Verbal Warning	Verbal Warning
Written Warning - Notice of Noncompliance/Notice of Violation - Administrative Compliance Order - Administrative Citations or Fines - Cease and Desist Order	Written Warning - Notice of Noncompliance/Notice of Violation
Stop Work Order	Enforcement of Contract - Stop Work Order - Withholding of Payment - Bond - Fines - Revocation of Contract
Revocation of Permit(s) and/or Denial of Future Permits	
Civil and Criminal Court Actions	Civil and Criminal Court Actions

8.5.3 Non-Compliance Reporting

In compliance with Provision E.4 of the Fifth Term Permit, the City provides notification to the RWQCB of all stop work orders or other high level enforcement actions taken in response to construction project violations of water quality standards.

Non-compliant construction projects that are determined to pose a threat to health or the environment are reported to the RWQCB within 24-hours of the discovery of non-compliance. Within 5 days of initial reporting, written notification is also submitted to the RWQCB. Written notification(s) contain a description of the noncompliance and its causes; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

8.6 REPORTING

In addition to any reporting requirements previously discussed, the City submits an annual progress report each year to RWQCB discussing City activities conducted pursuant to the Construction Component. At a minimum, the report includes the following information:

- Inventory of construction activities
- Summary of construction site inspections
- Summary of water quality enforcement actions
- Any updates to this LIP component and related exhibits

EXHIBIT 8.I

CONSTRUCTION BMP FACT SHEETS

EC-1 Scheduling
EC-2 Preservation of Existing Vegetation
EC-3 Hydraulic Mulch
EC-4 Hydroseeding
EC-5 Soil Binders
EC-6 Straw Mulch
EC-7 Geotextiles & Mats
EC-8 Wood Mulching
EC-9 Earth Dikes & Drainage Swales
EC-10 Velocity Dissipation Devices
EC-11 Slope Drains
EC-12 Streambank Stabilization
EC-13 Reserved
EC-14 Compost Blankets
EC-15 Soil Preparation/Roughening
EC-16 Non-Vegetative Stabilization

SE-1 Silt Fence
SE-2 Sediment Basin
SE-3 Sediment Trap
SE-4 Check Dam
SE-5 Fiber Rolls
SE-6 Gravel Bag Berm
SE-7 Street Sweeping & Vacuum
SE-8 Sandbag Barrier
SE-9 Straw Bale Barriers
SE-10 Storm Drain Inlet Protection
SE-11 Active Treatment Systems
SE-12 Temporary Silt Dike
SE-13 Compost Socks & Berms
SE-14 Biofilter Bags

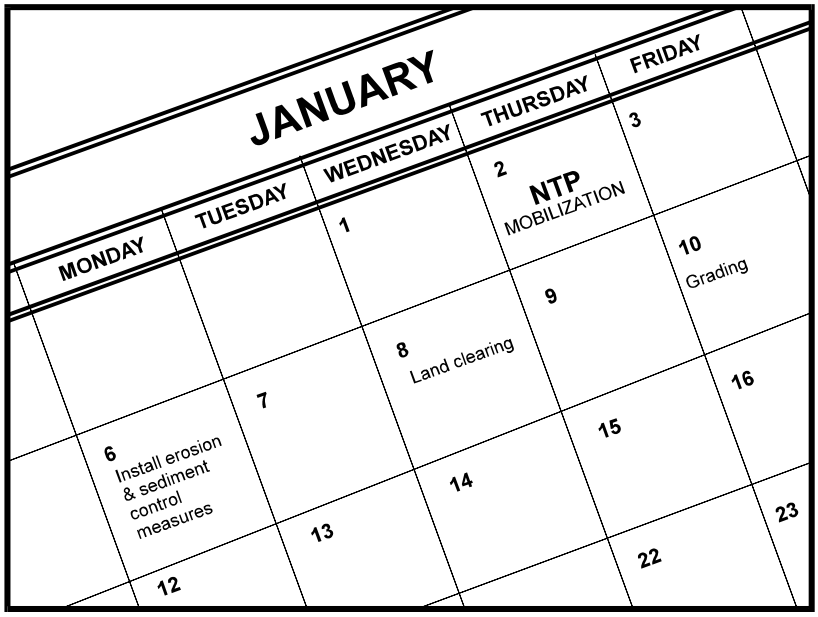
WE-1 Wind Erosion Control

TC-1 Stabilized Construction Entrance/Exit
TC-2 Stabilized Construction Roadway
TC-3 Entrance/Outlet Tire Wash

NS-1 Water Conservation Practices
NS-2 Dewatering Operations
NS-3 Paving & Grinding Operations
NS-4 Temporary Stream Crossing
NS-5 Clear Water Diversion
NS-6 Illicit Connection/Discharge
NS-7 Potable Water/Irrigation
NS-8 Vehicle & Equipment Cleaning
NS-9 Vehicle & Equipment Fueling
NS-10 Vehicle & Equipment Maintenance
NS-11 Pile Driving Operations
NS-12 Concrete Curing
NS-13 Concrete Finishing
NS-14 Material Over Water
NS-15 Demolition Adjacent to Water
NS-16 Temporary Batch Plants

WM-1 Material Delivery and Storage
WM-2 Material Use
WM-3 Stockpile Management
WM-4 Spill Prevention & Control
WM-5 Solid Waste Management
WM-6 Hazardous Waste Management
WM-7 Contaminated Soil Management
WM-8 Concrete Waste Management
WM-9 Sanitary/Septic Waste Management
WM-10 Liquid Waste Management

Scheduling EC-1



Description and Purpose

Scheduling is the development of a written plan that includes sequencing of construction activities and the implementation of BMPs such as erosion control and sediment control while taking local climate (rainfall, wind, etc.) into consideration. The purpose is to reduce the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking, and to perform the construction activities and control practices in accordance with the planned schedule.

Suitable Applications

Proper sequencing of construction activities to reduce erosion potential should be incorporated into the schedule of every construction project especially during rainy season. Use of other, more costly yet less effective, erosion and sediment control BMPs may often be reduced through proper construction sequencing.

Limitations

- Environmental constraints such as nesting season prohibitions reduce the full capabilities of this BMP.

Implementation

- Avoid rainy periods. Schedule major grading operations during dry months when practical. Allow enough time before rainfall begins to stabilize the soil with vegetation or physical means or to install sediment trapping devices.
- Plan the project and develop a schedule showing each phase of construction. Clearly show how the rainy season relates

Categories

EC	Erosion Control	☑
SE	Sediment Control	☒
TC	Tracking Control	☒
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Objective**
☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

to soil disturbing and re-stabilization activities. Incorporate the construction schedule into the SWPPP.

- Include on the schedule, details on the rainy season implementation and deployment of:
  - Erosion control BMPs
  - Sediment control BMPs
  - Tracking control BMPs
  - Wind erosion control BMPs
  - Non-stormwater BMPs
  - Waste management and materials pollution control BMPs
- Include dates for activities that may require non-stormwater discharges such as dewatering, sawcutting, grinding, drilling, boring, crushing, blasting, painting, hydro-demolition, mortar mixing, pavement cleaning, etc.
- Work out the sequencing and timetable for the start and completion of each item such as site clearing and grubbing, grading, excavation, paving, foundation pouring utilities installation, etc., to minimize the active construction area during the rainy season.
  - Sequence trenching activities so that most open portions are closed before new trenching begins.
  - Incorporate staged seeding and re-vegetation of graded slopes as work progresses.
  - Schedule establishment of permanent vegetation during appropriate planting time for specified vegetation.
- Non-active areas should be stabilized as soon as practical after the cessation of soil disturbing activities or one day prior to the onset of precipitation.
- Monitor the weather forecast for rainfall.
- When rainfall is predicted, adjust the construction schedule to allow the implementation of soil stabilization and sediment treatment controls on all disturbed areas prior to the onset of rain.
- Be prepared year round to deploy erosion control and sediment control BMPs. Erosion may be caused during dry seasons by un-seasonal rainfall, wind, and vehicle tracking. Keep the site stabilized year round, and retain and maintain rainy season sediment trapping devices in operational condition.
- Apply permanent erosion control to areas deemed substantially complete during the project's defined seeding window.

Costs

Construction scheduling to reduce erosion may increase other construction costs due to reduced economies of scale in performing site grading. The cost effectiveness of scheduling techniques should be compared with the other less effective erosion and sedimentation controls to achieve a cost effective balance.

Inspection and Maintenance

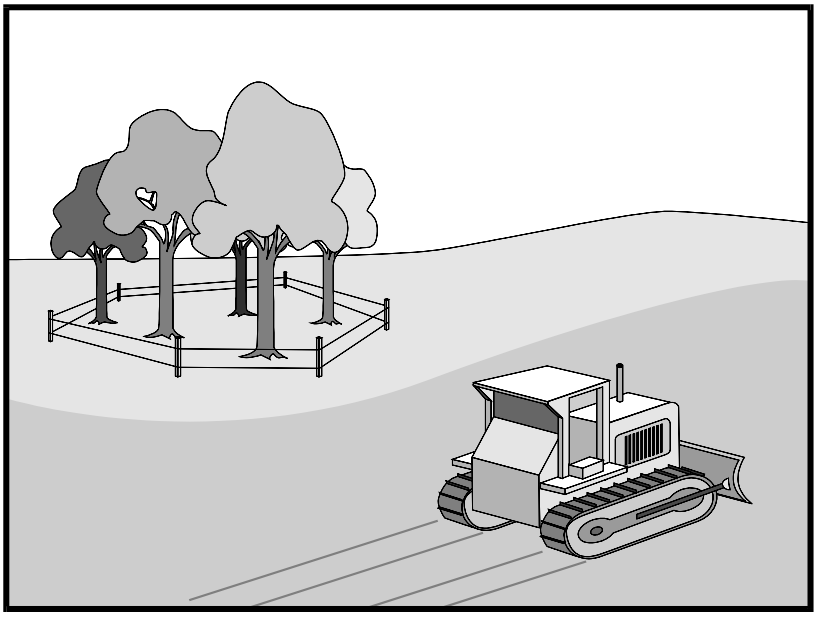
- Verify that work is progressing in accordance with the schedule. If progress deviates, take corrective actions.
- Amend the schedule when changes are warranted.
- Amend the schedule prior to the rainy season to show updated information on the deployment and implementation of construction site BMPs.

References

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities Developing Pollution Prevention Plans and Best Management Practices (EPA 832-R-92-005), U.S. Environmental Protection Agency, Office of Water, September 1992.

Preservation Of Existing Vegetation EC-2



Description and Purpose

Carefully planned preservation of existing vegetation minimizes the potential of removing or injuring existing trees, vines, shrubs, and grasses that protect soil from erosion.

Suitable Applications

Preservation of existing vegetation is suitable for use on most projects. Large project sites often provide the greatest opportunity for use of this BMP. Suitable applications include the following:

- Areas within the site where no construction activity occurs, or occurs at a later date. This BMP is especially suitable to multi year projects where grading can be phased.
- Areas where natural vegetation exists and is designated for preservation. Such areas often include steep slopes, watercourse, and building sites in wooded areas.
- Areas where local, state, and federal government require preservation, such as vernal pools, wetlands, marshes, certain oak trees, etc. These areas are usually designated on the plans, or in the specifications, permits, or environmental documents.
- Where vegetation designated for ultimate removal can be temporarily preserved and be utilized for erosion control and sediment control.

Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Preservation Of Existing Vegetation EC-2

Limitations

- Requires forward planning by the owner/developer, contractor, and design staff.
- Limited opportunities for use when project plans do not incorporate existing vegetation into the site design.
- For sites with diverse topography, it is often difficult and expensive to save existing trees while grading the site satisfactory for the planned development.

Implementation

The best way to prevent erosion is to not disturb the land. In order to reduce the impacts of new development and redevelopment, projects may be designed to avoid disturbing land in sensitive areas of the site (e.g., natural watercourses, steep slopes), and to incorporate unique or desirable existing vegetation into the site's landscaping plan. Clearly marking and leaving a buffer area around these unique areas during construction will help to preserve these areas as well as take advantage of natural erosion prevention and sediment trapping.

Existing vegetation to be preserved on the site must be protected from mechanical and other injury while the land is being developed. The purpose of protecting existing vegetation is to ensure the survival of desirable vegetation for shade, beautification, and erosion control. Mature vegetation has extensive root systems that help to hold soil in place, thus reducing erosion. In addition, vegetation helps keep soil from drying rapidly and becoming susceptible to erosion. To effectively save existing vegetation, no disturbances of any kind should be allowed within a defined area around the vegetation. For trees, no construction activity should occur within the drip line of the tree.

Timing

- Provide for preservation of existing vegetation prior to the commencement of clearing and grubbing operations or other soil disturbing activities in areas where no construction activity is planned or will occur at a later date.

Design and Layout

- Mark areas to be preserved with temporary fencing. Include sufficient setback to protect roots.
  - Orange colored plastic mesh fencing works well.
  - Use appropriate fence posts and adequate post spacing and depth to completely support the fence in an upright position.
- Locate temporary roadways, stockpiles, and layout areas to avoid stands of trees, shrubs, and grass.
- Consider the impact of grade changes to existing vegetation and the root zone.
- Maintain existing irrigation systems where feasible. Temporary irrigation may be required.
- Instruct employees and subcontractors to honor protective devices. Prohibit heavy equipment, vehicular traffic, or storage of construction materials within the protected area.

Costs

There is little cost associated with preserving existing vegetation if properly planned during the project design, and these costs may be offset by aesthetic benefits that enhance property values. During construction, the cost for preserving existing vegetation will likely be less than the cost of applying erosion and sediment controls to the disturbed area. Replacing vegetation inadvertently destroyed during construction can be extremely expensive, sometimes in excess of $10,000 per tree.

Inspection and Maintenance

During construction, the limits of disturbance should remain clearly marked at all times. Irrigation or maintenance of existing vegetation should be described in the landscaping plan. If damage to protected trees still occurs, maintenance guidelines described below should be followed:

- Verify that protective measures remain in place. Restore damaged protection measures immediately.
- Serious tree injuries shall be attended to by an arborist.
- Damage to the crown, trunk, or root system of a retained tree shall be repaired immediately.
- Trench as far from tree trunks as possible, usually outside of the tree drip line or canopy. Curve trenches around trees to avoid large roots or root concentrations. If roots are encountered, consider tunneling under them. When trenching or tunneling near or under trees to be retained, place tunnels at least 18 in. below the ground surface, and not below the tree center to minimize impact on the roots.
- Do not leave tree roots exposed to air. Cover exposed roots with soil as soon as possible. If soil covering is not practical, protect exposed roots with wet burlap or peat moss until the tunnel or trench is ready for backfill.
- Cleanly remove the ends of damaged roots with a smooth cut.
- Fill trenches and tunnels as soon as possible. Careful filling and tamping will eliminate air spaces in the soil, which can damage roots.
- If bark damage occurs, cut back all loosened bark into the undamaged area, with the cut tapered at the top and bottom and drainage provided at the base of the wood. Limit cutting the undamaged area as much as possible.
- Aerate soil that has been compacted over a trees root zone by punching holes 12 in. deep with an iron bar, and moving the bar back and forth until the soil is loosened. Place holes 18 in. apart throughout the area of compacted soil under the tree crown.
- Fertilization
  - Fertilize stressed or damaged broadleaf trees to aid recovery.
  - Fertilize trees in the late fall or early spring.

- Apply fertilizer to the soil over the feeder roots and in accordance with label instructions, but never closer than 3 ft to the trunk. Increase the fertilized area by one-fourth of the crown area for conifers that have extended root systems.

- Retain protective measures until all other construction activity is complete to avoid damage during site cleanup and stabilization.

References

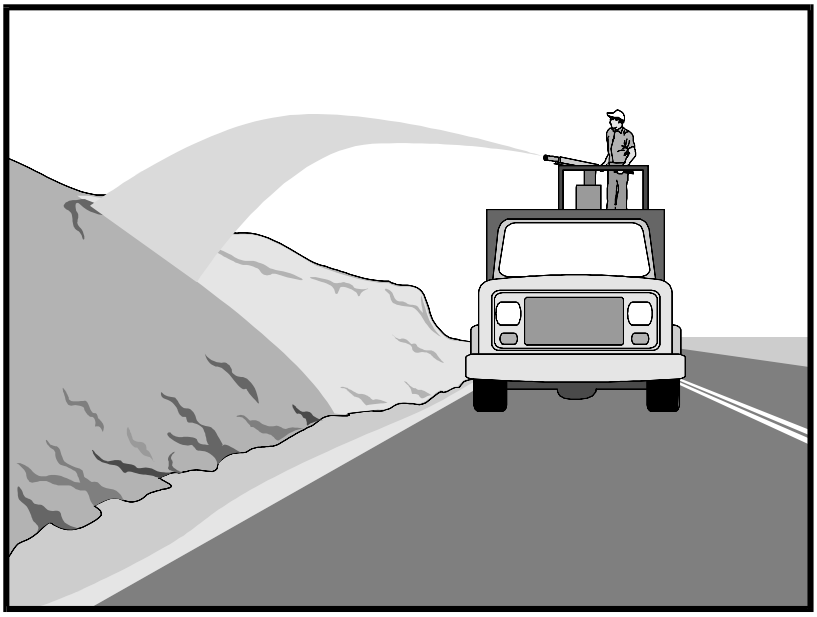
County of Sacramento Tree Preservation Ordinance, September 1981.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for The Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Hydraulic Mulch EC-3



Description and Purpose

Hydraulic Mulch consists of various types of fibrous materials mixed with water and sprayed onto the soil surface in slurry form to provide a layer of temporary protection from wind and water erosion.

Suitable Applications

Hydraulic mulch as a temporary, stand alone, erosion control BMP is suitable for disturbed areas that require temporary protection from wind and water erosion until permanent soil stabilization activities commence. Examples include:

- Rough-graded areas that will remain inactive for longer than permit-required thresholds (e.g., 14 days) or otherwise require stabilization to minimize erosion or prevent sediment discharges.
- Soil stockpiles.
- Slopes with exposed soil between existing vegetation such as trees or shrubs.
- Slopes planted with live, container-grown vegetation or plugs.
- Slopes burned by wildfire.

Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-4 Hydroseeding

EC-5 Soil Binders

EC-6 Straw Mulch

EC-7 Geotextiles and Mats

EC-8 Wood Mulching

EC-14 Compost Blanket

EC-16 Non-Vegetative Stabilization

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Hydraulic mulch can also be applied to augment other erosion control BMPs such as:

- In conjunction with straw mulch (see EC-6 Straw Mulch) where the rate of hydraulic mulch is reduced to 100-500 lbs per acre and the slurry is applied over the straw as a tackifying agent to hold the straw in place.
- Supplemental application of soil amendments, such as fertilizer, lime, gypsum, soil bio-stimulants or compost.

Limitations

In general, hydraulic mulch is not limited by slope length, gradient or soil type. However, the following limitations typically apply:

- Most hydraulic mulch applications, particularly bonded fiber matrices (BFMs), require at least 24 hours to dry before rainfall occurs.
- Temporary applications (i.e., without a vegetative component) may require a second application in order to remain effective for an entire rainy season.
- Treatment areas must be accessible to hydraulic mulching equipment.
- Availability of water sources in remote areas for mixing and application.
- As a stand-alone temporary BMP, hydraulic mulches may need to be re-applied to maintain their erosion control effectiveness, typically after 6-12 months depending on the type of mulch used.
- Availability of hydraulic mulching equipment may be limited just prior to the rainy season and prior to storms due to high demand.
- Cellulose fiber mulches alone may not perform well on steep slopes or in course soils.
- This BMP consists of a mixture of several constituents (e.g., fibers/mulches, tackifiers, and other chemical constituents), some of which may be proprietary and may come pre-mixed by the manufacturer. The water quality impacts of these constituents are relatively unknown and some may have water quality impacts due to their chemical makeup. Refer to specific chemical properties identified in the product Material Safety Data Sheet; products should be evaluated for project-specific implementation by the SWPPP Preparer. Refer to factsheet EC-05 for further guidance on selecting soil binders.

Implementation

- Where feasible, it is preferable to prepare soil surfaces prior to application by roughening embankments and fill areas with a crimping or punching type roller or by track walking.
- The majority of hydraulic mulch applications do not necessarily require surface/soil preparation (See EC-15 Soil Preparation) although in almost every case where re-vegetation is included as part of the practice, soil preparation can be beneficial. One of the advantages of hydraulic mulch over other erosion control methods is that it can be applied in areas where soil preparation is precluded by site conditions, such as steep slopes, rocky soils, or inaccessibility.

- Avoid mulch over spray onto roads, sidewalks, drainage channels, existing vegetation, etc.
- Hydraulic mulching is generally performed utilizing specialized machines that have a large water-holding/mixing tank and some form of mechanical agitation or other recirculation method to keep water, mulch and soil amendments in suspension. The mixed hydraulic slurry can be applied from a tower sprayer on top of the machine or by extending a hose to areas remote from the machine.
- Where possible apply hydraulic mulch from multiple directions to adequately cover the soil. Application from a single direction can result in shadowing, uneven coverage and failure of the BMP.
- Hydraulic mulch can also include a vegetative component, such as seed, rhizomes, or stolons (see EC-4 Hydraulic Seed).
- Typical hydraulic mulch application rates range from 2,000 pounds per acre for standard mulches (SMs) to 3,500 pounds per acre for BFMs. However, the required amount of hydraulic mulch to provide adequate coverage of exposed topsoil may appear to exceed the standard rates when the roughness of the soil surface is changed due to soil preparation methods (see EC-15 Soil Preparation) or by slope gradient.
- Other factors such as existing soil moisture and soil texture can have a profound effect on the amount of hydraulic mulch required (i.e. application rate) applied to achieve an erosion-resistant covering.
- Avoid use of mulch without a tackifier component, especially on slopes.
- Mulches used in the hydraulic mulch slurry can include:
  - Cellulose fiber
  - Thermally-processed wood fibers
  - Cotton
  - Synthetics
  - Compost (see EC-14, Compost Blanket)
- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

Categories of Hydraulic Mulches

Standard Hydraulic Mulch (SM)

Standard hydraulic mulches are generally applied at a rate of 2,000 pounds per acre and are manufactured containing around 5% tackifier (i.e. soil binder), usually a plant-derived guar or psyllium type. Most standard mulches are green in color derived from food-color based dyes.

Hydraulic Matrices (HM) and Stabilized Fiber Matrices (SFM)

Hydraulic matrices and stabilized fiber matrices are slurries which contain increased levels of tackifiers/soil binders; usually 10% or more by weight. HMs and SFMs have improved performance compared to a standard hydraulic mulch (SM) because of the additional percentage of tackifier and because of their higher application rates, typically 2,500 – 4,000 pounds per acre. Hydraulic matrices can include a mixture of fibers, for example, a 50/50 blend of paper and wood fiber. In the case of an SFM, the tackifier/soil binder is specified as a polyacrylamide (PAM).

Bonded Fiber Matrix (BFM)

Bonded fiber matrices (BFMs) are hydraulically-applied systems of fibers, adhesives (typically guar based) and chemical cross-links. Upon drying, the slurry forms an erosion-resistant blanket that prevents soil erosion and promotes vegetation establishment. The cross-linked adhesive in the BFM should be biodegradable and should not dissolve or disperse upon re-wetting. BFMs are typically applied at rates from 3,000 to 4,000 lbs/acre based on the manufacturer's recommendation. BFMs should not be applied immediately before, during or immediately after rainfall or if the soil is saturated. Depending on the product, BFMs typically require 12 to 24 hours to dry and become effective.

Mechanically-Bonded Fiber Matrices (MBFM)

Mechanically-bonded fiber matrices (MBFMs) are hydraulically applied systems similar to BFM that use crimped synthetic fibers and PAM and are typically applied to a slope at a higher application rate than a standard BFM.

Hydraulic Compost Matrix (HCM)

Hydraulic compost matrix (HCM) is a field-derived practice whereby finely graded or sifted compost is introduced into the hydraulic mulch slurry. A guar-type tackifier can be added for steeper slope applications as well as any specified seed mixtures. A HCM can help to accelerate seed germination and growth. HCMs are particularly useful as an in-fill for three-dimensional re-vegetation geocomposites, such as turf reinforcement mats (TRM) (see EC-7 Geotextiles and Mats).

Costs

Average installed costs for hydraulic mulch categories are is provided in Table 1, below.

Table 1
HYDRAULIC MULCH BMPs
INSTALLED COSTS

BMP	Installed Cost/Acre
Standard Hydraulic Mulching (SM)	$1,700 - $3,600 per acre
Hydraulic Matrices (HM) and Stabilized Fiber Matrices	
Guar-based	$2,000 - $4,000 per acre
PAM-based	$2,500 - $5,610 per acre
Bonded Fiber Matrix (BFM)	$3,900 - $6,900 per acre
Mechanically Bonded Fiber Matrix (MBFM)	$4,500 - $6,000 per acre
Hydraulic Compost Matrix (HCM)	$3,000 - $3,500 per acre

Source: Cost information received from individual product manufacturers solicited by Geosyntec Consultants (2004)

Inspection and Maintenance

- Maintain an unbroken, temporary mulched ground cover throughout the period of construction when the soils are not being reworked.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Areas where erosion is evident should be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- Compare the number of bags or weight of applied mulch to the area treated to determine actual application rates and compliance with specifications.

References

Soil Stabilization BMP Research for Erosion and Sediment Controls: Cost Survey Technical Memorandum, State of California Department of Transportation (Caltrans), July 2007.

Controlling Erosion of Construction Sites, Agricultural Information #347, U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service – SCS).

Guides for Erosion and Sediment Control in California, USDA Soils Conservation Service, January 1991.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Sedimentation and Erosion Control, An Inventory of Current Practices Draft, US EPA, April 1990.

Soil Erosion by Water, Agriculture Information Bulletin #513, U.S. Department of Agriculture, Soil Conservation Service.

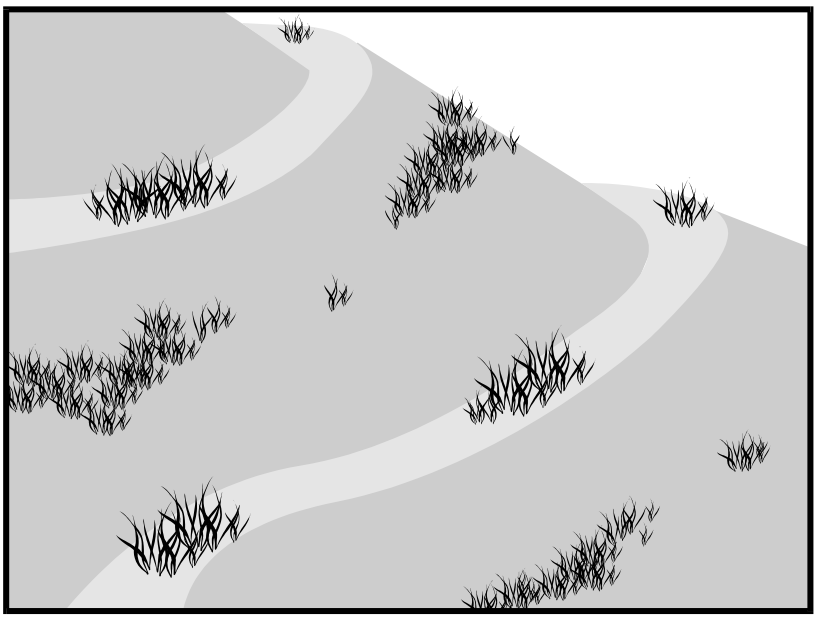
Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Hydroseeding EC-4



Description and Purpose

Hydroseeding typically consists of applying a mixture of a hydraulic mulch, seed, fertilizer, and stabilizing emulsion with a hydraulic mulcher, to temporarily protect exposed soils from erosion by water and wind. Hydraulic seeding, or hydroseeding, is simply the method by which temporary or permanent seed is applied to the soil surface.

Suitable Applications

Hydroseeding is suitable for disturbed areas requiring temporary protection until permanent stabilization is established, for disturbed areas that will be re-disturbed following an extended period of inactivity, or to apply permanent stabilization measures. Hydroseeding without mulch or other cover (e.g. EC-7, Erosion Control Blanket) is not a stand-alone erosion control BMP and should be combined with additional measures until vegetation establishment.

Typical applications for hydroseeding include:

- Disturbed soil/graded areas where permanent stabilization or continued earthwork is not anticipated prior to seed germination.
- Cleared and graded areas exposed to seasonal rains or temporary irrigation.
- Areas not subject to heavy wear by construction equipment or high traffic.

Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch
EC-5 Soil Binders
EC-6 Straw Mulch
EC-7 Geotextiles and Mats
EC-8 Wood Mulching
EC-14 Compost Blanket
EC-16 Non-Vegetative Stabilization

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Limitations

- Availability of hydroseeding equipment may be limited just prior to the rainy season and prior to storms due to high demand.
- Hydraulic seed should be applied with hydraulic mulch or a stand-alone hydroseed application should be followed by one of the following:
    - Straw mulch (see Straw Mulch EC-6)
    - Rolled erosion control products (see Geotextiles and Mats EC-7)
    - Application of Compost Blanket (see Compost Blanket EC-14)

  Hydraulic seed may be used alone only on small flat surfaces when there is sufficient time in the season to ensure adequate vegetation establishment and coverage to provide adequate erosion control.
- Hydraulic seed without mulch does not provide immediate erosion control.
- Temporary seeding may not be appropriate for steep slopes (i.e., slopes readily prone to rill erosion or without sufficient topsoil).
- Temporary seeding may not be appropriate in dry periods without supplemental irrigation.
- Temporary vegetation may have to be removed before permanent vegetation is applied.
- Temporary vegetation may not be appropriate for short term inactivity (i.e. less than 3-6 months).
- This BMP consists of a mixture of several constituents (e.g., fibers/mulches, tackifiers, and other chemical constituents), some of which may be proprietary and may come pre-mixed by the manufacturer. The water quality impacts of these constituents are relatively unknown and some may have water quality impacts due to their chemical makeup. Additionally these constituents may require non-visible pollutant monitoring. Refer to specific chemical properties identified in the product Material Safety Data Sheet; products should be evaluated for project-specific implementation by the SWPPP Preparer. Refer to factsheet EC-05 for further guidance on selecting soil binders.

Implementation

In order to select appropriate hydraulic seed mixtures, an evaluation of site conditions should be performed with respect to:

- Soil conditions
- Site topography and exposure (sun/wind)
- Season and climate
- Vegetation types
- Maintenance requirements
- Sensitive adjacent areas
- Water availability
- Plans for permanent vegetation

The local office of the U.S.D.A. Natural Resources Conservation Service (NRCS), Resource Conservation Districts and Agricultural Extension Service can provide information on appropriate seed mixes.

The following steps should be followed for implementation:

- Where appropriate or feasible, soil should be prepared to receive the seed by disking or otherwise scarifying (See EC-15, Soil Preparation) the surface to eliminate crust, improve air and water infiltration and create a more favorable environment for germination and growth.
- Avoid use of hydraulic seed in areas where the BMP would be incompatible with future earthwork activities.
- Hydraulic seed can be applied using a multiple step or one step process.
  - In a multiple step process, hydraulic seed is applied first, followed by mulch or a Rolled Erosion Control Product (RECP).
  - In the one step process, hydraulic seed is applied with hydraulic mulch in a hydraulic matrix. When the one step process is used to apply the mixture of fiber, seed, etc., the seed rate should be increased to compensate for all seeds not having direct contact with the soil.
- All hydraulically seeded areas should have mulch, or alternate erosion control cover to keep seeds in place and to moderate soil moisture and temperature until the seeds germinate and grow.
- All seeds should be in conformance with the California State Seed Law of the Department of Agriculture. Each seed bag should be delivered to the site sealed and clearly marked as to species, purity, percent germination, dealer's guarantee, and dates of test. The container should be labeled to clearly reflect the amount of Pure Live Seed (PLS) contained. All legume seed should be pellet inoculated. Inoculant sources should be species specific and should be applied at a rate of 2 lb of inoculant per 100 lb seed.
- Commercial fertilizer should conform to the requirements of the California Food and Agricultural Code, which can be found at http://www.leginfo.ca.gov/.html/fac_table_of_contents.html. Fertilizer should be pelleted or granular form.
- Follow up applications should be made as needed to cover areas of poor coverage or germination/vegetation establishment and to maintain adequate soil protection.
- Avoid over spray onto roads, sidewalks, drainage channels, existing vegetation, etc.
- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

Costs

Average cost for installation and maintenance may vary from as low as $1,900 per acre for flat slopes and stable soils, to $4,000 per acre for moderate to steep slopes and/or erosive soils. Cost of seed mixtures vary based on types of required vegetation.

BMP	Installed Cost per Acre
Hydraulic Seed	$1,900-$4,000

Source: Cost information received from individual product manufacturers solicited by Geosyntec Consultants (2004).

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Areas where erosion is evident should be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- Where seeds fail to germinate, or they germinate and die, the area must be re-seeded, fertilized, and mulched within the planting season, using not less than half the original application rates.
- Irrigation systems, if applicable, should be inspected daily while in use to identify system malfunctions and line breaks. When line breaks are detected, the system must be shut down immediately and breaks repaired before the system is put back into operation.
- Irrigation systems should be inspected for complete coverage and adjusted as needed to maintain complete coverage.

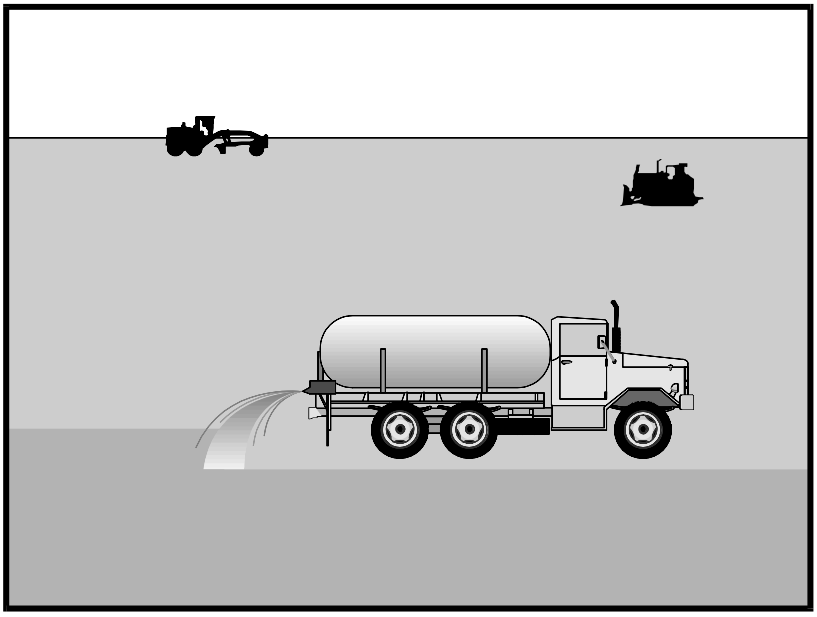
References

Soil Stabilization BMP Research for Erosion and Sediment Controls: Cost Survey Technical Memorandum, State of California Department of Transportation (Caltrans), July 2007.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999.

Soil Binders EC-5



Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch
EC-4 Hydroseeding
EC-6 Straw Mulch
EC-7 Geotextiles and Mats
EC-8 Wood Mulching

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Soil binding consists of application and maintenance of a soil stabilizer to exposed soil surfaces. Soil binders are materials applied to the soil surface to temporarily prevent water and wind induced erosion of exposed soils on construction sites.

Suitable Applications

Soil binders are typically applied to disturbed areas requiring temporary protection. Because soil binders, when used as a stand-alone practice, can often be incorporated into the soil, they are a good alternative to mulches in areas where grading activities will soon resume. Soil binders are commonly used in the following areas:

- Rough graded soils that will be inactive for a short period of time
- Soil stockpiles
- Temporary haul roads prior to placement of crushed rock
- Compacted soil road base
- Construction staging, materials storage, and layout areas

Limitations

- Soil binders are temporary in nature and may need reapplication.
- Soil binders require a minimum curing time until fully effective, as prescribed by the manufacturer. Curing time

may be 24 hours or longer. Soil binders may need reapplication after a storm event.

- Soil binders will generally experience spot failures during heavy rainfall events. If runoff penetrates the soil at the top of a slope treated with a soil binder, it is likely that the runoff will undercut the stabilized soil layer and discharge at a point further down slope.
- Plant-material-based soil binders do not generally hold up to pedestrian or vehicular traffic across treated areas as well as polymeric emulsion blends or cementitious-based binders.
- Soil binders may not sufficiently penetrate compacted soils.
- Some soil binders are soil texture specific in terms of their effectiveness. For example, polyacrylamides (PAMs) work very well on silt and clayey soils but their performance decreases dramatically in sandy soils.
- Some soil binders may not perform well with low relative humidity. Under rainy conditions, some agents may become slippery or leach out of the soil.
- Soil binders may not cure if low temperatures occur within 24 hours of application.
- The water quality impacts of some chemical soil binders are relatively unknown and some may have water quality impacts due to their chemical makeup. Additionally, these chemical may require non-visible pollutant monitoring. Products should be evaluated for project-specific implementation by the SWPPP Preparer. Refer to the product Material Safety Data Sheet for chemical properties.

Implementation

General Considerations

- Soil binders should conform to local municipality specifications and requirements.
- Site soil types will dictate appropriate soil binders to be used.
- A soil binder must be environmentally benign (non-toxic to plant and animal life), easy to apply, easy to maintain, economical, and should not stain paved or painted surfaces. Soil binders should not pollute stormwater when cured. Obtain a Material Safety Data Sheet (MSDS) from the manufacturer to ensure non-toxicity.
- Stormwater runoff from PAM treated soils should pass through one of the following sediment control BMP prior to discharging to surface waters.
    - When the total drainage area is greater than or equal to 5 acres, PAM treated areas should drain to a sediment basin.
    - Areas less than 5 acres should drain to sediment control BMPs, such as a sediment trap, or a series of check dams. The total number of check dams used should be maximized to achieve the greatest amount of settlement of sediment prior to discharging from the site. Each check dam should be spaced evenly in the drainage channel through which stormwater flows are discharged off site.

- Performance of soil binders depends on temperature, humidity, and traffic across treated areas.
- Avoid over spray onto roads, sidewalks, drainage channels, existing vegetation, etc.
- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

Selecting a Soil Binder

Properties of common soil binders used for erosion control are provided on Table 1 at the end of this Fact Sheet. Use Table 1 to select an appropriate soil binder. Refer to WE-1, Wind Erosion Control, for dust control soil binders.

Factors to consider when selecting a soil binder include the following:

- Suitability to situation - Consider where the soil binder will be applied, if it needs a high resistance to leaching or abrasion, and whether it needs to be compatible with any existing vegetation. Determine the length of time soil stabilization will be needed, and if the soil binder will be placed in an area where it will degrade rapidly. In general, slope steepness is not a discriminating factor for the listed soil binders.
- Soil types and surface materials - Fines and moisture content are key properties of surface materials. Consider a soil binder's ability to penetrate, likelihood of leaching, and ability to form a surface crust on the surface materials.
- Frequency of application - The frequency of application is related to the functional longevity of the binder, which can be affected by subgrade conditions, surface type, climate, and maintenance schedule.
- Frequent applications could lead to high costs. Application frequency may be minimized if the soil binder has good penetration, low evaporation, and good longevity. Consider also that frequent application will require frequent equipment clean up.

Plant-Material-Based (Short Lived, <6 months) Binders

Guar: Guar is a non-toxic, biodegradable, natural galactomannan-based hydrocolloid treated with dispersant agents for easy field mixing. It should be mixed with water at the rate of 11 to 15 lb per 1,000 gallons. Recommended minimum application rates are as follows:

Application Rates for Guar Soil Stabilizer

Slope (H:V):	Flat	4:1	3:1	2:1	1:1
lb/acre:	40	45	50	60	70

Psyllium: Psyllium is composed of the finely ground muciloid coating of plantago seeds that is applied as a dry powder or in a wet slurry to the surface of the soil. It dries to form a firm but rewettable membrane that binds soil particles together, but permits germination and growth of seed. Psyllium requires 12 to 18 hours drying time. Application rates should be from 80 to 200 lb/acre, with enough water in solution to allow for a uniform slurry flow.

Starch: Starch is non-ionic, cold water soluble (pre-gelatinized) granular cornstarch. The material is mixed with water and applied at the rate of 150 lb/acre. Approximate drying time is 9 to 12 hours.

Plant-Material-Based (Long Lived, 6-12 months) Binders

Pitch and Rosin Emulsion: Generally, a non-ionic pitch and rosin emulsion has a minimum solids content of 48%. The rosin should be a minimum of 26% of the total solids content. The soil stabilizer should be non-corrosive, water dilutable emulsion that upon application cures to a water insoluble binding and cementing agent. For soil erosion control applications, the emulsion is diluted and should be applied as follows:

- For clayey soil: 5 parts water to 1 part emulsion
- For sandy soil: 10 parts water to 1 part emulsion

Application can be by water truck or hydraulic seeder with the emulsion and product mixture applied at the rate specified by the manufacturer.

Polymeric Emulsion Blend Binders

Acrylic Copolymers and Polymers: Polymeric soil stabilizers should consist of a liquid or solid polymer or copolymer with an acrylic base that contains a minimum of 55% solids. The polymeric compound should be handled and mixed in a manner that will not cause foaming or should contain an anti-foaming agent. The polymeric emulsion should not exceed its shelf life or expiration date; manufacturers should provide the expiration date. Polymeric soil stabilizer should be readily miscible in water, non-injurious to seed or animal life, non-flammable, should provide surface soil stabilization for various soil types without totally inhibiting water infiltration, and should not re-emulsify when cured. The applied compound typically requires 12 to 24 hours drying time. Liquid copolymer should be diluted at a rate of 10 parts water to 1 part polymer and the mixture applied to soil at a rate of 1,175 gallons/acre.

Liquid Polymers of Methacrylates and Acrylates: This material consists of a tackifier/sealer that is a liquid polymer of methacrylates and acrylates. It is an aqueous 100% acrylic emulsion blend of 40% solids by volume that is free from styrene, acetate, vinyl, ethoxylated surfactants or silicates. For soil stabilization applications, it is diluted with water in accordance with the manufacturer's recommendations, and applied with a hydraulic seeder at the rate of 20 gallons/acre. Drying time is 12 to 18 hours after application.

Copolymers of Sodium Acrylates and Acrylamides: These materials are non-toxic, dry powders that are copolymers of sodium acrylate and acrylamide. They are mixed with water and applied to the soil surface for erosion control at rates that are determined by slope gradient:

Slope Gradient (H:V)	lb/acre
Flat to 5:1	3.0 – 5.0
5:1 to 3:1	5.0 – 10.0
2:1 to 1:1	10.0 – 20.0

Poly-Acrylamide (PAM) and Copolymer of Acrylamide**:** Linear copolymer polyacrylamide for use as a soil binder is packaged as a dry flowable solid, as a liquid. Refer to the manufacturer's recommendation for dilution and application rates as they vary based on liquid or dry form, site conditions and climate.

- Limitations specific to PAM are as follows:
  - Do not use PAM on a slope that flows into a water body without passing through a sediment trap or sediment basin.
  - The specific PAM copolymer formulation must be anionic. Cationic PAM should not be used in any application because of known aquatic toxicity problems. Only the highest drinking water grade PAM, certified for compliance with ANSI/NSF Standard 60 for drinking water treatment, should be used for soil applications.
  - PAM designated for erosion and sediment control should be "water soluble" or "linear" or "non-cross linked".
  - PAM should not be used as a stand-alone BMP to protect against water-based erosion. When combined with mulch, its effectiveness increases dramatically.

Hydro-Colloid Polymers: Hydro-Colloid Polymers are various combinations of dry flowable poly-acrylamides, copolymers and hydro-colloid polymers that are mixed with water and applied to the soil surface at rates of 55 to 60 lb/acre. Drying times are 0 to 4 hours.

Cementitious-Based Binders

Gypsum: This is a formulated gypsum based product that readily mixes with water and mulch to form a thin protective crust on the soil surface. It is composed of high purity gypsum that is ground, calcined and processed into calcium sulfate hemihydrate with a minimum purity of 86%. It is mixed in a hydraulic seeder and applied at rates 4,000 to 12,000 lb/acre. Drying time is 4 to 8 hours.

Applying Soil Binders

After selecting an appropriate soil binder, the untreated soil surface must be prepared before applying the soil binder. The untreated soil surface must contain sufficient moisture to assist the agent in achieving uniform distribution. In general, the following steps should be followed:

- Follow manufacturer's written recommendations for application rates, pre-wetting of application area, and cleaning of equipment after use.
- Prior to application, roughen embankment and fill areas.
- Consider the drying time for the selected soil binder and apply with sufficient time before anticipated rainfall. Soil binders should not be applied during or immediately before rainfall.
- Avoid over spray onto roads, sidewalks, drainage channels, sound walls, existing vegetation, etc.

- Soil binders should not be applied to frozen soil, areas with standing water, under freezing or rainy conditions, or when the temperature is below 40°F during the curing period.
- More than one treatment is often necessary, although the second treatment may be diluted or have a lower application rate.
- Generally, soil binders require a minimum curing time of 24 hours before they are fully effective. Refer to manufacturer's instructions for specific cure time.
- For liquid agents:
  - Crown or slope ground to avoid ponding.
  - Uniformly pre-wet ground at 0.03 to 0.3 gal/yd^2 or according to manufacturer's recommendations.
  - Apply solution under pressure. Overlap solution 6 to 12 in.
  - Allow treated area to cure for the time recommended by the manufacturer; typically at least 24 hours.
  - Apply second treatment before first treatment becomes ineffective, using 50% application rate.
  - In low humidities, reactivate chemicals by re-wetting with water at 0.1 to 0.2 gal/yd^2.

Costs

Costs vary according to the soil stabilizer selected for implementation. The following are approximate installed costs:

Soil Binder	Cost per Acre (2004)[1]	Estimated Cost per Acre (2009)[2]
Plant-Material-Based (Short Lived) Binders	$700-$900	$770-$990
Plant-Material-Based (Long Lived) Binders	$1,200-$1,500	$1,320-$1,650
Polymeric Emulsion Blend Binders	$700 -$1,500	$770-$1,650
Cementitious-Based Binders	$800-$1,200	$880-$1,350

1. Source: Cost information received from individual product manufacturers solicited by Geosyntec Consultants (2004).

2. 2009 costs reflect a 10% escalation over year 2004 costs. Escalation based on informal survey of industry trends. Note: Expected cost increase is offset by competitive economic conditions.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Areas where erosion is evident should be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- Reapply the selected soil binder as needed to maintain effectiveness.

Table 1 Properties of Soil Binders for Erosion Control

Evaluation Criteria	Binder Type			
	Plant Material Based (Short Lived)	**Plant Material Based (Long Lived)**	**Polymeric Emulsion Blends**	**Cementitious-Based Binders**
Relative Cost	Low	Moderate to High	Low to High	Low to Moderate
Resistance to Leaching	High	High	Low to Moderate	Moderate
Resistance to Abrasion	Moderate	Low	Moderate to High	Moderate to High
Longevity	Short to Medium	Medium	Medium to Long	Medium
Minimum Curing Time before Rain	9 to 18 hours	19 to 24 hours	0 to 24 hours	4 to 8 hours
Compatibility with Existing Vegetation	Good	Poor	Poor	Poor
Mode of Degradation	Biodegradable	Biodegradable	Photodegradable/ Chemically Degradable	Photodegradable/ Chemically Degradable
Labor Intensive	No	No	No	No
Specialized Application Equipment	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher
Liquid/Powder	Powder	Liquid	Liquid/Powder	Powder
Surface Crusting	Yes, but dissolves on rewetting	Yes	Yes, but dissolves on rewetting	Yes
Clean Up	Water	Water	Water	Water
Erosion Control Application Rate	Varies (1)	Varies (1)	Varies (1)	4,000 to 12,000 lbs/acre

(1) See Implementation for specific rates.

References

Erosion Control Pilot Study Report, State of California Department of Transportation (Caltrans), June 2000.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

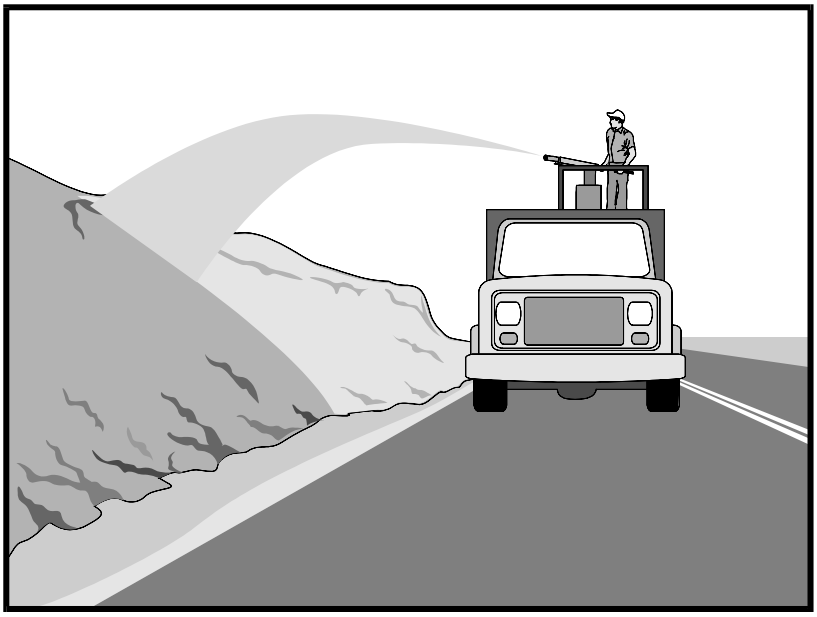
Sedimentation and Erosion Control, An Inventory of Current Practices Draft, US EPA, April 1990.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Straw Mulch EC-6



Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch
EC-4 Hydroseeding
EC-5 Soil Binders
EC-7 Geotextiles and Mats
EC-8 Wood Mulching
EC-14 Compost Blanket

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Straw mulch consists of placing a uniform layer of straw and incorporating it into the soil with a studded roller or crimper, or anchoring it with a tackifier or stabilizing emulsion. Straw mulch protects the soil surface from the impact of rain drops, preventing soil particles from becoming dislodged.

Suitable Applications

Straw mulch is suitable for disturbed areas requiring temporary protection until permanent stabilization is established. Straw mulch can be specified for the following applications:

- As a stand-alone BMP on disturbed areas until soils can be prepared for permanent vegetation. The longevity of straw mulch is typically less than six months.
- Applied in combination with temporary seeding strategies
- Applied in combination with permanent seeding strategies to enhance plant establishment and final soil stabilization
- Applied around containerized plantings to control erosion until the plants become established to provide permanent stabilization

Limitations

Availability of straw and straw blowing equipment may be limited just prior to the rainy season and prior to storms due to high demand.

- There is a potential for introduction of weed seed and unwanted plant material if weed-free agricultural straw is not specified.
- Straw mulch applied by hand is more time intensive and potentially costly.
- Wind may limit application of straw and blow straw into undesired locations.
- May have to be removed prior to permanent seeding or prior to further earthwork.
- "Punching" of straw does not work in sandy soils, necessitating the use of tackifiers.
- Potential fugitive dust control issues associated with straw applications can occur. Application of a stabilizing emulsion or a water stream at the same time straw is being blown can reduce this problem.
- Use of plastic netting should be avoided in areas where wildlife may be entrapped and may be prohibited for projects in certain areas with sensitive wildlife species, especially reptiles and amphibians.

Implementation

- Straw should be derived from weed-free wheat, rice, or barley. Where required by the plans, specifications, permits, or environmental documents, native grass straw should be used.
- Use tackifier to anchor straw mulch to the soil on slopes.
- Crimping, punch roller-type rollers, or track walking may also be used to incorporate straw mulch into the soil on slopes. Track walking can be used where other methods are impractical.
- Avoid placing straw onto roads, sidewalks, drainage channels, sound walls, existing vegetation, etc.
- Straw mulch with tackifier should not be applied during or immediately before rainfall.
- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

Application Procedures

- When using a tackifier to anchor the straw mulch, roughen embankment or fill areas by rolling with a crimping or punching-type roller or by track walking before placing the straw mulch. Track walking should only be used where rolling is impractical.
- Apply straw at a rate of between 3,000 and 4,000 lb/acre, either by machine or by hand distribution and provide 100% ground cover. A lighter application is used for flat surfaces and a heavier application is used for slopes.
- Evenly distribute straw mulch on the soil surface.
- Anchoring straw mulch to the soil surface by "punching" it into the soil mechanically (incorporating) can be used in lieu of a tackifier.

- Methods for holding the straw mulch in place depend upon the slope steepness, accessibility, soil conditions, and longevity.

  - A tackifier acts to glue the straw fibers together and to the soil surface. The tackifier should be selected based on longevity and ability to hold the fibers in place. A tackifier is typically applied at a rate of 125 lb/acre. In windy conditions, the rates are typically 180 lb/acre.

  - On very small areas, a spade or shovel can be used to punch in straw mulch.

  - On slopes with soils that are stable enough and of sufficient gradient to safely support construction equipment without contributing to compaction and instability problems, straw can be "punched" into the ground using a knife blade roller or a straight bladed coulter, known commercially as a "crimper."

Costs

Average annual cost for installation and maintenance is included in the table below. Application by hand is more time intensive and potentially more costly.

BMP	Unit Cost per Acre
Straw mulch, crimped or punched	$2,458-$5,375
Straw mulch with tackifier	$1,823-$4,802

Source: Cost information received from individual product suppliers solicited by Geosyntec Consultants (2004).

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Areas where erosion is evident should be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.

- The key consideration in inspection and maintenance is that the straw needs to last long enough to achieve erosion control objectives. Straw mulch as a stand-alone BMP is temporary and is not suited for long-term erosion control.

- Maintain an unbroken, temporary mulched ground cover while disturbed soil areas are inactive. Repair any damaged ground cover and re-mulch exposed areas.

- Reapplication of straw mulch and tackifier may be required to maintain effective soil stabilization over disturbed areas and slopes.

References

Soil Stabilization BMP Research for Erosion and Sediment Controls: Cost Survey Technical Memorandum, State of California Department of Transportation (Caltrans), July 2007.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Controlling Erosion of Construction Sites, Agricultural Information Bulletin #347, U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service – SCS).

Guides for Erosion and Sediment Control in California, USDA Soils Conservation Service, January 1991.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

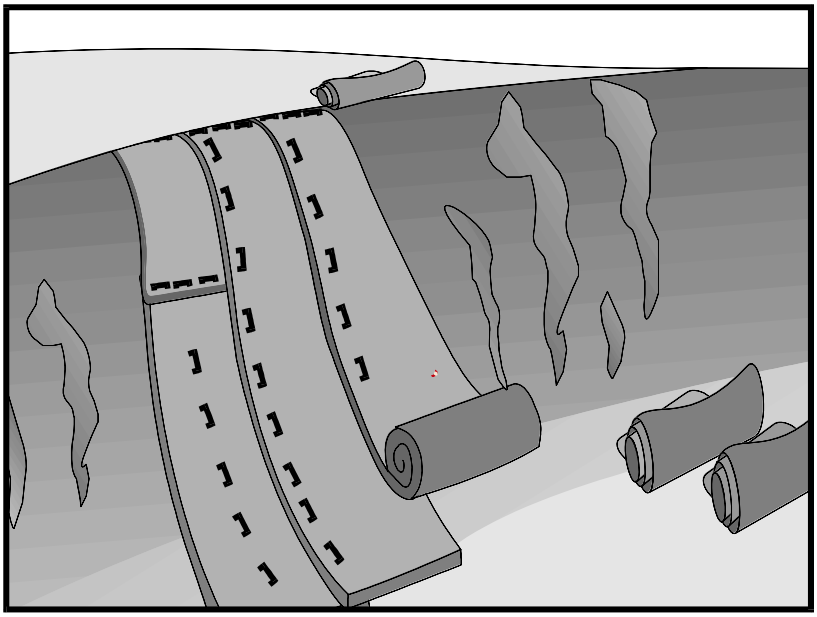
Soil Erosion by Water, Agricultural Information Bulletin #513, U.S. Department of Agriculture, Soil Conservation Service.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Geotextiles and Mats EC-7



Categories		
EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch

EC-4 Hydroseeding

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Mattings, or Rolled Erosion Control Products (RECPs), can be made of natural or synthetic materials or a combination of the two. RECPs are used to cover the soil surface to reduce erosion from rainfall impact, hold soil in place, and absorb and hold moisture near the soil surface. Additionally, RECPs may be used to stabilize soils until vegetation is established or to reinforce non-woody surface vegetation.

Suitable Applications

RECPs are typically applied on slopes where erosion hazard is high and vegetation will be slow to establish. Mattings are also used on stream banks, swales and other drainage channels where moving water at velocities between 3 ft/s and 6 ft/s are likely to cause scour and wash out new vegetation, and in areas where the soil surface is disturbed and where existing vegetation has been removed. RECPs may also be used when seeding cannot occur (e.g., late season construction and/or the arrival of an early rain season). RECPs should be considered when the soils are fine grained and potentially erosive. RECPs should be considered in the following situations.

- Steep slopes, generally steeper than 3:1 (H:V)
- Slopes where the erosion potential is high
- Slopes and disturbed soils where mulch must be anchored
- Disturbed areas where plants are slow to develop

- Channels with flows exceeding 3.3 ft/s
- Channels to be vegetated
- Stockpiles
- Slopes adjacent to water bodies

Limitations

- RECP installed costs are generally higher than other erosion control BMPs, limiting their use to areas where other BMPs are ineffective (e.g. channels, steep slopes).
- RECPs may delay seed germination, due to reduction in soil temperature.
- RECPs are generally not suitable for excessively rocky sites or areas where the final vegetation will be mowed (since staples and netting can catch in mowers). If a staple or pin cannot be driven into the soil because the underlying soil is too hard or rocky, then an alternative BMP should be selected.
- If used for temporary erosion control, RECPs should be removed and disposed of prior to application of permanent soil stabilization measures.
- The use of plastic should be limited to covering stockpiles or very small graded areas for short periods of time (such as through one imminent storm event) until more environmentally friendly measures, such as seeding and mulching, may be installed.
    - Plastic sheeting is easily vandalized, easily torn, photodegradable, and must be disposed of at a landfill.
    - Plastic sheeting results in 100% runoff, which may cause serious erosion problems in the areas receiving the increased flow.
- RECPs may have limitations based on soil type, slope gradient, or channel flow rate; consult the manufacturer for proper selection.
- Not suitable for areas that have foot traffic (tripping hazard) – e.g., pad areas around buildings under construction.
- RECPs that incorporate a plastic netting (e.g. straw blanket typically uses a plastic netting to hold the straw in place) may not be suitable near known wildlife habitat. Wildlife can become trapped in the plastic netting.
- RECPs may have limitations in extremely windy climates. However, when RECPs are properly trenched at the top and bottom and stapled in accordance with the manufacturer's recommendations, problems with wind can be minimized.

Implementation

Material Selection

- Natural RECPs have been found to be effective where re-vegetation will be provided by re-seeding. The choice of material should be based on the size of area, side slopes, surface conditions such as hardness, moisture, weed growth, and availability of materials.

- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

- The following natural and synthetic RECPs are commonly used:

Geotextiles

- Material can be a woven or a non-woven polypropylene fabric with minimum thickness of 0.06 in., minimum width of 12 ft and should have minimum tensile strength of 150 lbs (warp), 80 lbs (fill) in conformance with the requirements in ASTM Designation: D 4632. The permittivity of the fabric should be approximately 0.07 sec^{-1} in conformance with the requirements in ASTM Designation: D4491. The fabric should have an ultraviolet (UV) stability of 70 percent in conformance with the requirements in ASTM designation: D4355. Geotextile blankets must be secured in place with wire staples or sandbags and by keying into tops of slopes to prevent infiltration of surface waters under geotextile. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- Geotextiles may be reused if they are suitable for the use intended.

Plastic Covers

- Generally plastic sheeting should only be used as stockpile covering or for very small graded areas for short periods of time (such as through one imminent storm event). If plastic sheeting must be used, choose a plastic that will withstand photo degradation.

- Plastic sheeting should have a minimum thickness of 6 mils, and must be keyed in at the top of slope (when used as a temporary slope protection) and firmly held in place with sandbags or other weights placed no more than 10 ft apart. Seams are typically taped or weighted down their entire length, and there should be at least a 12 in. to 24 in. overlap of all seams. Edges should be embedded a minimum of 6 in. in soil (when used as a temporary slope protection).

- All sheeting must be inspected periodically after installation and after significant rainstorms to check for erosion, undermining, and anchorage failure. Any failures must be repaired immediately. If washout or breakages occur, the material should be re-installed after repairing the damage to the slope.

Erosion Control Blankets/Mats

- Biodegradable RECPs are typically composed of jute fibers, curled wood fibers, straw, coconut fiber, or a combination of these materials. In order for an RECP to be considered 100% biodegradable, the netting, sewing or adhesive system that holds the biodegradable mulch fibers together must also be biodegradable. See typical installation details at the end of this fact sheet.

- **Jute** is a natural fiber that is made into a yarn that is loosely woven into a biodegradable mesh. The performance of jute as a stand-alone RECP is low. Most other RECPs outperform jute as a temporary erosion control product and therefore jute is not commonly used. It is designed to be used in conjunction with vegetation. The material is supplied in rolled strips, which should be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Excelsior** (curled wood fiber) blanket material should consist of machine produced mats of curled wood excelsior with 80 percent of the fiber 6 in. or longer. The excelsior blanket should be of consistent thickness. The wood fiber must be evenly distributed over the entire area of the blanket. The top surface of the blanket should be covered with a photodegradable extruded plastic mesh. The blanket should be smolder resistant without the use of chemical additives and should be non-toxic and non-injurious to plant and animal life. Excelsior blankets should be furnished in rolled strips, a minimum of 48 in. wide, and should have an average weight of 0.8 lb/yd^2, ±10 percent, at the time of manufacture. Excelsior blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Straw blanket** should be machine produced mats of straw with a lightweight biodegradable netting top layer. The straw should be attached to the netting with biodegradable thread or glue strips. The straw blanket should be of consistent thickness. The straw should be evenly distributed over the entire area of the blanket. Straw blanket should be furnished in rolled strips a minimum of 6.5 ft wide, a minimum of 80 ft long and a minimum of 0.5 lb/yd^2. Straw blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Wood fiber blanket** is composed of biodegradable fiber mulch with extruded plastic netting held together with adhesives. The material is designed to enhance re-vegetation. The material is furnished in rolled strips, which must be secured to the ground with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Coconut fiber blanket** should be a machine produced mat of 100 percent coconut fiber with biodegradable netting on the top and bottom. The coconut fiber should be attached to the netting with biodegradable thread or glue strips. The coconut fiber blanket should be of consistent thickness. The coconut fiber should be evenly distributed over the entire area of the blanket. Coconut fiber blanket should be furnished in rolled strips with a minimum of 6.5 ft wide, a minimum of 80 ft. long and a minimum of 0.5 lb/yd^2. Coconut fiber blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Coconut fiber mesh** is a thin permeable membrane made from coconut or corn fiber that is spun into a yarn and woven into a biodegradable mat. It is designed to be used in conjunction with vegetation and typically has longevity of several years. The material is supplied in rolled strips, which must be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Straw coconut fiber blanket** should be machine produced mats of 70 percent straw and 30 percent coconut fiber with a biodegradable netting top layer and a biodegradable bottom net. The straw and coconut fiber should be attached to the netting with biodegradable thread or glue strips. The straw coconut fiber blanket should be of consistent thickness. The straw and coconut fiber should be evenly distributed over the entire area of the blanket. Straw coconut fiber blanket should be furnished in rolled strips a minimum of 6.5 ft wide, a minimum of 80 ft long and a minimum of 0.5 lb/yd^2. Straw coconut fiber blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- Non-biodegradable RECPs are typically composed of polypropylene, polyethylene, nylon or other synthetic fibers. In some cases, a combination of biodegradable and synthetic fibers is used to construct the RECP. Netting used to hold these fibers together is typically non-biodegradable as well.

  - **Plastic netting** is a lightweight biaxially oriented netting designed for securing loose mulches like straw or paper to soil surfaces to establish vegetation. The netting is photodegradable. The netting is supplied in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

  - **Plastic mesh** is an open weave geotextile that is composed of an extruded synthetic fiber woven into a mesh with an opening size of less than ¼ in. It is used with re-vegetation or may be used to secure loose fiber such as straw to the ground. The material is supplied in rolled strips, which must be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

  - **Synthetic fiber with netting** is a mat that is composed of durable synthetic fibers treated to resist chemicals and ultraviolet light. The mat is a dense, three dimensional mesh of synthetic (typically polyolefin) fibers stitched between two polypropylene nets. The mats are designed to be re-vegetated and provide a permanent composite system of soil, roots, and geomatrix. The material is furnished in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

  - **Bonded synthetic fibers** consist of a three dimensional geomatrix nylon (or other synthetic) matting. Typically it has more than 90 percent open area, which facilitates root growth. It's tough root reinforcing system anchors vegetation and protects against hydraulic lift and shear forces created by high volume discharges. It can be installed over prepared soil, followed by seeding into the mat. Once vegetated, it becomes an invisible composite system of soil, roots, and geomatrix. The material is furnished in rolled strips that must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

  - **Combination synthetic and biodegradable RECPs** consist of biodegradable fibers, such as wood fiber or coconut fiber, with a heavy polypropylene net stitched to the top and a high strength continuous filament geomatrix or net stitched to the bottom. The material is designed to enhance re-vegetation. The material is furnished in rolled strips,

which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

Site Preparation

- Proper soil preparation is essential to ensure complete contact of the RECP with the soil. Soil Roughening is not recommended in areas where RECPs will be installed.
- Grade and shape the area of installation.
- Remove all rocks, clods, vegetation or other obstructions so that the installed blankets or mats will have complete, direct contact with the soil.
- Prepare seedbed by loosening 2 to 3 in. of topsoil.

Seeding/Planting

Seed the area before blanket installation for erosion control and re-vegetation. Seeding after mat installation is often specified for turf reinforcement application. When seeding prior to blanket installation, all areas disturbed during blanket installation must be re-seeded. Where soil filling is specified for turf reinforcement mats (TRMs), seed the matting and the entire disturbed area after installation and prior to filling the mat with soil.

Fertilize and seed in accordance with seeding specifications or other types of landscaping plans. The protective matting can be laid over areas where grass has been planted and the seedlings have emerged. Where vines or other ground covers are to be planted, lay the protective matting first and then plant through matting according to design of planting.

Check Slots

Check slots shall be installed as required by the manufacturer.

Laying and Securing Matting

- Before laying the matting, all check slots should be installed and the seedbed should be friable, made free from clods, rocks, and roots. The surface should be compacted and finished according to the requirements of the manufacturer's recommendations.
- Mechanical or manual lay down equipment should be capable of handling full rolls of fabric and laying the fabric smoothly without wrinkles or folds. The equipment should meet the fabric manufacturer's recommendations or equivalent standards.

Anchoring

- U-shaped wire staples, metal geotextile stake pins, or triangular wooden stakes can be used to anchor mats and blankets to the ground surface.
- Wire staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.
- Metal stake pins should be 0.188 in. diameter steel with a 1.5 in. steel washer at the head of the pin, and 8 in. in length.
- Wire staples and metal stakes should be driven flush to the soil surface.

Installation on Slopes

Installation should be in accordance with the manufacturer's recommendations. In general, these will be as follows:

- Begin at the top of the slope and anchor the blanket in a 6 in. deep by 6 in. wide trench. Backfill trench and tamp earth firmly.
- Unroll blanket down slope in the direction of water flow.
- Overlap the edges of adjacent parallel rolls 2 to 3 in. and staple every 3 ft (or greater, per manufacturer's specifications).
- When blankets must be spliced, place blankets end over end (shingle style) with 6 in. overlap. Staple through overlapped area, approximately 12 in. apart.
- Lay blankets loosely and maintain direct contact with the soil. Do not stretch.
- Staple blankets sufficiently to anchor blanket and maintain contact with the soil. Staples should be placed down the center and staggered with the staples placed along the edges. Steep slopes, 1:1 (H:V) to 2:1 (H:V), require a minimum of 2 staples/yd^2. Moderate slopes, 2:1 (H:V) to 3:1 (H:V), require a minimum of 1 ½ staples/yd^2. Check manufacturer's specifications to determine if a higher density staple pattern is required.

Installation in Channels

Installation should be in accordance with the manufacturer's recommendations. In general, these will be as follows:

- Dig initial anchor trench 12 in. deep and 6 in. wide across the channel at the lower end of the project area.
- Excavate intermittent check slots, 6 in. deep and 6 in. wide across the channel at 25 to 30 ft intervals along the channels.
- Cut longitudinal channel anchor trenches 4 in. deep and 4 in. wide along each side of the installation to bury edges of matting, whenever possible extend matting 2 to 3 in. above the crest of the channel side slopes.
- Beginning at the downstream end and in the center of the channel, place the initial end of the first roll in the anchor trench and secure with fastening devices at 12 in. intervals. Note: matting will initially be upside down in anchor trench.
- In the same manner, position adjacent rolls in anchor trench, overlapping the preceding roll a minimum of 3 in.
- Secure these initial ends of mats with anchors at 12 in. intervals, backfill and compact soil.
- Unroll center strip of matting upstream. Stop at next check slot or terminal anchor trench. Unroll adjacent mats upstream in similar fashion, maintaining a 3 in. overlap.

- Fold and secure all rolls of matting snugly into all transverse check slots. Lay mat in the bottom of the slot then fold back against itself. Anchor through both layers of mat at 12 in. intervals, then backfill and compact soil. Continue rolling all mat widths upstream to the next check slot or terminal anchor trench.
- Alternate method for non-critical installations: Place two rows of anchors on 6 in. centers at 25 to 30 ft. intervals in lieu of excavated check slots.
- Staple shingled lap spliced ends a minimum of 12 in. apart on 12 in. intervals.
- Place edges of outside mats in previously excavated longitudinal slots; anchor using prescribed staple pattern, backfill, and compact soil.
- Anchor, fill, and compact upstream end of mat in a 12 in. by 6 in. terminal trench.
- Secure mat to ground surface using U-shaped wire staples, geotextile pins, or wooden stakes.
- Seed and fill turf reinforcement matting with soil, if specified.

Soil Filling (if specified for turf reinforcement mat (TRM))

Installation should be in accordance with the manufacturer's recommendations. Typical installation guidelines are as follows:

- After seeding, spread and lightly rake ½-3/4 inches of fine topsoil into the TRM apertures to completely fill TRM thickness. Use backside of rake or other flat implement.
- Alternatively, if allowed by product specifications, spread topsoil using lightweight loader, backhoe, or other power equipment. Avoid sharp turns with equipment.
- Always consult the manufacturer's recommendations for installation.
- Do not drive tracked or heavy equipment over mat.
- Avoid any traffic over matting if loose or wet soil conditions exist.
- Use shovels, rakes, or brooms for fine grading and touch up.
- Smooth out soil filling just exposing top netting of mat.

Temporary Soil Stabilization Removal

- Temporary soil stabilization removed from the site of the work must be disposed of if necessary.

Costs

Installed costs can be relatively high compared to other BMPs. Approximate costs for installed materials are shown below:

Rolled Erosion Control Products		Installed Cost per Acre (2004)[1]	Estimated Cost per Acre (2009)[2]
Biodegradable	Jute Mesh	$6,000-$7,000	$6,600-$7,700
	Curled Wood Fiber	$8,000-$10,500	$8,800-$11,050
	Straw	$8,000-$10,500	$8,800-$11,050
	Wood Fiber	$8,000-$10,500	$8,800-$11,050
	Coconut Fiber	$13,000-$14,000	$14,300-$15,400
	Coconut Fiber Mesh	$30,000-$33,000	$33,000-$36,300
	Straw Coconut Fiber	$10,000-$12,000	$11,000-$13,200
Non-Biodegradable	Plastic Netting	$2,000-$2,200	$2,200-$2,220
	Plastic Mesh	$3,000-$3,500	$3,300-$3,850
	Synthetic Fiber with Netting	$34,000-$40,000	$37,400-$44,000
	Bonded Synthetic Fibers	$45,000-$55,000	$49,500-$60,500
	Combination with Biodegradable	$30,000-$36,000	$33,000-$39,600

1. Source: Cost information received from individual product manufacturers solicited by Geosyntec Consultants (2004).

2. 2009 costs reflect a 10% escalation over year 2004 costs. Escalation based on informal survey of industry trends. Note: Expected cost increase is offset by competitive economic conditions.

Inspection and Maintenance

- RECPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Areas where erosion is evident shall be repaired and BMPs reapplied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require reapplication of BMPs.
- If washout or breakage occurs, re-install the material after repairing the damage to the slope or channel.
- Make sure matting is uniformly in contact with the soil.
- Check that all the lap joints are secure.
- Check that staples are flush with the ground.

References

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005

Erosion Control Pilot Study Report, State of California Department of Transportation (Caltrans), June 2000.

Guides for Erosion and Sediment Controls in California, USDA Soils Conservation Service, January 1991.

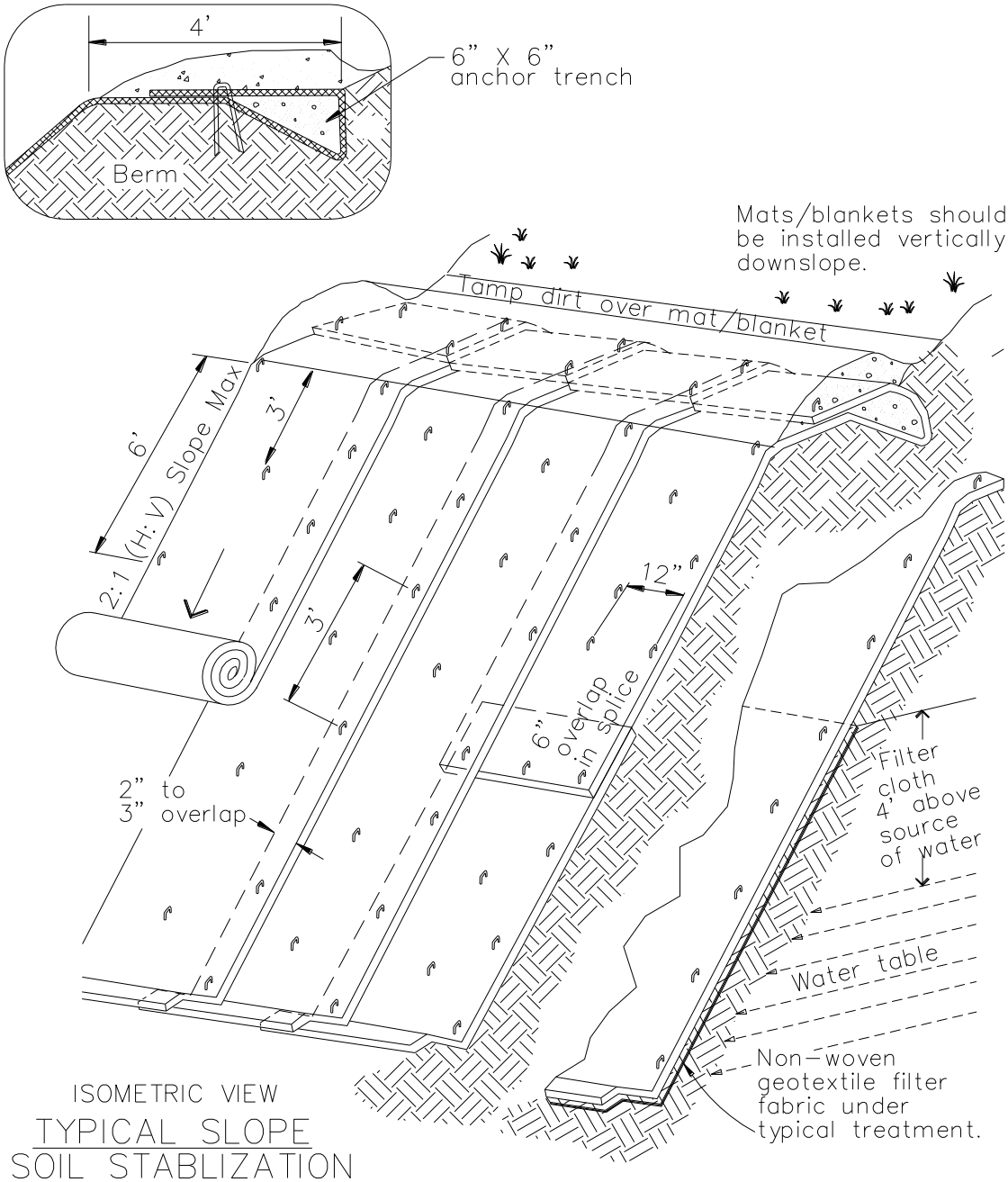
National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for The Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



ISOMETRIC VIEW

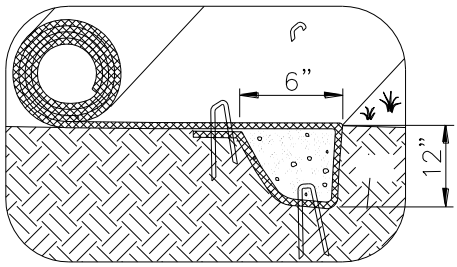
TYPICAL SLOPE
SOIL STABLIZATION
NTS

WET SLOPE LINING
NTS

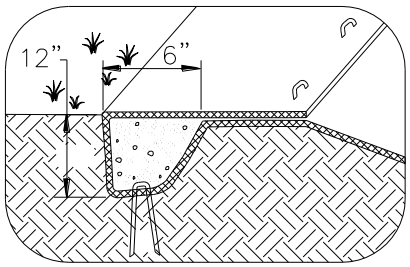
NOTES:

1. Slope surface shall be free of rocks, clods, sticks and grass. Mats/blankets shall have good soil contact.
2. Lay blankets loosely and stake or staple to maintain direct contact with the soil. Do not stretch.
3. Install per manufacturer's recommendations

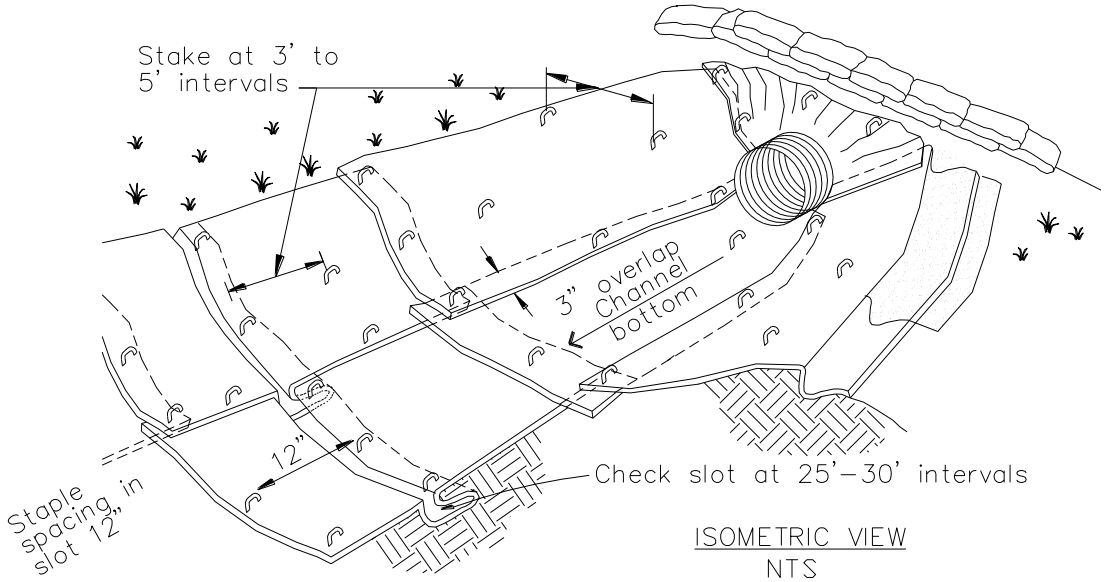
TYPICAL INSTALLATION DETAIL



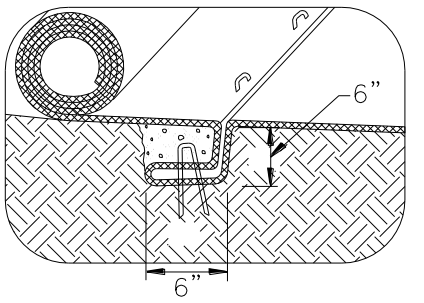
INITIAL CHANNEL ANCHOR TRENCH
NTS



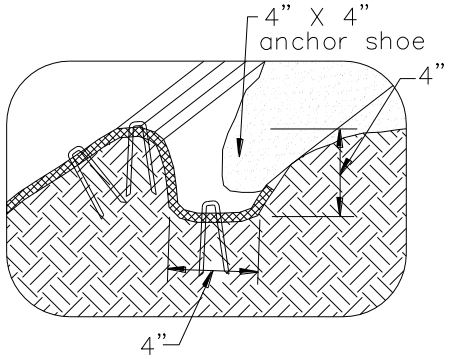
TERMINAL SLOPE AND CHANNEL ANCHOR TRENCH
NTS



ISOMETRIC VIEW
NTS



INTERMITTENT CHECK SLOT
NTS



LONGITUDINAL ANCHOR TRENCH
NTS

NOTES:
1. Check slots to be constructed per manufacturers specifications.
2. Staking or stapling layout per manufacturers specifications.
3. Install per manufacturer's recommendations

TYPICAL INSTALLATION DETAIL

Wood Mulching EC-8



Description and Purpose

Wood mulching consists of applying a mixture of shredded wood mulch, bark or compost to disturbed soils. The primary function of wood mulching is to reduce erosion by protecting bare soil from rainfall impact, increasing infiltration, and reducing runoff.

Suitable Applications

Wood mulching is suitable for disturbed soil areas requiring temporary protection until permanent stabilization is established.

Limitations

- Not suitable for use on slopes steeper than 3:1 (H:V). Best suited to flat areas or gentle slopes or 5:1 (H:V) or flatter.
- Wood mulch and compost may introduce unwanted species.
- Not suitable for areas exposed to concentrated flows.
- May need to be removed prior to further earthwork.

Implementation

Mulch Selection

There are many types of mulches. Selection of the appropriate type of mulch should be based on the type of application, site conditions, and compatibility with planned or future uses.

Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch

EC-4 Hydroseeding

EC-5 Soil Binders

EC-6 Straw Mulch

EC-7 Geotextiles and Mats

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Application Procedures

Prior to application, after existing vegetation has been removed, roughen embankment and fill areas by rolling with a device such as a punching type roller or by track walking. The construction application procedures for mulches vary significantly depending upon the type of mulching method specified. Two methods are highlighted here:

- Green Material: This type of mulch is produced by the recycling of vegetation trimmings such as grass, shredded shrubs, and trees. Methods of application are generally by hand although pneumatic methods are available.
  - Green material can be used as a temporary ground cover with or without seeding.
  - The green material should be evenly distributed on site to a depth of not more than 2 in.
- Shredded Wood: Suitable for ground cover in ornamental or revegetated plantings.
  - Shredded wood/bark is conditionally suitable. See note under limitations.
  - Distribute by hand or use pneumatic methods.
  - Evenly distribute the mulch across the soil surface to a depth of 2 to 3 in.
- Avoid mulch placement onto roads, sidewalks, drainage channels, existing vegetation, etc.

Costs

Average annual cost for installation and maintenance (3-4 months useful life) is around $4,000 per acre, but cost can increase if the source is not close to the project site.

Inspection and Maintenance

- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Areas where erosion is evident shall be repaired and BMPs reapplied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require reapplication of BMPs.
- Regardless of the mulching technique selected, the key consideration in inspection and maintenance is that the mulch needs to last long enough to achieve erosion control objectives. If the mulch is applied as a stand alone erosion control method over disturbed areas (without seed), it should last the length of time the site will remain barren or until final re-grading and revegetation.
- Where vegetation is not the ultimate cover, such as ornamental and landscape applications of bark or wood chips, inspection and maintenance should focus on longevity and integrity of the mulch.
- Reapply mulch when bare earth becomes visible.

References

Controlling Erosion of Construction Sites Agriculture Information Bulletin #347, U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service – SCS).

Guides for Erosion and Sediment Control in California, USDA Soils Conservation Service, January 1991.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group Working Paper, USEPA, April 1992.

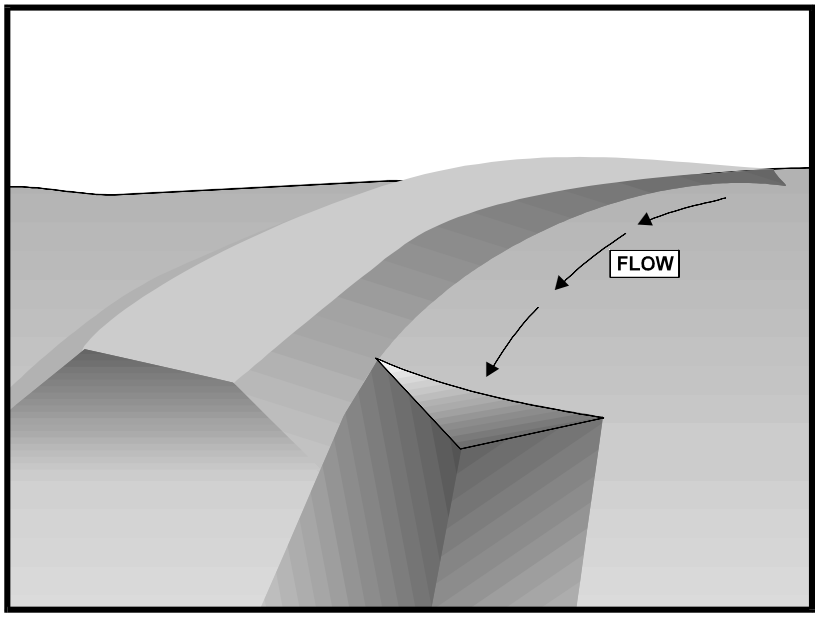
Sedimentation and Erosion Control, An Inventory of Current Practices Draft, U.S. EPA, April 1990.

Soil Erosion by Water Agricultural Information Bulletin #513, U.S. Department of Agriculture, Soil Conservation Service.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Earth Dikes and Drainage Swales EC-9



Description and Purpose

An earth dike is a temporary berm or ridge of compacted soil used to divert runoff or channel water to a desired location. A drainage swale is a shaped and sloped depression in the soil surface used to convey runoff to a desired location. Earth dikes and drainage swales are used to divert off site runoff around the construction site, divert runoff from stabilized areas and disturbed areas, and direct runoff into sediment basins or traps.

Suitable Applications

Earth dikes and drainage swales are suitable for use, individually or together, where runoff needs to be diverted from one area and conveyed to another.

- Earth dikes and drainage swales may be used:
  - To convey surface runoff down sloping land
  - To intercept and divert runoff to avoid sheet flow over sloped surfaces
  - To divert and direct runoff towards a stabilized watercourse, drainage pipe or channel
  - To intercept runoff from paved surfaces
  - Below steep grades where runoff begins to concentrate
  - Along roadways and facility improvements subject to flood drainage

Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- At the top of slopes to divert runon from adjacent or undisturbed slopes
- At bottom and mid slope locations to intercept sheet flow and convey concentrated flows
- Divert sediment laden runoff into sediment basins or traps

Limitations

Dikes should not be used for drainage areas greater than 10 acres or along slopes greater than 10 percent. For larger areas more permanent drainage structures should be built. All drainage structures should be built in compliance with local municipal requirements.

- Earth dikes may create more disturbed area on site and become barriers to construction equipment.
- Earth dikes must be stabilized immediately, which adds cost and maintenance concerns.
- Diverted stormwater may cause downstream flood damage.
- Dikes should not be constructed of soils that may be easily eroded.
- Regrading the site to remove the dike may add additional cost.
- Temporary drains and swales or any other diversion of runoff should not adversely impact upstream or downstream properties.
- Temporary drains and swales must conform to local floodplain management requirements.
- Earth dikes/drainage swales are not suitable as sediment trapping devices.
- It may be necessary to use other soil stabilization and sediment controls such as check dams, plastics, and blankets, to prevent scour and erosion in newly graded dikes, swales, and ditches.
- Sediment accumulation, scour depressions, and/or persistent non-stormwater discharges can result in areas of standing water suitable for mosquito production in drainage swales.

Implementation

The temporary earth dike is a berm or ridge of compacted soil, located in such a manner as to divert stormwater to a sediment trapping device or a stabilized outlet, thereby reducing the potential for erosion and offsite sedimentation. Earth dikes can also be used to divert runoff from off site and from undisturbed areas away from disturbed areas and to divert sheet flows away from unprotected slopes.

An earth dike does not itself control erosion or remove sediment from runoff. A dike prevents erosion by directing runoff to an erosion control device such as a sediment trap or directing runoff away from an erodible area. Temporary diversion dikes should not adversely impact adjacent properties and must conform to local floodplain management regulations, and should not be used in areas with slopes steeper than 10%.

Slopes that are formed during cut and fill operations should be protected from erosion by runoff. A combination of a temporary drainage swale and an earth dike at the top of a slope can divert

runoff to a location where it can be brought to the bottom of the slope (see EC-11, Slope Drains). A combination dike and swale is easily constructed by a single pass of a bulldozer or grader and compacted by a second pass of the tracks or wheels over the ridge. Diversion structures should be installed when the site is initially graded and remain in place until post construction BMPs are installed and the slopes are stabilized.

Diversion practices concentrate surface runoff, increasing its velocity and erosive force. Thus, the flow out of the drain or swale must be directed onto a stabilized area or into a grade stabilization structure. If significant erosion will occur, a swale should be stabilized using vegetation, chemical treatment, rock rip-rap, matting, or other physical means of stabilization. Any drain or swale that conveys sediment laden runoff must be diverted into a sediment basin or trap before it is discharged from the site.

General

- Care must be applied to correctly size and locate earth dikes, drainage swales. Excessively steep, unlined dikes, and swales are subject to erosion and gully formation.
- Conveyances should be stabilized.
- Use a lined ditch for high flow velocities.
- Select flow velocity based on careful evaluation of the risks due to erosion of the measure, soil types, overtopping, flow backups, washout, and drainage flow patterns for each project site.
- Compact any fills to prevent unequal settlement.
- Do not divert runoff onto other property without securing written authorization from the property owner.
- When possible, install and utilize permanent dikes, swales, and ditches early in the construction process.
- Provide stabilized outlets.

Earth Dikes

Temporary earth dikes are a practical, inexpensive BMP used to divert stormwater runoff. Temporary diversion dikes should be installed in the following manner:

- All dikes should be compacted by earth moving equipment.
- All dikes should have positive drainage to an outlet.
- All dikes should have 2:1 or flatter side slopes, 18 in. minimum height, and a minimum top width of 24 in. Wide top widths and flat slopes are usually needed at crossings for construction traffic.
- The outlet from the earth dike must function with a minimum of erosion. Runoff should be conveyed to a sediment trapping device such as a Sediment Trap (SE-3) or Sediment Basin

(SE-2) when either the dike channel or the drainage area above the dike are not adequately stabilized.

- Temporary stabilization may be achieved using seed and mulching for slopes less than 5% and either rip-rap or sod for slopes in excess of 5%. In either case, stabilization of the earth dike should be completed immediately after construction or prior to the first rain.
- If riprap is used to stabilize the channel formed along the toe of the dike, the following typical specifications apply:

Channel Grade	Riprap Stabilization
0.5-1.0%	4 in. Rock
1.1-2.0%	6 in. Rock
2.1-4.0%	8 in. Rock
4.1-5.0%	8 in. -12 in. Riprap

- The stone riprap, recycled concrete, etc. used for stabilization should be pressed into the soil with construction equipment.
- Filter cloth may be used to cover dikes in use for long periods.
- Construction activity on the earth dike should be kept to a minimum.

Drainage Swales

Drainage swales are only effective if they are properly installed. Swales are more effective than dikes because they tend to be more stable. The combination of a swale with a dike on the downhill side is the most cost effective diversion.

Standard engineering design criteria for small open channel and closed conveyance systems should be used (see the local drainage design manual). Unless local drainage design criteria state otherwise, drainage swales should be designed as follows:

- No more than 5 acres may drain to a temporary drainage swale.
- Place drainage swales above or below, not on, a cut or fill slope.
- Swale bottom width should be at least 2 ft
- Depth of the swale should be at least 18 in.
- Side slopes should be 2:1 or flatter.
- Drainage or swales should be laid at a grade of at least 1 percent, but not more than 15 percent.
- The swale must not be overtopped by the peak discharge from a 10-year storm, irrespective of the design criteria stated above.

- Remove all trees, stumps, obstructions, and other objectionable material from the swale when it is built.
- Compact any fill material along the path of the swale.
- Stabilize all swales immediately. Seed and mulch swales at a slope of less than 5 percent, and use rip-rap or sod for swales with a slope between 5 and 15 percent. For temporary swales, geotextiles and mats (EC-7) may provide immediate stabilization.
- Irrigation may be required to establish sufficient vegetation to prevent erosion.
- Do not operate construction vehicles across a swale unless a stabilized crossing is provided.
- Permanent drainage facilities must be designed by a professional engineer (see the local drainage design criteria for proper design).
- At a minimum, the drainage swale should conform to predevelopment drainage patterns and capacities.
- Construct the drainage swale with a positive grade to a stabilized outlet.
- Provide erosion protection or energy dissipation measures if the flow out of the drainage swale can reach an erosive velocity.

Costs

- Cost ranges from $15 to $55 per ft for both earthwork and stabilization and depends on availability of material, site location, and access.
- Small dikes: $2.50 - $6.50/linear ft; Large dikes: $2.50/yd^3.
- The cost of a drainage swale increases with drainage area and slope. Typical swales for controlling internal erosion are inexpensive, as they are quickly formed during routine earthwork.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspect ditches and berms for washouts. Replace lost riprap, damaged linings or soil stabilizers as needed.
- Inspect channel linings, embankments, and beds of ditches and berms for erosion and accumulation of debris and sediment. Remove debris and sediment and repair linings and embankments as needed.
- Temporary conveyances should be completely removed as soon as the surrounding drainage area has been stabilized or at the completion of construction

References

Erosion and Sediment Control Handbook, S.J. Goldman, K. Jackson, T.A. Bursetynsky, P.E., McGraw Hill Book Company, 1986.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Metzger, M.E. 2004. Managing mosquitoes in stormwater treatment devices. University of California Division of Agriculture and Natural Resources, Publication 8125. On-line: http://anrcatalog.ucdavis.edu/pdf/8125.pdf

National Association of Home Builders (NAHB). Stormwater Runoff & Nonpoint Source Pollution Control Guide for Builders and Developers. National Association of Home Builders, Washington, D.C., 1995

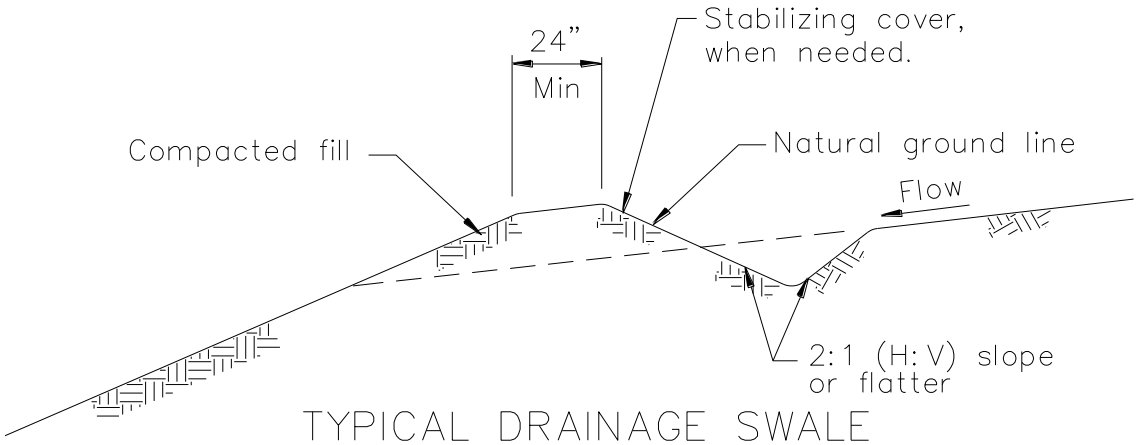
National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Southeastern Wisconsin Regional Planning Commission (SWRPC). Costs of Urban Nonpoint Source Water Pollution Control Measures. Technical Report No. 31. Southeastern Wisconsin Regional Planning Commission, Waukesha, WI. 1991

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

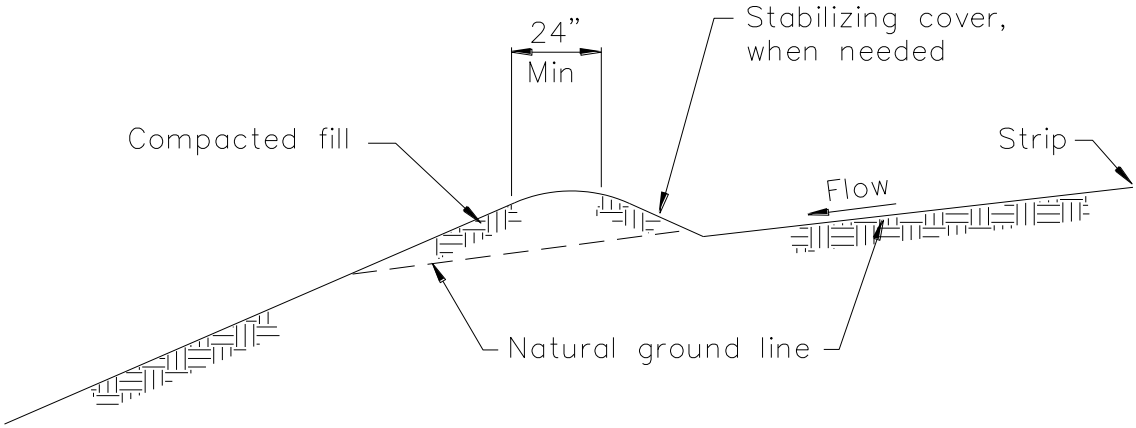
Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



TYPICAL DRAINAGE SWALE
NOT TO SCALE

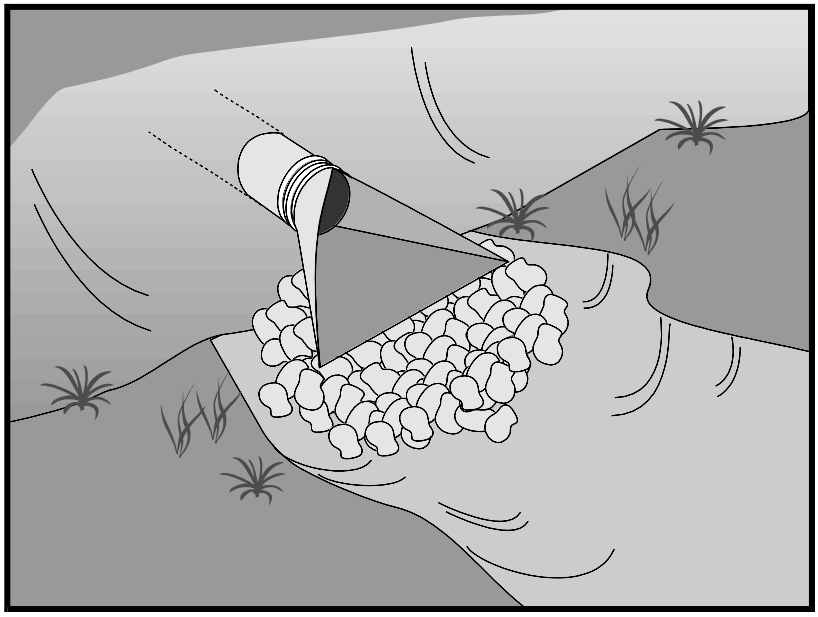
NOTES:

1. Stabilize inlet, outlets and slopes.
2. Properly compact the subgrade.



TYPICAL EARTH DIKE
NOT TO SCALE

Velocity Dissipation Devices EC-10



Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Outlet protection is a physical device composed of rock, grouted riprap, or concrete rubble, which is placed at the outlet of a pipe or channel to prevent scour of the soil caused by concentrated, high velocity flows.

Suitable Applications

Whenever discharge velocities and energies at the outlets of culverts, conduits, or channels are sufficient to erode the next downstream reach. This includes temporary diversion structures to divert runon during construction.

- These devices may be used at the following locations:
  - Outlets of pipes, drains, culverts, slope drains, diversion ditches, swales, conduits, or channels.
  - Outlets located at the bottom of mild to steep slopes.
  - Discharge outlets that carry continuous flows of water.
  - Outlets subject to short, intense flows of water, such as flash floods.
  - Points where lined conveyances discharge to unlined conveyances

Limitations

- Large storms or high flows can wash away the rock outlet protection and leave the area susceptible to erosion.

- Sediment captured by the rock outlet protection may be difficult to remove without removing the rock.
- Outlet protection may negatively impact the channel habitat.
- Grouted riprap may break up in areas of freeze and thaw.
- If there is not adequate drainage, and water builds up behind grouted riprap, it may cause the grouted riprap to break up due to the resulting hydrostatic pressure.
- Sediment accumulation, scour depressions, and/or persistent non-stormwater discharges can result in areas of standing water suitable for mosquito production in velocity dissipation devices.

Implementation

General

Outlet protection is needed where discharge velocities and energies at the outlets of culverts, conduits or channels are sufficient to erode the immediate downstream reach. This practice protects the outlet from developing small eroded pools (plange pools), and protects against gully erosion resulting from scouring at a culvert mouth.

Design and Layout

As with most channel design projects, depth of flow, roughness, gradient, side slopes, discharge rate, and velocity should be considered in the outlet design. Compliance to local and state regulations should also be considered while working in environmentally sensitive streambeds. General recommendations for rock size and length of outlet protection mat are shown in the rock outlet protection figure in this BMP and should be considered minimums. The apron length and rock size gradation are determined using a combination of the discharge pipe diameter and estimate discharge rate: Select the longest apron length and largest rock size suggested by the pipe size and discharge rate. Where flows are conveyed in open channels such as ditches and swales, use the estimated discharge rate for selecting the apron length and rock size. Flows should be same as the culvert or channel design flow but never the less than the peak 5 year flow for temporary structures planned for one rainy season, or the 10 year peak flow for temporary structures planned for two or three rainy seasons.

- There are many types of energy dissipaters, with rock being the one that is represented in the attached figure.
- Best results are obtained when sound, durable, and angular rock is used.
- Install riprap, grouted riprap, or concrete apron at selected outlet. Riprap aprons are best suited for temporary use during construction. Grouted or wired tied rock riprap can minimize maintenance requirements.
- Rock outlet protection is usually less expensive and easier to install than concrete aprons or energy dissipaters. It also serves to trap sediment and reduce flow velocities.
- Carefully place riprap to avoid damaging the filter fabric.

- Stone 4 in. to 6 in. may be carefully dumped onto filter fabric from a height not to exceed 12 in.

- Stone 8 in. to 12 in. must be hand placed onto filter fabric, or the filter fabric may be covered with 4 in. of gravel and the 8 in. to 12 in. rock may be dumped from a height not to exceed 16 in.

- Stone greater than 12 in. shall only be dumped onto filter fabric protected with a layer of gravel with a thickness equal to one half the D_{50} rock size, and the dump height limited to twice the depth of the gravel protection layer thickness.

- For proper operation of apron: Align apron with receiving stream and keep straight throughout its length. If a curve is needed to fit site conditions, place it in upper section of apron.

- Outlets on slopes steeper than 10 percent should have additional protection.

Costs

Costs are low if material is readily available. If material is imported, costs will be higher. Average installed cost is $150 per device.

Inspection and Maintenance

- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Inspect BMPs subjected to non-stormwater discharges daily while non-stormwater discharges occur. Minimize areas of standing water by removing sediment blockages and filling scour depressions.

- Inspect apron for displacement of the riprap and damage to the underlying fabric. Repair fabric and replace riprap that has washed away. If riprap continues to wash away, consider using larger material.

- Inspect for scour beneath the riprap and around the outlet. Repair damage to slopes or underlying filter fabric immediately.

- Temporary devices should be completely removed as soon as the surrounding drainage area has been stabilized or at the completion of construction.

References

County of Sacramento Improvement Standards, Sacramento County, May 1989.

Erosion and Sediment Control Handbook, S.J. Goldman, K. Jackson, T.A. Bursztynsky, P.E., McGraw Hill Book Company, 1986.

Handbook of Steel Drainage & Highway Construction, American Iron and Steel Institute, 1983.

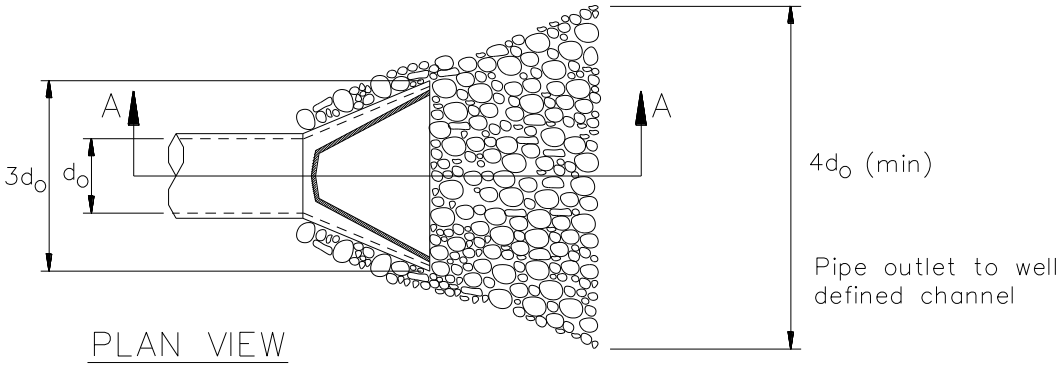
Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Metzger, M.E. 2004. Managing mosquitoes in stormwater treatment devices. University of California Division of Agriculture and Natural Resources, Publication 8125. On-line: http://anrcatalog.ucdavis.edu/pdf/8125.pdf

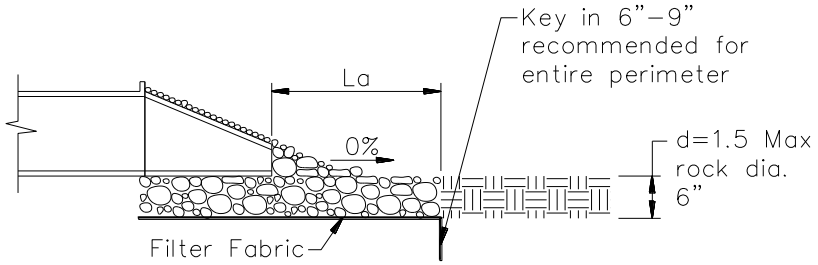
Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, state of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



PLAN VIEW

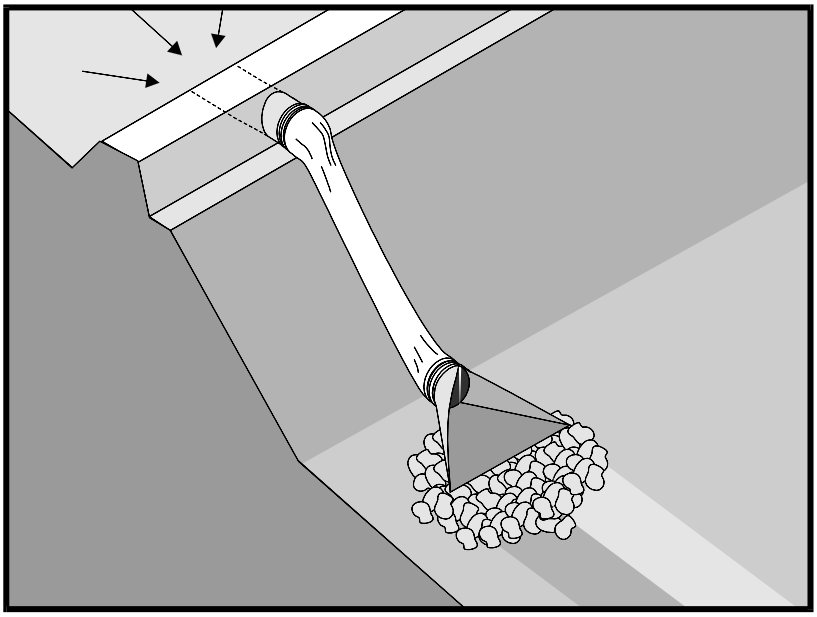


SECTION A–A

Pipe Diameter inches	Discharge ft³/s	Apron Length, La ft	Rip Rap D_{50} Diameter Min inches
12	5	10	4
	10	13	6
18	10	10	6
	20	16	8
	30	23	12
	40	26	16
24	30	16	8
	40	26	8
	50	26	12
	60	30	16

For larger or higher flows consult a Registered Civil Engineer
Source: USDA - SCS

Slope Drains EC-11



Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-9 Earth Dike, Drainage Swales

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

A slope drain is a pipe used to intercept and direct surface runoff or groundwater into a stabilized watercourse, trapping device, or stabilized area. Slope drains are used with earth dikes and drainage ditches to intercept and direct surface flow away from slope areas to protect cut or fill slopes.

Suitable Applications

- Where concentrated flow of surface runoff must be conveyed down a slope in order to prevent erosion.
- Drainage for top of slope diversion dikes or swales.
- Drainage for top of cut and fill slopes where water can accumulate.
- Emergency spillway for a sediment basin.

Limitations

Installation is critical for effective use of the pipe slope drain to minimize potential gully erosion.

- Maximum drainage area per slope drain is 10 acres. (For large areas use a paved chute, rock lined channel, or additional pipes.)
- Severe erosion may result when slope drains fail by overtopping, piping, or pipe separation.

- During large storms, pipe slope drains may become clogged or over charged, forcing water around the pipe and causing extreme slope erosion.
- If the sectional downdrain is not sized correctly, the runoff can spill over the drain sides causing gully erosion and potential failure of the structure.

- Dissipation of high flow velocities at the pipe outlet is required to avoid downstream erosion.
- Sediment accumulation, scour depressions, and/or persistent non-stormwater discharges can result in areas of standing water suitable for mosquito production in energy dissipaters associated with slope drain outlets.

Implementation

General

The slope drain is applicable for any construction site where concentrated surface runoff can accumulate and must be conveyed down the slope in order to prevent erosion. The slope drain is effective because it prevents the stormwater from flowing directly down the slope by confining all the runoff into an enclosed pipe or channel. Due to the time lag between grading slopes and installation of permanent stormwater collection systems and slope stabilization measures, temporary provisions to intercept runoff are sometimes necessary. Particularly in steep terrain, slope drains can protect unstabilized areas from erosion.

Installation

The slope drain may be a rigid pipe, such as corrugated metal, a flexible conduit, or a lined terrace drain with the inlet placed on the top of a slope and the outlet at the bottom of the slope. This BMP typically is used in combination with a diversion control, such as an earth dike or drainage swale at the top of the slope.

The following criteria must be considered when siting slope drains.

- Permanent structures included in the project plans can often serve as construction BMPs if implemented early. However, the permanent structure must meet or exceed the criteria for the temporary structure.
- Inlet structures must be securely entrenched and compacted to avoid severe gully erosion.
- Slope drains must be securely anchored to the slope and must be adequately sized to carry the capacity of the design storm and associated forces.
- Outlets must be stabilized with riprap, concrete or other type of energy dissipator, or directed into a stable sediment trap or basin. See EC-10, Velocity Dissipation Devices.
- Debris racks are recommended at the inlet. Debris racks located several feet upstream of the inlet can usually be larger than racks at the inlet, and thus provide enhanced debris protection and less plugging.
- Safety racks are also recommended at the inlet and outlet of pipes where children or animals could become entrapped.
- Secure inlet and surround with dikes to prevent gully erosion and anchor pipe to slope.

- When using slope drains, limit drainage area to 10 acres per pipe. For larger areas, use a rock lined channel or a series of pipes.
- Size to convey at least the peak flow of a 10-year storm. The design storm is conservative due to the potential impact of system failures.
- Maximum slope generally limited to 2:1 (H:V) as energy dissipation below steeper slopes is difficult.
- Direct surface runoff to slope drains with interceptor dikes. See BMP EC-9, Earth Dikes and Drainage Swales. Top of interceptor dikes should be 12 in. higher than the top of the slope drain.
- Slope drains can be placed on or buried underneath the slope surface.
- Recommended materials include both metal and plastic pipe, either corrugated or smooth wall. Concrete pipe can also be used.
- When installing slope drains:
  - Install slope drains perpendicular to slope contours.
  - Compact soil around and under entrance, outlet, and along length of pipe.
  - Securely anchor and stabilize pipe and appurtenances into soil.
  - Check to ensure that pipe connections are watertight.
  - Protect area around inlet with filter cloth. Protect outlet with riprap or other energy dissipation device. For high energy discharges, reinforce riprap with concrete or use reinforced concrete device.
  - Protect outlet of slope drains using a flared end section when outlet discharges to a flexible energy dissipation device.
  - A flared end section installed at the inlet will improve flow into the slope drain and prevent erosion at the pipe entrance. Use a flared end section with a 6 in. minimum toe plate to help prevent undercutting. The flared section should slope towards the pipe inlet.

Design and Layout

The capacity for temporary drains should be sufficient to convey at least the peak runoff from a 10-year rainfall event. The pipe size may be computed using the Rational Method or a method established by the local municipality. Higher flows must be safely stored or routed to prevent any offsite concentration of flow and any erosion of the slope. The design storm is purposely conservative due to the potential impacts associated with system failures.

As a guide, temporary pipe slope drains should not be sized smaller than shown in the following table:

Minimum Pipe Diameter (Inches)	Maximum Drainage Area (Acres)
12	1.0
18	3.0
21	5.0
24	7.0
30	10.0

Larger drainage areas can be treated if the area can be subdivided into areas of 10 acres or less and each area is treated as a separate drainage. Drainage areas exceeding 10 acres must be designed by a Registered Civil Engineer and approved by the agency that issued the grading permit.

Materials:

Soil type, rainfall patterns, construction schedule, local requirements, and available supply are some of the factors to be considered when selecting materials. The following types of slope drains are commonly used:

- **Rigid Pipe:** This type of slope drain is also known as a pipe drop. The pipe usually consists of corrugated metal pipe or rigid plastic pipe. The pipe is placed on undisturbed or compacted soil and secured onto the slope surface or buried in a trench. Concrete thrust blocks must be used when warranted by the calculated thrust forces. Collars should be properly installed and secured with metal strappings or watertight collars.

- **Flexible Pipe**: The flexible pipe slope drain consists of a flexible tube of heavy duty plastic, rubber, or composite material. The tube material is securely anchored onto the slope surface. The tube should be securely fastened to the metal inlet and outlet conduit sections with metal strappings or watertight collars.

- **Section Downdrains**: The section downdrain consists of pre-fabricated, section conduit of half round or third round material. The sectional downdrain performs similar to a flume or chute. The pipe must be placed on undisturbed or compacted soil and secured into the slope.

- **Concrete-lined Terrace Drain:** This is a concrete channel for draining water from a terrace on a slope to the next level. These drains are typically specified as permanent structures and if installed early, can serve as slope drains during construction, which should be designed according to local drainage design criteria.

Costs

- Cost varies based on pipe selection and selected outlet protection.

Corrugated Steel Pipes, Per Foot	
Size	Supplied and Installed Cost (No Trenching Included)
12”	$19.60 per LF
15”	$22.00
18”	$26.00
24”	$32.00
30”	$50.00
PVC Pipes, Per Foot	
Size	Supplied and Installed Cost (No Trenching Included)
12”	$24.50
14”	$49.00
16”	$51.00
18”	$54.00
20”	$66.00
24”	$93.00
30”	$130.00

Inspection and Maintenance

- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subjected to non-stormwater discharges daily while non-stormwater discharges occur. Minimize areas of standing water by removing sediment blockages and filling scour depressions.
- Inspect outlet for erosion and downstream scour. If eroded, repair damage and install additional energy dissipation measures. If downstream scour is occurring, it may be necessary to reduce flows being discharged into the channel unless other preventative measures are implemented.
- Insert inlet for clogging or undercutting. Remove debris from inlet to maintain flows. Repair undercutting at inlet and if needed, install flared section or rip rap around the inlet to prevent further undercutting.
- Inspect pipes for leakage. Repair leaks and restore damaged slopes.
- Inspect slope drainage for accumulations of debris and sediment.

- Remove built up sediment from entrances and outlets as required. Flush drains if necessary; capture and settle out sediment from discharge.
- Make sure water is not ponding onto inappropriate areas (e.g., active traffic lanes, material storage areas, etc.).
- Pipe anchors must be checked to ensure that the pipe remains anchored to the slope. Install additional anchors if pipe movement is detected.

References

Draft – Sedimentation and Erosion Control, An Inventory of Current Practices, U.S.E.P.A., April 1990.

Metzger, M.E. 2004. Managing mosquitoes in stormwater treatment devices. University of California Division of Agriculture and Natural Resources, Publication 8125. On-line: http://anrcatalog.ucdavis.edu/pdf/8125.pdf

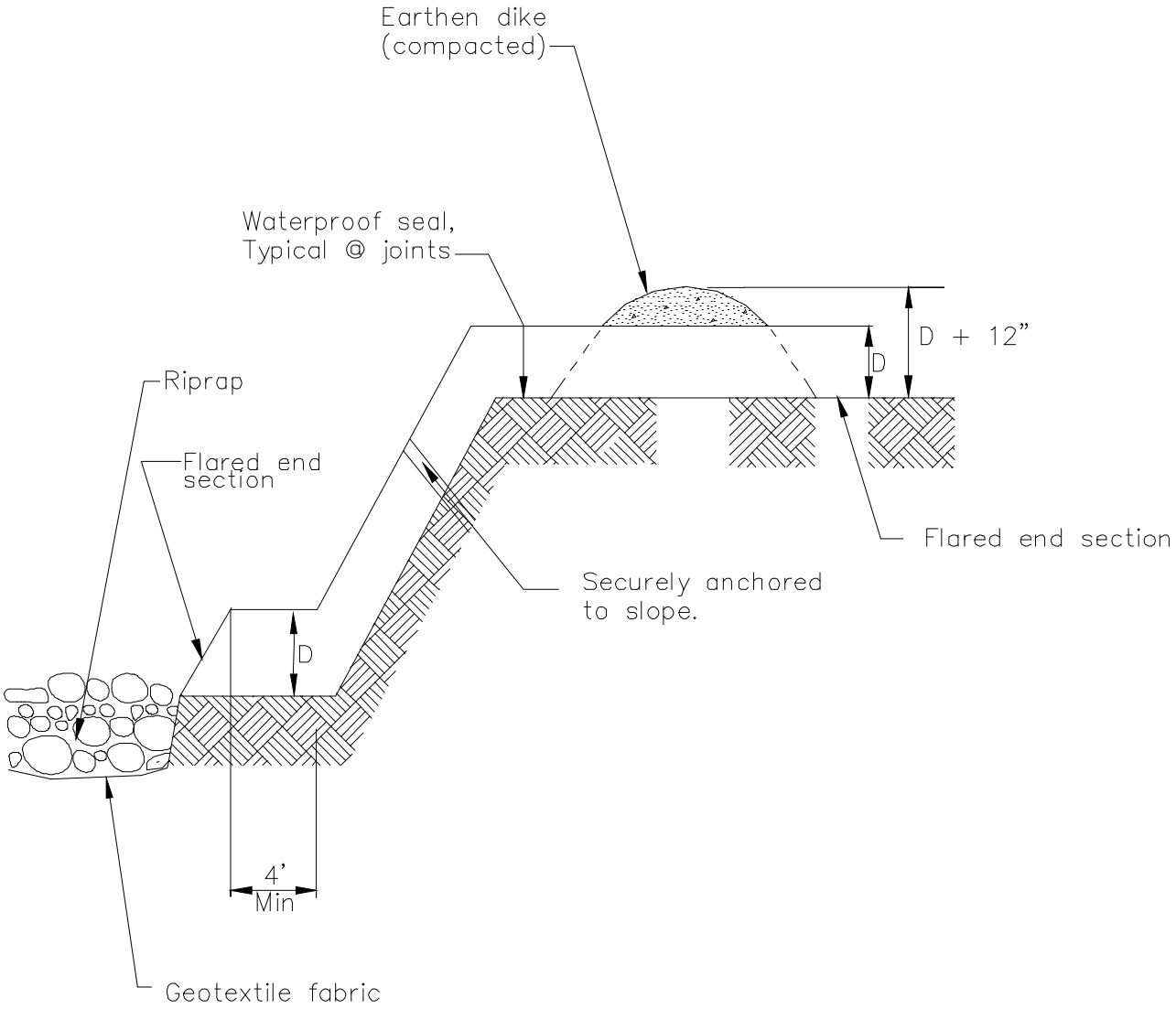
National Association of Home Builders (NAHB). Stormwater Runoff & Nonpoint Source Pollution Control Guide for Builders and Developers. National Association of Home Builders, Washington, D.C., 1995

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



TYPICAL SLOPE DRAIN
NOT TO SCALE

Streambank Stabilization EC-12



Categories

EC	Erosion Control	☑
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☒
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

Combination of erosion and sediment controls.

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Stream channels, streambanks, and associated riparian areas are dynamic and sensitive ecosystems that respond to changes in land use activity. Streambank and channel disturbance resulting from construction activities can increase the stream's sediment load, which can cause channel erosion or sedimentation and have adverse affects on the biotic system. BMPs can reduce the discharge of sediment and other pollutants to minimize the impact of construction activities on watercourses. Streams on the 303(d) list and listed for sediment may require numerous measures to prevent any increases in sediment load to the stream.

Suitable Applications

These procedures typically apply to all construction projects that disturb or occur within stream channels and their associated riparian areas.

Limitations

Specific permit requirements or mitigation measures such as Regional Water Quality Control Board (RWQCB) 401 Certification, U.S. Army Corps of Engineers 404 permit and approval by California Department of Fish and Game supercede the guidance in this BMP.

- If numerical based water quality standards are mentioned in any of these and other related permits, testing and sampling may be required. Streams listed as 303(d) impaired for sediment, silt, or turbidity, are required to

conduct sampling to verify that there is no net increase in sediment load due to construction activities.

Implementation

Planning

- Proper planning, design, and construction techniques can minimize impacts normally associated with in stream construction activities. Poor planning can adversely affect soil, fish, wildlife resources, land uses, or land users. Planning should take into account: scheduling; avoidance of in-stream construction; minimizing disturbance area and construction time period; using pre-disturbed areas; selecting crossing location; and selecting equipment.

Scheduling

- Construction activities should be scheduled according to the relative sensitivity of the environmental concerns and in accordance with EC-1, Scheduling. Scheduling considerations will be different when working near perennial streams vs. ephemeral streams and are as follows.

- When in-stream construction is conducted in a perennial stream, work should optimally be performed during the rainy season. This is because in the summer, any sediment-containing water that is discharged into the watercourse will cause a large change in both water clarity and water chemistry. During the rainy season, there is typically more and faster flowing water in the stream so discharges are diluted faster. However, should in-stream work be scheduled for summer, establishing an isolation area, or diverting the stream, will significantly decrease the amount of sediment stirred up by construction work. Construction work near perennial streams should optimally be performed during the dry season (see below).

- When working in or near ephemeral streams, work should be performed during the dry season. By their very nature, ephemeral streams are usually dry in the summer, and therefore, in-stream construction activities will not cause significant water quality problems. However, when tying up the site at the end of the project, wash any fines (see Washing Fines) that accumulated in the channel back into the bed material, to decrease pollution from the first rainstorm of the season.

- When working near ephemeral or perennial streams, erosion and sediment controls (see silt fences, straw bale barriers, etc.) should be implemented to keep sediment out of stream channel.

Minimize Disturbance

- Minimize disturbance through: selection of the narrowest crossing location; limiting the number of equipment trips across a stream during construction; and, minimizing the number and size of work areas (equipment staging areas and spoil storage areas). Place work areas at least 50 ft from stream channel. Field reconnaissance should be conducted during the planning stage to identify work areas.

Use of Pre-Disturbed Areas

- Locate project sites and work areas in areas disturbed by prior construction or other activity when possible.

Selection of Project Site

- Avoid steep and unstable banks, highly erodible or saturated soils, or highly fractured rock.
- Select project site that minimizes disturbance to aquatic species or habitat.

Equipment Selection

- Select equipment that reduces the amount of pressure exerted on the ground surface, and therefore, reduces erosion potential and/or use overhead or aerial access for transporting equipment across drainage channels. Use equipment that exerts ground pressures of less than 5 or 6 lb/in^2, where possible. Low ground pressure equipment includes: wide or high flotation tires (34 to 72 in. wide); dual tires; bogie axle systems; tracked machines; lightweight equipment; and, central tire inflation systems.

Streambank Stabilization

Preservation of Existing Vegetation

- Preserve existing vegetation in accordance with EC-2, Preservation of Existing Vegetation. In a streambank environment, preservation of existing vegetation provides the following benefits.

Water Quality Protection

- Vegetated buffers on slopes trap sediment and promote groundwater recharge. The buffer width needed to maintain water quality ranges from 15 to 100 ft. On gradual slopes, most of the filtering occurs within the first 30 ft. Steeper slopes require a greater width of vegetative buffer to provide water quality benefits.

Streambank Stabilization

- The root system of riparian vegetation stabilizes streambanks by increasing tensile strength in the soil. The presence of vegetation modifies the moisture condition of slopes (infiltration, evapo transpiration, interception) and increases bank stability.

Riparian Habitat

- Buffers of diverse riparian vegetation provide food and shelter for riparian and aquatic organisms. Minimizing impacts to fisheries habitat is a major concern when working near streams and rivers. Riparian vegetation provides shade, shelter, organic matter (leaf detritus and large woody debris), and other nutrients that are necessary for fish and other aquatic organisms. Buffer widths for habitat concerns are typically wider than those recommended for water quality concerns (100 to 1500 ft).
- When working near watercourses, it is important to understand the work site's placement in the watershed. Riparian vegetation in headwater streams has a greater impact on overall water quality than vegetation in downstream reaches. Preserving existing vegetation upstream is necessary to maintain water quality, minimize bank failure, and maximize riparian habitat, downstream of the work site.

Limitations

- Local county and municipal ordinances regarding width, extent and type of vegetative buffer required may exceed the specifications provided here; these ordinances should be investigated prior to construction.

Streambank Stabilization Specific Installation

- As a general rule, the width of a buffer strip between a road and the stream is recommended to be 50 ft plus four times the percent slope of the land, measured between the road and the top of stream bank.

Hydraulic Mulch

- Apply hydraulic mulch on disturbed streambanks above mean high water level in accordance with EC-3, Hydraulic Mulch to provide temporary soil stabilization.

Limitations

- Do not place hydraulic mulch or tackifiers below the mean high water level, as these materials could wash into the channel and impact water quality or possibly cause eutrophication (eutrophication is an algal bloom caused by excessively high nutrient levels in the water).

Hydroseeding

- Hydroseed disturbed streambanks in accordance with EC-4, Hydroseeding.

Limitations

- Do not place tackifiers or fertilizers below the mean high water level, as these materials could wash into the channel and impact water quality or possibly cause eutrophication.

Soil Binders

- Apply soil binders to disturbed streambanks in accordance with EC-5, Soil Binders.

Limitations

- Do not place soil binders below the mean high water level. Soil binder must be environmentally benign and non-toxic to aquatic organisms.

Straw Mulch

- Apply straw mulch to disturbed streambanks in accordance with EC-6, Straw Mulch.

Limitations

- Do not place straw mulch below the mean high water level, as this material could wash into the channel and impact water quality or possibly cause eutrophication.

Geotextiles and Mats

- Install geotextiles and mats as described in EC-7, Geotextiles and Mats, to stabilize disturbed channels and streambanks. Not all applications should be in the channel, for example, certain geotextile netting may snag fish gills and are not appropriate in fish bearing streams. Geotextile fabrics that are not biodegradable are not appropriate for in stream use. Additionally, geotextile fabric or blankets placed in channels must be adequate to sustain anticipated hydraulic forces.

Earth Dikes, Drainage Swales, and Lined Ditches

- Convey, intercept, or divert runoff from disturbed streambanks using EC-9, Earth Dikes and Drainage Swales.

Limitations

- Do not place earth dikes in watercourses, as these structures are only suited for intercepting sheet flow, and should not be used to intercept concentrated flow.

- Appropriately sized velocity dissipation devices (EC-10) must be placed at outlets to minimize erosion and scour.

Velocity Dissipation Devices

- Place velocity dissipation devices at outlets of pipes, drains, culverts, slope drains, diversion ditches, swales, conduits or channels in accordance with EC-10, Velocity Dissipation Devices.

Slope Drains

- Use slope drains to intercept and direct surface runoff or groundwater into a stabilized watercourse, trapping device or stabilized area in accordance with EC-11, Slope Drains.

Limitations

- Appropriately sized outlet protection and velocity dissipation devices (EC-10) must be placed at outlets to minimize erosion and scour.

Streambank Sediment Control

Silt Fences

- Install silt fences in accordance with SE-1, Silt Fence, to control sediment. Silt fences should only be installed where sediment laden water can pond, thus allowing the sediment to settle out.

Fiber Rolls

- Install fiber rolls in accordance with SE-5, Fiber Rolls, along contour of slopes above the high water level to intercept runoff, reduce flow velocity, release the runoff as sheet flow and provide removal of sediment from the runoff. In a stream environment, fiber rolls should be used in conjunction with other sediment control methods such as SE-1, Silt Fence or SE-9 Straw Bale Barrier. Install silt fence, straw bale barrier, or other erosion control method along toe of slope above the high water level.

Gravel Bag Berm

- A gravel bag berm or barrier can be utilized to intercept and slow the flow of sediment laden sheet flow runoff in accordance with SE-6, Gravel Bag Berm. In a stream environment gravel bag barriers can allow sediment to settle from runoff before water leaves the construction site and can be used to isolate the work area from the live stream.

Limitations

- Gravel bag barriers are not recommended as a perimeter sediment control practice around streams.

Straw Bale Barrier

- Install straw bale barriers in accordance with SE-9, Straw Bale Barrier, to control sediment. Straw bale barriers should only be installed where sediment laden water can pond, thus allowing the sediment to settle out. Install a silt fence in accordance with SE-1, Silt Fence,

on down slope side of straw bale barrier closest to stream channel to provide added sediment control.

Rock Filter

Description and Purpose

Rock filters are temporary erosion control barriers composed of rock that is anchored in place. Rock filters detain the sediment laden runoff, retain the sediment, and release the water as sheet flow at a reduced velocity. Typical rock filter installations are illustrated at the end of this BMP.

Applications

- Near the toe of slopes that may be subject to flow and rill erosion.

Limitations

- Inappropriate for contributing drainage areas greater than 5 acres.
- Requires sufficient space for ponded water.
- Ineffective for diverting runoff because filters allow water to slowly seep through.
- Rock filter berms are difficult to remove when construction is complete.
- Unsuitable in developed areas or locations where aesthetics is a concern.

Specifications

- Rock: open graded rock, 0.75 to 5 in. for concentrated flow applications.
- Woven wire sheathing: 1 in. diameter, hexagonal mesh, galvanized 20gauge (used with rock filters in areas of concentrated flow).
- In construction traffic areas, maximum rock berm heights should be 12 in. Berms should be constructed every 300 ft on slopes less than 5%, every 200 ft on slopes between 5% and 10%, and every 100 ft on slopes greater than 10%.

Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Reshape berms as needed and replace lost or dislodged rock, and filter fabric.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.

K-rail

Description and Purpose

This is temporary sediment control that uses K-rails to form the sediment deposition area, or to isolate the near bank construction area. Install K-rails at toe of slope in accordance with procedures described in NS-5, Clear Water Diversion.

Barriers are placed end to end in a pre-designed configuration and gravel filled bags are used at the toe of the barrier and at their abutting ends to seal and prevent movement of sediment beneath or through the barrier walls.

Appropriate Applications

- This technique is useful at the toe of embankments, cuts or fills slopes.

Limitations

- The K-rail method should not be used to dewater a project site, as the barrier is not watertight.

Implementation

- Refer to NS-5, Clear Water Diversion, for implementation requirements.

Instream Construction Sediment Control

There are three different options currently available for reducing turbidity while working in a stream or river. The stream can be isolated from the area in which work is occurring by means of a water barrier, the stream can be diverted around the work site through a pipe or temporary channel, or one can employ construction practices that minimize sediment suspension.

Whatever technique is implemented, an important thing to remember is that dilution can sometimes be the solution. A probable "worst time" to release high TSS into a stream system might be when the stream is very low; summer low flow, for example. During these times, the flow may be low while the biological activity in the stream is very high. Conversely, the addition of high TSS or sediment during a big storm discharge might have a relatively low impact, because the stream is already turbid, and the stream energy is capable of transporting both suspended solids, and large quantities of bedload through the system. The optimum time to "pull" in-stream structures may be during the rising limb of a storm hydrograph.

Techniques to minimize Total Suspended Solids (TSS)

- **Padding** - Padding laid in the stream below the work site may trap some solids that are deposited in the stream during construction. After work is done, the padding is removed from the stream, and placed on the bank to assist in re-vegetation.

- **Clean, washed gravel** - Using clean, washed gravel decreases solid suspension, as there are fewer small particles deposited in the stream.

- **Excavation using a large bucket** - Each time a bucket of soil is placed in the stream, a portion is suspended. Approximately the same amount is suspended whether a small amount of soil is placed in the stream, or a large amount. Therefore, using a large excavator bucket instead of a small one, will reduce the total amount of soil that washes downstream.

- **Use of dozer for backfilling** - Using a dozer for backfilling instead of a backhoe follows the same principles – the fewer times soil is deposited in the stream, the less soil will be suspended.

- **Partial dewatering with a pump** - Partially dewatering a stream with a pump reduces the amount of water, and thus the amount of water that can suspend sediment.

Washing Fines

Definition and Purpose

- Washing fines is an "in-channel" sediment control method, which uses water, either from a water truck or hydrant, to wash stream fines that were brought to the surface of the channel bed during restoration, back into the interstitial spaces of the gravel and cobbles.

- The purpose of this technique is to reduce or eliminate the discharge of sediment from the channel bottom during the first seasonal flow. Sediment should not be allowed into stream channels; however, occasionally in-channel restoration work will involve moving or otherwise disturbing fines (sand and silt sized particles) that are already in the stream, usually below bankfull discharge elevation. Subsequent re-watering of the channel can result in a plume of turbidity and sedimentation.

- This technique washes the fines back into the channel bed. Bedload materials, including gravel cobbles, boulders and those fines, are naturally mobilized during higher storm flows. This technique is intended to delay the discharge until the fines would naturally be mobilized.

Appropriate Applications

- This technique should be used when construction work is required in channels. It is especially useful in intermittent or ephemeral streams in which work is performed "in the dry", and which subsequently become re-watered.

Limitations

- The stream must have sufficient gravel and cobble substrate composition.

- The use of this technique requires consideration of time of year and timing of expected stream flows.

- The optimum time for the use of this technique is in the fall, prior to winter flows.

- Consultation with, and approval from the Department of Fish and Game and the Regional Water Quality Control Board may be required.

Implementation

- Apply sufficient water to wash fines, but not cause further erosion or runoff.

- Apply water slowly and evenly to prevent runoff and erosion.

- Consult with Department of Fish and Game and the Regional Water Quality Control Board for specific water quality requirements of applied water (e.g. chlorine).

Inspection and Maintenance

- None necessary

Costs

Cost may vary according to the combination of practices implemented.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events until final stabilization is achieved.

- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.

- Inspect and repair equipment (for damaged hoses, fittings, and gaskets).

References

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

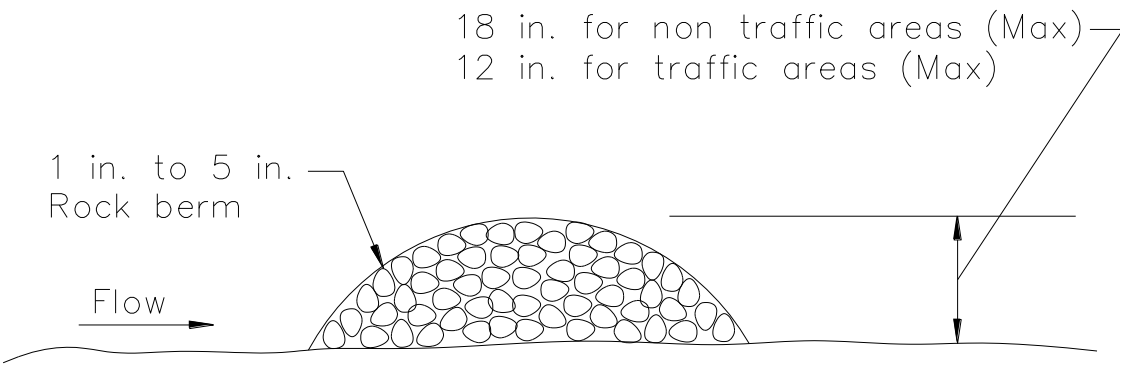
Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group Working Paper, USEPA, April 1992.

Sedimentation and Erosion Control Practices, An Inventory of Current Practices (Draft), UESPA, 1990.

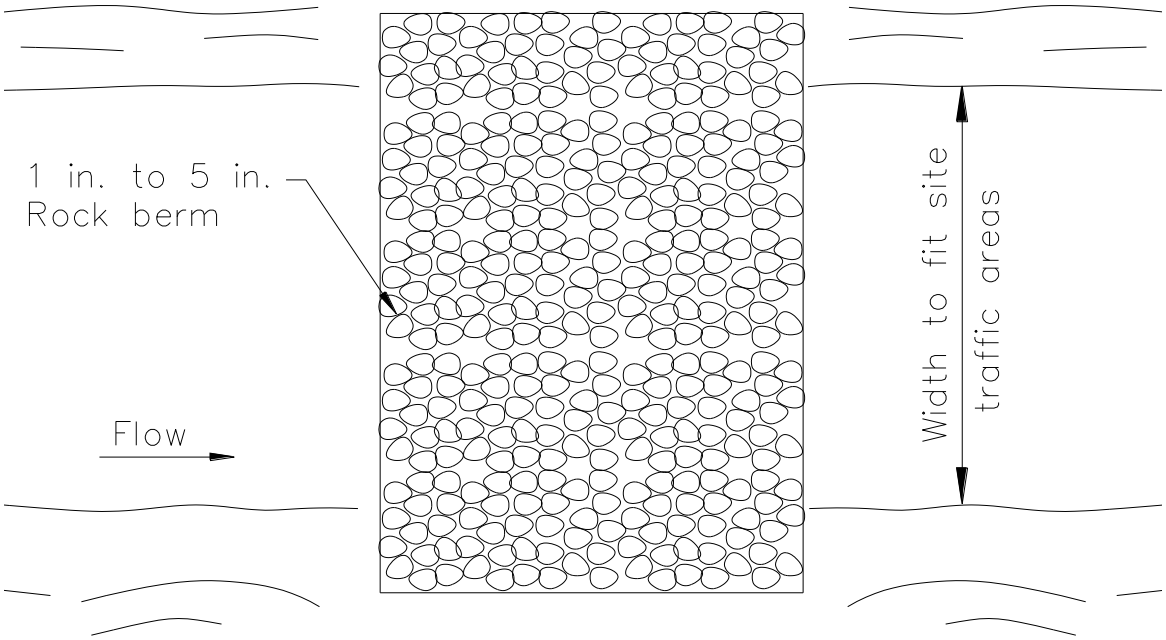
Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



SECTION



PLAN

TYPICAL ROCK FILTER
NOT TO SCALE

Reserved EC-13

BMP Factsheet removed in 2009.
Formerly PAM. See SE-11, Active Treatment Systems.

Categories

EC	Erosion Control
SE	Sediment Control
TC	Tracking Control
WE	Wind Erosion Control
NS	Non-Stormwater Management Control
WM	Waste Management and Materials Pollution Control

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment
Nutrients
Trash
Metals
Bacteria
Oil and Grease
Organics

Potential Alternatives

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Compost Blanket EC-14



Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch

EC-4 Hydroseeding

EC-5 Soil Binders

EC-7 Geotextiles and Mats

EC-8 Wood Mulching

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

A compost blanket is applied to slopes and earth disturbed areas to prevent erosion, and in some cases, increase infiltration and/or establish vegetation. The compost blanket can be applied by hand, conveyor system, compost spreader, or pneumatic delivery (blower) system. The blanket thickness is determined from the slope steepness and anticipated precipitation. A compost blanket protects the soil surface from raindrop erosion, particularly rills and gullies that may form under other methods of erosion control.

A compost blanket, if properly installed, can be very successful at vegetation establishment, weed suppression and erosion control. The compost blanket comes into direct contact with the underlying soil, reducing rill formation. Furthermore, compost provides organic matter and nutrients important for vegetation growth. The compost blanket provides soil structure that allows water to infiltrate the soil surface and retain moisture, which also promotes seed germination and vegetation growth, in addition to reducing runoff.

Compost is typically derived from combinations of feedstocks, biosolids, leaf and yard trimmings, manure, wood, or mixed solid waste. Many types of compost are products of municipal recycle or "Greenwaste" programs. Compost is organic and biodegradable and can be left onsite. There are many types of compost with a variety of properties with specific functions, and accordingly, compost selection is an important design consideration in the application of this type of erosion control.

Suitable Applications

A compost blanket is appropriate for slopes and earth disturbed areas requiring protection until permanent stabilization is established. A compost blanket can also used in combination with temporary and/or permanent seeding strategies to enhance plant establishment. Examples include:

- Rough-graded areas that will remain inactive for longer than 14 days
- Soil stockpiles
- Slopes with exposed soil between existing vegetation such as trees or shrubs
- Slopes planted with live, container-grown vegetation
- Disturbed areas where plants are slow to develop

A compost blanket is typically used on slopes of 2:1 (H:V) or gentler. However, a compost blanket can be effective when applied to slopes as steep as 1:1 (H:V) with appropriate design considerations including slope length, blanket thickness, adding components such as a tackifier, or using compost blankets in conjunction with other techniques, such as compost socks and berms or fiber rolls.

Compost can be pre-seeded prior to application to the soil (recommended by the EPA for construction site stormwater runoff control) or seeded after the blanket has been installed. The compost medium can also remove pollutants in stormwater including heavy metals; oil and grease; and hydrocarbons (USEPA, 1998).

Limitations

- Compost can potentially leach nutrients (dissolved phosphorus and nitrogen) into runoff and potentially impact water quality. Compost should not be used directly upstream from nutrient impaired waterbodies (Adams et. al, 2008).
- Compost may also contain other undesirable constituents that are detrimental to water quality. Carefully consider the qualifications and experience of any compost producer/supplier.
- A compost blanket applied by hand is more time intensive and potentially costly. Using a pneumatic blower truck is the recommended cost effective method of application.
- When blowers are used, the treatment areas should be within 300 ft of a road or surface capable of supporting trucks.
- Wind may limit application of compost and result in application to undesired locations.
- Compost blankets should not be applied in areas of concentrated flows.
- Steeper slopes may require additional blanket thickness and other stability measures such as using tackifiers or slope interruption devices (compost socks and berms, or fiber rolls). The same applies for sites with high precipitation totals or during the rainy season.

Implementation

- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

Compost Materials

- California Compost Regulations (Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7, Section 17868.3) define and require a quality of compost for application. Compost should comply with all physical and chemical requirements. Specific requirements are provided in Table 1 below, taken from Caltrans Standard Special Provision 10-1 (SSP 10-1), Erosion Control (Compost Blanket).

- The compost producer should be fully permitted as specified under the California Integrated Waste Management Board, Local Enforcement Agencies and any other State and Local Agencies that regulate Solid Waste Facilities. If exempt from State permitting requirements, the composting facility should certify that it follows guidelines and procedures for production of compost meeting the environmental health standards of Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7.

- The compost producer should be a participant in United States Composting Council's Seal of Testing Assurance program.

- Compost moisture should be considered for composition quality and application purposes. A range of 30-50% is typical. Compost that is too dry is hard to apply and compost that is too wet is more difficult (and more expensive) to transport. For arid or semi-arid areas, or for application during the dry season, use compost with greater moisture content than areas with wetter climates. For wetter or more humid climates or for application during the wet season, drier composts can be used as the compost will absorb moisture from the ambient air.

- Organic content of the compost is also important and should range from 30 to 65% depending on site conditions.

- Compost should be high-quality mature compost. Immature compost can potentially leach nutrients.

- Compost should not be derived from mixed municipal solid waste and should be free of visible contaminants.

- Compost should not contain paint, petroleum products, pesticides or any other chemical residues harmful to animal life or plant growth. Metal concentrations in compost should not exceed the maximum metal concentrations listed under Title 14, California Code of Regulations, Division 7, Chapter 3.1, Section 17868.2.

- Compost should not possess objectionable odors.

- Compost should be weed free.

Table 1. Physical/Chemical Requirements of Compost
Reference - Caltrans SSP-10 Erosion Control Blanket (Compost)

Property	Test Method	Requirement
pH	*TMECC 04.11-A Elastometric pH 1:5 Slurry Method pH Units	6.0–8.0
Soluble Salts	TMECC 04.10-A Electrical Conductivity 1:5 Slurry Method dS/m (mmhos/cm)	0-10.0
Moisture Content	TMECC 03.09-A Total Solids & Moisture at 70+/- 5 deg C % Wet Weight Basis	30-60
Organic Matter Content	TMECC 05.07-A Loss-On-Ignition Organic Matter Method (LOI) % Dry Weight Basis	30–65
Maturity	TMECC 05.05-A Germination and Vigor Seed Emergence Seedling Vigor % Relative to Positive Control	 80 or Above 80 or Above
Stability	TMECC 05.08-B Carbon Dioxide Evolution Rate mg CO_2-C/g OM per day	8 or below
Particle Size	TMECC 02.02-B Sample Sieving for Aggregate Size Classification % Dry Weight Basis	100% Passing, 3 inch 90-100% Passing, 1 inch 65-100% Passing, 3/4 inch 0 - 75% Passing, 1/4 inch Maximum length 6 inches
Pathogen	TMECC 07.01-B Fecal Coliform Bacteria < 1000 MPN/gram dry wt.	Pass
Pathogen	TMECC 07.01-B Salmonella < 3 MPN/4 grams dry wt.	Pass
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Plastic, Glass and Metal % > 4mm fraction	Combined Total: < 1.0
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Sharps (Sewing needles, straight pins and hypodermic needles) % > 4mm fraction	None Detected

*TMECC refers to "Test Methods for the Examination of Composting and Compost," published by the United States Department of Agriculture and the United States Compost Council (USCC).

Installation

- Prior to compost application, prepare the slope by removing loose rocks, roots, stumps, and other debris greater than 2" in diameter. Prepare the slope area surface by scarifying or track walking/roughening if necessary.
- Select method to apply the compost blanket. A pneumatic blower is most cost effective and most adaptive in applying compost to steep, rough terrain, and hard to reach locations.
- A compost blanket thickness of 1" to 4" should be applied to slopes of 2:1 (H:V) or gentler, based on site-specific conditions. Increase blanket thickness with increased slope steepness and/or during installation during the rainy season (for example, 2" to 3" should be used for a

3:1 slope, while 1" to 2" can be used for a 4:1 slope). Erosion control using a compost blanket is not recommended for slopes greater than 1:1 (H:V).

- For steeper slopes, tackifiers should be utilized and/or other stabilization techniques employed. For example, compost socks or berms can be installed at intervals over the compost blanket (in a similar manner as Fiber Rolls, SE-5).
- Compost socks or berms (or equivalent linear sediment control BMP) should be placed at the top and/or bottom of the slope for additional erosion control performance.
- For optimum vegetation establishment, a blanket thickness of 1" to 2" is recommended. If vegetation establishment is not the primary function of the compost blanket, a thicker blanket may be recommended based on slope or rainfall conditions.
- Evenly distribute compost on the soil surface to the desired blanket thickness (1/2" to 4" as calculated prior based on site conditions and objectives). Even distribution is an important factor in preventing future rill and gully erosion.
- The compost blanket should extend 3 to 6 feet over the top of the shoulder of the slope. A compost sock or compost berm can be used at the top of the slope as an auxiliary technique to prevent runoff from flowing underneath the compost blanket.
- Use additional anchoring and erosion control BMPs in conjunction of the compost blanket as needed.

Costs

The cost associated with a compost blanket is similar to that of a straw mat and generally less expensive than a geotextile blanket (USEPA, 2009). Caltrans has provided a recent estimate for $5,000 to $8,000 per acre for application of an unseeded 1 inch compost blanket (Caltrans Compost Specifications, 2009). Recently obtained vendor costs indicate that proprietary blends of compost that are seeded and contain a nutrient rich "tackifier" can cost approximately $0.35 per square foot, or approximately $15,000 per acre for a 2 inch blanket. Application by hand is more time intensive and likely more costly.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Areas where erosion is evident, another layer of compost should be reapplied as soon as possible. It may be necessary to install an additional type of stormwater BMP at the top of slope or as a slope interrupter to control flow, such as a fiber roll (SE-5) or compost sock (SE-11).
- Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require reapplication of BMPs.
- Limit or prohibit foot traffic to minimize damage to BMP or impede vegetation establishment.

References

An Analysis of Composting as an Environmental Remediation Technology, U.S. Environmental Protection Agency (USEPA), Solid Waste and Emergency Response (5305W), EPA530-R-8-008, 1998.

Characteristics of Compost: Moisture Holding and Water Quality Improvement, Center for Research in Water Resources, Kirchoff, C., Malina, J., and Barrett, M., 2003.

Compost Utilization for Erosion Control, The University of Georgia College of Agricultural and Environmental Sciences, pubs.caes.uga.edu/caespubs/pubcd/B1200.htm, Faucette, B. and Risse, M., 2009.

Demonstration Project Using Yard Debris Compost for Erosion Control, Final Report, presented to Metropolitan Service District, W&H Pacific, 1993.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, 2005.

Standard Special Provision 10-1, Erosion Control (Compost Blanket), California Department of Transportation (Caltrans). 2007 Update.

Evaluation of Environmental Benefits and Impacts of Compost and Industry Standard Erosion and Sediment Controls Measures Used in Construction Activities, Dissertation, Institute of Ecology, University of Georgia, Faucette, B., 2004.

Filter Sock Presentation provided at Erosion, Sediment Control and Stormwater Management with Compost BMPs Workshop, U.S. Composting Council 13th Annual Conference and Trade Show, McCoy, S., 2005.

National Pollutant Discharge Elimination System (NPDES), Compost Blankets, U.S. Environmental Protection Agency (USEPA). http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=118, 2009.

Standard Specifications for Transportation Materials and Methods of Sampling and Testing Designation M10-03, Compost for Erosion/Sediment Control (Compost Blankets), Provisional, American Association of State Highway Transportation Officials (AASHTO), 2003.

Stormwater Best Management Practices (BMPs) Field Trials of Erosion Control Compost in Reclamation of Rock Quarry Operations, Nonpoint Source Protection Program CWA §319(h), Texas Commission on Environmental Quality, Adams, T., McFarland, A., Hauck, L., Barrett, M., and Eck, B., 2008.

Soil Preparation/Roughening EC-15



Description and Purpose

Soil Preparation/Roughening involves assessment and preparation of surface soils for BMP installation. This can include soil testing (for seed base, soil characteristics, or nutrients), as well as roughening surface soils by mechanical methods (including sheepsfoot rolling, track walking, scarifying, stair stepping, and imprinting) to prepare soil for additional BMPs, or to break up sheet flow. Soil Preparation can also involve tilling topsoil to prepare a seed bed and/or incorporation of soil amendments, to enhance vegetative establishment.

Suitable Applications

Soil preparation: Soil preparation is essential to proper vegetative establishment. In particular, soil preparation (i.e. tilling, raking, and amendment) is suitable for use in combination with any soil stabilization method, including RECPs or sod. Soil preparation should not be confused with roughening.

Roughening: Soil roughening is generally referred to as track walking (sometimes called imprinting) a slope, where treads from heavy equipment run parallel to the contours of the slope and act as mini terraces. Soil preparation is most effective when used in combination with erosion controls. Soil Roughening is suitable for use as a complementary process for controlling erosion on a site. Roughening is not intended to be used as a stand-alone BMP, and should be used with perimeter controls, additional erosion control measures, grade breaks, and vegetative establishment for maximum effectiveness. Roughening is intended to only affect surface soils and should not compromise slope stability or overall compaction. Suitable applications for soil roughening include:

Categories

EC	Erosion Control	☑
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch

EC-5 Soil Binders

EC-7 Geotextiles and Mats

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Along any disturbed slopes, including temporary stockpiles, sediment basins, or compacted soil diversion berms and swales.

- Roughening should be used in combination with hydraulically applied stabilization methods, compost blanket, or straw mulch; but should not be used in combination with RECPs or sod because roughening is intended to leave terraces on the slope.

Limitations

- Preparation and roughening must take place prior to installing other erosion controls (such as hydraulically applied stabilizers) or sediment controls (such as fiber rolls) on the faces of slopes.

- In such cases where slope preparation is minimal, erosion control/revegetation BMPs that do not require extensive soil preparation - such as hydraulic mulching and seeding applications - should be employed.

- Consideration should be given to the type of erosion control BMP that follows surface preparation, as some BMPs are not designed to be installed over various types of tillage/roughening, i.e., RECPs (erosion control blankets) should not be used with soil roughening due to a "bridging" effect, which suspends the blanket above the seed bed.

- Surface roughness has an effect on the amount of mulch material that needs to be applied, which shows up as a general increase in mulch material due to an increase in surface area (Topographic Index -see EC-3 Hydraulic Mulching).

Implementation

- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

General

A roughened surface can significantly reduce erosion. Based on tests done at the San Diego State Erosion Research Laboratory, various roughening techniques on slopes can result in a 12 - 76% reduction in the erosion rate versus smooth slopes.

Materials

Minimal materials are required unless amendments and/or seed are added to the soil. The majority of soil roughening/preparation can be done with equipment that is on hand at a normal construction site, such as bull dozers and compaction equipment.

Installation Guidelines

Soil Preparation

- Where appropriate or feasible, soil should be prepared to receive the seed by disking or otherwise scarifying the surface to eliminate crust, improve air and water infiltration and create a more favorable environment for germination and growth.

- Based upon soil testing conducted, apply additional soil amendments (e.g. fertilizers, additional seed) to the soil to help with germination. Follow EC-4, Hydroseeding, when selecting and applying seed and fertilizers.

Cut Slope Roughening:

- Stair-step grade or groove the cut slopes that are steeper than 3:1.
- Use stair-step grading on any erodible material soft enough to be ripped with a bulldozer. Slopes consisting of soft rock with some subsoil are particularly suited to stair-step grading.
- Make the vertical cut distance less than the horizontal distance, and slightly slope the horizontal position of the "step" in toward the vertical wall.
- Do not make individual vertical cuts more than 2 feet (0.6 m) high in soft materials or more than 3 feet (0.9 m) high in rocky materials.
- Groove the slope using machinery to create a series of ridges and depressions that run across the slope, on the contour.

Fill Slope Roughening:

- Place on fill slopes with a gradient steeper than 3:1 in lifts not to exceed 8 inches (0.2 m), and make sure each lift is properly compacted.
- Ensure that the face of the slope consists of loose, uncompacted fill 4-6 inches (0.1-0.2 m) deep.
- Use grooving or tracking to roughen the face of the slopes, if necessary.
- Do not blade or scrape the final slope face.

Roughening for Slopes to be Mowed:

- Slopes which require mowing activities should not be steeper than 3:1.
- Roughen these areas to shallow grooves by track walking, scarifying, sheepsfoot rolling, or imprinting.
- Make grooves close together (less than 10 inches), and not less than 1 inch deep, and perpendicular to the direction of runoff (i.e., parallel to the slope contours).
- Excessive roughness is undesirable where mowing is planned.

Roughening With Tracked Machinery:

- Limit roughening with tracked machinery to soils with a sandy textural component to avoid undue compaction of the soil surface.
- Operate tracked machinery up and down the slope to leave horizontal depressions in the soil. Do not back-blade during the final grading operation.
- Seed and mulch roughened areas as soon as possible to obtain optimum seed germination and growth.

Costs

Costs are based on the additional labor of tracking or preparation of the slope plus the cost of any required soil amendment materials.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Check the seeded slopes for signs of erosion such as rills and gullies. Fill these areas slightly above the original grade, then reseed and mulch as soon as possible.
- Inspect BMPs weekly during normal operations, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

References

Soil Stabilization BMP Research for Erosion and Sediment Controls: Cost Survey Technical Memorandum, State of California Department of Transportation (Caltrans), July 2007.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Non-Vegetative Stabilization EC-16



Description and Purpose

Non-vegetative stabilization methods are used for temporary or permanent stabilization of areas prone to erosion and should be used only where vegetative options are not feasible; examples include:

- Areas of vehicular or pedestrian traffic such as roads or paths;
- Arid environments where vegetation would not provide timely ground coverage, or would require excessive irrigation;
- Rocky substrate, infertile or droughty soils where vegetation would be difficult to establish; and
- Areas where vegetation will not grow adequately within the construction time frame.

There are several non-vegetative stabilization methods and selection should be based on site-specific conditions.

Decomposed Granite (DG) is a permanent erosion protection method that consists of a layer of stabilized decomposed granite placed over an erodible surface.

Degradable Mulches of various types (see EC-3, EC-6, EC-8) can be used for temporary non-vegetative stabilization; examples include straw mulch, compost, wood chips or hydraulic mulch.

Geotextiles and Mats can be used for temporary non-vegetative stabilization (see EC-7). These BMPs are typically manufactured from degradable or synthetic materials and are

Categories

EC	Erosion Control	☑
SE	Sediment Control	☒
TR	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

designed and specified based on their functional longevity, i.e., how long they will persist and provide erosion protection. All geotextiles and mats should be replaced when they exceed their functional longevity or when permanent stabilization methods are instituted.

Gravel Mulch is a non-degradable erosion control product that is composed of washed and screened coarse to very coarse gravel, 16 mm to 64 mm (0.6" - 2.5"), similar to an AASHTO No. 3 coarse aggregate.

Rock Slope Protection consists of utilizing large rock or rip-rap (4"- 24") to stabilize slopes with a high erosion potential and those subject to scour along waterways.

Soil Binders can be used for temporary non-vegetative stabilization (see EC-5). The key to their use is functional longevity. In most cases, the soil binder will need to be routinely monitored and re-applied to maintain an erosion-resistant coverage.

Suitable Applications

Non-vegetated stabilization methods are suitable for use on disturbed soil areas and on material stockpiles that need to be temporarily or permanently protected from erosion by water and wind. Non-vegetated stabilization should only be utilized when vegetation cannot be established in the required timeframe, due to soil or climactic conditions, or where vegetation may be a potential fire hazard.

Decomposed Granite (DG) and Gravel Mulch are suitable for use in areas where vegetation establishment is difficult, on flat surfaces, trails and pathways, and when used in conjunction with a stabilizer or tackifier, on shallow slopes (i.e., 10:1 [H:V]). DG and gravel can also be used on shallow rocky slopes where vegetation cannot be established for permanent erosion control.

Degradable Mulches can be used to cover and protect soil surfaces from erosion both in temporary and permanent applications. In many cases, the use of mulches by themselves requires routine inspection and re-application. See EC-3 Hydraulic Mulch, EC-6 Straw Mulch, EC-8 Wood Mulch, or EC-14 Compost Blankets for more information.

Geotextiles and Mats can be used as a temporary stand-alone soil stabilization method. Depending on material selection, geotextiles and mats can be a short-term (3 mos – 1 year) or long-term (1-2 years) temporary stabilization method. For more information on geotextiles and mats see EC-7 Geotextiles and Mats.

Rock Slope Protection can be used when the slopes are subject to scour or have a high erosion potential, such as slopes adjacent to flowing waterways or slopes subject to overflow from detention facilities (spillways).

Soil Binders can be used for temporary stabilization of stockpiles and disturbed areas not subject to heavy traffic. See EC-5 Soil Binders for more information.

Limitations

General

- Refer to EC-3, EC-6, EC-8, and EC-14 for limitations on use of mulches. Refer to EC-7 for limitations on use of geotextiles and mats. Refer to EC-5 for limitations on use of Soil Binders.

Decomposed Granite

- Not available in some geographic regions.
- If not tackified, material may be susceptible to erosion even on slight slopes (e.g., 30:1 [H:V]).
- Installed costs may be more expensive than vegetative stabilization methods.

Gravel Mulch

- Availability is limited in some geographic regions.
- If not properly screened and washed, can contain fine material that can erode and/or create dust problems.
- If inadequately sized, material may be susceptible to erosion on sloped areas.
- Pore spaces fill with dirt and debris over time; may provide a growing medium for weeds.

Rock Slope Protection

- Installation is labor intensive.
- Installed costs can be significantly higher than vegetative stabilization methods.
- Rounded stones may not be used on slopes greater than 2:1 [H:V].

Implementation

General

Non-vegetated stabilization should be used in accordance with the following general guidance:

- Should be used in conjunction with other BMPs, including drainage, erosion controls and sediment controls.
- Refer to EC-3, EC-6, EC-8, and EC-14 for implementation details for mulches. Refer to EC-7 for implementation details for geotextiles and mats. Refer to EC-5 for implementation details for soil binders.
- Non-vegetated stabilization measures should be implemented as soon as the disturbance in the areas they are intended to protect has ceased.
- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

Decomposed Granite Stabilization

- If used for a road or path should be installed on a prepared base.
- Should be mixed with a stabilizer if used for roads or pathways, or on slope applications.
- Though porous it is recommended to prevent standing water on or next to a decomposed granite road or pathway.

Gravel Mulch

- Should be sized based on slope, rainfall, and upgradient run-on conditions. Stone size should be increased as potential for erosion increases (steeper slopes, high intensity rainfall).
- If permanent, a weed control fabric should be placed prior to installation.
- Should be installed at a minimum 2" depth.
- Should completely cover all exposed surfaces.

Rock Slope Protection

- Rock slope protection installation should follow Caltrans Standard Specification 72-2: Rock Slope Protection. Refer to the specification for rock conformity requirements and installation methods.
- When using rock slope protection, rock size and installation method should be specified by an Engineer.
- A geotextile fabric should be placed prior to installation.

Costs

- Costs are highly variable depending not only on technique chosen, but also on materials chosen within specific techniques. In addition, availability of certain materials will vary by region/location, which will also affect the cost. Costs of mulches, geotextiles and mats, and soil binders are presented in their respective fact sheets. Costs for decomposed granite, gravel mulch stabilization and rock slope protection may be higher depending on location and availability of materials. Caltrans has provided an estimate for gravel mulch of \$10 - \$15/yd^2 in flat areas and \$11 - \$23/yd^2 on side slopes.

Inspection and Maintenance

General

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- For permanent installation, require inspection periodically and after major storm events to look for signs of erosion or damage to the stabilization.
- All damage should be repaired immediately.
- Refer to EC-3, EC-6, EC-8, and EC-14 for inspection and maintenance requirements for mulches. Refer to EC-7 for inspection and maintenance requirements for geotextiles and mats. Refer to EC-5 for inspection and maintenance requirements for soil binders.

Decomposed Granite and Gravel Mulch Stabilization

- Rake out and add decomposed granite or gravel as needed to areas subject to rill erosion. Inspect upgradient drainage controls and repair/modify as necessary.

- Should remain stable under loose surface material. Any significant problem areas should be repaired to restore uniformity to the installation.

References

Arid Zone Forestry: A Guide for Field Technicians. Food and Agriculture Organization of the United Nations, 1989.

Design of Roadside Channels with Flexible Linings, Hydraulic Engineering Circular Number 15, Third Edition, Federal Highway Administration, 2007.

Design Standards for Urban Infrastructure - Soft Landscape Design, Department of Territory and Municipal Services - Australian Capital Territory http://www.tams.act.gov.au/work/standards_and_procedures/design_standards_for_urban_infrastructure

Erosion and Sediment Control Handbook: A Guide for Protection of State Waters through the use of Best Management Practices during Land Disturbing Activities, Tennessee Department of Environment and Conservation, 2002.

Gravel Mulch, Landscape Architecture Non-Standard Specification 10-2, California Department of Transportation (Caltrans), http://www.dot.ca.gov/hq/LandArch/roadside/detail-gm.htm

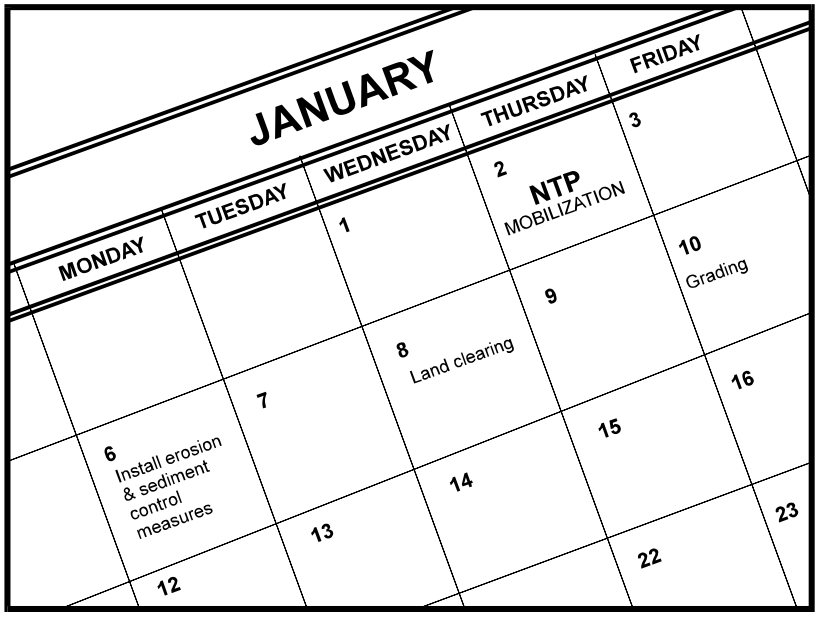
Maine Erosion and Sediment Control BMPs, DEPLW0588, Maine Department of Environmental Protection: Bureau of Land and Water Quality, 2003.

National Menu of Best Management Practices, US Environmental Protection Agency, 2006.

Standard Specification 72-2: Rock Slope Protection. California Department of Transportation, 2006.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Scheduling EC-1



Description and Purpose

Scheduling is the development of a written plan that includes sequencing of construction activities and the implementation of BMPs such as erosion control and sediment control while taking local climate (rainfall, wind, etc.) into consideration. The purpose is to reduce the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking, and to perform the construction activities and control practices in accordance with the planned schedule.

Suitable Applications

Proper sequencing of construction activities to reduce erosion potential should be incorporated into the schedule of every construction project especially during rainy season. Use of other, more costly yet less effective, erosion and sediment control BMPs may often be reduced through proper construction sequencing.

Limitations

- Environmental constraints such as nesting season prohibitions reduce the full capabilities of this BMP.

Implementation

- Avoid rainy periods. Schedule major grading operations during dry months when practical. Allow enough time before rainfall begins to stabilize the soil with vegetation or physical means or to install sediment trapping devices.
- Plan the project and develop a schedule showing each phase of construction. Clearly show how the rainy season relates

Categories

EC	Erosion Control	☑
SE	Sediment Control	☒
TC	Tracking Control	☒
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Objective**
☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

to soil disturbing and re-stabilization activities. Incorporate the construction schedule into the SWPPP.

- Include on the schedule, details on the rainy season implementation and deployment of:
  - Erosion control BMPs
  - Sediment control BMPs
  - Tracking control BMPs
  - Wind erosion control BMPs
  - Non-stormwater BMPs
  - Waste management and materials pollution control BMPs
- Include dates for activities that may require non-stormwater discharges such as dewatering, sawcutting, grinding, drilling, boring, crushing, blasting, painting, hydro-demolition, mortar mixing, pavement cleaning, etc.
- Work out the sequencing and timetable for the start and completion of each item such as site clearing and grubbing, grading, excavation, paving, foundation pouring utilities installation, etc., to minimize the active construction area during the rainy season.
  - Sequence trenching activities so that most open portions are closed before new trenching begins.
  - Incorporate staged seeding and re-vegetation of graded slopes as work progresses.
  - Schedule establishment of permanent vegetation during appropriate planting time for specified vegetation.
- Non-active areas should be stabilized as soon as practical after the cessation of soil disturbing activities or one day prior to the onset of precipitation.
- Monitor the weather forecast for rainfall.
- When rainfall is predicted, adjust the construction schedule to allow the implementation of soil stabilization and sediment treatment controls on all disturbed areas prior to the onset of rain.
- Be prepared year round to deploy erosion control and sediment control BMPs. Erosion may be caused during dry seasons by un-seasonal rainfall, wind, and vehicle tracking. Keep the site stabilized year round, and retain and maintain rainy season sediment trapping devices in operational condition.
- Apply permanent erosion control to areas deemed substantially complete during the project's defined seeding window.

Costs

Construction scheduling to reduce erosion may increase other construction costs due to reduced economies of scale in performing site grading. The cost effectiveness of scheduling techniques should be compared with the other less effective erosion and sedimentation controls to achieve a cost effective balance.

Inspection and Maintenance

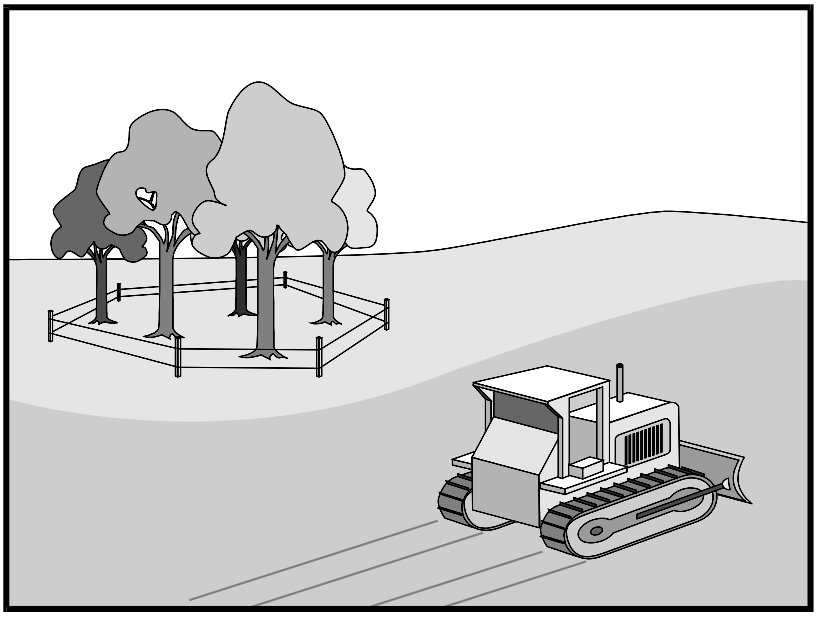
- Verify that work is progressing in accordance with the schedule. If progress deviates, take corrective actions.
- Amend the schedule when changes are warranted.
- Amend the schedule prior to the rainy season to show updated information on the deployment and implementation of construction site BMPs.

References

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities Developing Pollution Prevention Plans and Best Management Practices (EPA 832-R-92-005), U.S. Environmental Protection Agency, Office of Water, September 1992.

Preservation Of Existing Vegetation EC-2



Description and Purpose

Carefully planned preservation of existing vegetation minimizes the potential of removing or injuring existing trees, vines, shrubs, and grasses that protect soil from erosion.

Suitable Applications

Preservation of existing vegetation is suitable for use on most projects. Large project sites often provide the greatest opportunity for use of this BMP. Suitable applications include the following:

- Areas within the site where no construction activity occurs, or occurs at a later date. This BMP is especially suitable to multi year projects where grading can be phased.
- Areas where natural vegetation exists and is designated for preservation. Such areas often include steep slopes, watercourse, and building sites in wooded areas.
- Areas where local, state, and federal government require preservation, such as vernal pools, wetlands, marshes, certain oak trees, etc. These areas are usually designated on the plans, or in the specifications, permits, or environmental documents.
- Where vegetation designated for ultimate removal can be temporarily preserved and be utilized for erosion control and sediment control.

Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Preservation Of Existing Vegetation EC-2

Limitations

- Requires forward planning by the owner/developer, contractor, and design staff.
- Limited opportunities for use when project plans do not incorporate existing vegetation into the site design.
- For sites with diverse topography, it is often difficult and expensive to save existing trees while grading the site satisfactory for the planned development.

Implementation

The best way to prevent erosion is to not disturb the land. In order to reduce the impacts of new development and redevelopment, projects may be designed to avoid disturbing land in sensitive areas of the site (e.g., natural watercourses, steep slopes), and to incorporate unique or desirable existing vegetation into the site's landscaping plan. Clearly marking and leaving a buffer area around these unique areas during construction will help to preserve these areas as well as take advantage of natural erosion prevention and sediment trapping.

Existing vegetation to be preserved on the site must be protected from mechanical and other injury while the land is being developed. The purpose of protecting existing vegetation is to ensure the survival of desirable vegetation for shade, beautification, and erosion control. Mature vegetation has extensive root systems that help to hold soil in place, thus reducing erosion. In addition, vegetation helps keep soil from drying rapidly and becoming susceptible to erosion. To effectively save existing vegetation, no disturbances of any kind should be allowed within a defined area around the vegetation. For trees, no construction activity should occur within the drip line of the tree.

Timing

- Provide for preservation of existing vegetation prior to the commencement of clearing and grubbing operations or other soil disturbing activities in areas where no construction activity is planned or will occur at a later date.

Design and Layout

- Mark areas to be preserved with temporary fencing. Include sufficient setback to protect roots.
  - Orange colored plastic mesh fencing works well.
  - Use appropriate fence posts and adequate post spacing and depth to completely support the fence in an upright position.
- Locate temporary roadways, stockpiles, and layout areas to avoid stands of trees, shrubs, and grass.
- Consider the impact of grade changes to existing vegetation and the root zone.
- Maintain existing irrigation systems where feasible. Temporary irrigation may be required.
- Instruct employees and subcontractors to honor protective devices. Prohibit heavy equipment, vehicular traffic, or storage of construction materials within the protected area.

Costs

There is little cost associated with preserving existing vegetation if properly planned during the project design, and these costs may be offset by aesthetic benefits that enhance property values. During construction, the cost for preserving existing vegetation will likely be less than the cost of applying erosion and sediment controls to the disturbed area. Replacing vegetation inadvertently destroyed during construction can be extremely expensive, sometimes in excess of $10,000 per tree.

Inspection and Maintenance

During construction, the limits of disturbance should remain clearly marked at all times. Irrigation or maintenance of existing vegetation should be described in the landscaping plan. If damage to protected trees still occurs, maintenance guidelines described below should be followed:

- Verify that protective measures remain in place. Restore damaged protection measures immediately.
- Serious tree injuries shall be attended to by an arborist.
- Damage to the crown, trunk, or root system of a retained tree shall be repaired immediately.
- Trench as far from tree trunks as possible, usually outside of the tree drip line or canopy. Curve trenches around trees to avoid large roots or root concentrations. If roots are encountered, consider tunneling under them. When trenching or tunneling near or under trees to be retained, place tunnels at least 18 in. below the ground surface, and not below the tree center to minimize impact on the roots.
- Do not leave tree roots exposed to air. Cover exposed roots with soil as soon as possible. If soil covering is not practical, protect exposed roots with wet burlap or peat moss until the tunnel or trench is ready for backfill.
- Cleanly remove the ends of damaged roots with a smooth cut.
- Fill trenches and tunnels as soon as possible. Careful filling and tamping will eliminate air spaces in the soil, which can damage roots.
- If bark damage occurs, cut back all loosened bark into the undamaged area, with the cut tapered at the top and bottom and drainage provided at the base of the wood. Limit cutting the undamaged area as much as possible.
- Aerate soil that has been compacted over a trees root zone by punching holes 12 in. deep with an iron bar, and moving the bar back and forth until the soil is loosened. Place holes 18 in. apart throughout the area of compacted soil under the tree crown.
- Fertilization
  - Fertilize stressed or damaged broadleaf trees to aid recovery.
  - Fertilize trees in the late fall or early spring.

- Apply fertilizer to the soil over the feeder roots and in accordance with label instructions, but never closer than 3 ft to the trunk. Increase the fertilized area by one-fourth of the crown area for conifers that have extended root systems.

- Retain protective measures until all other construction activity is complete to avoid damage during site cleanup and stabilization.

References

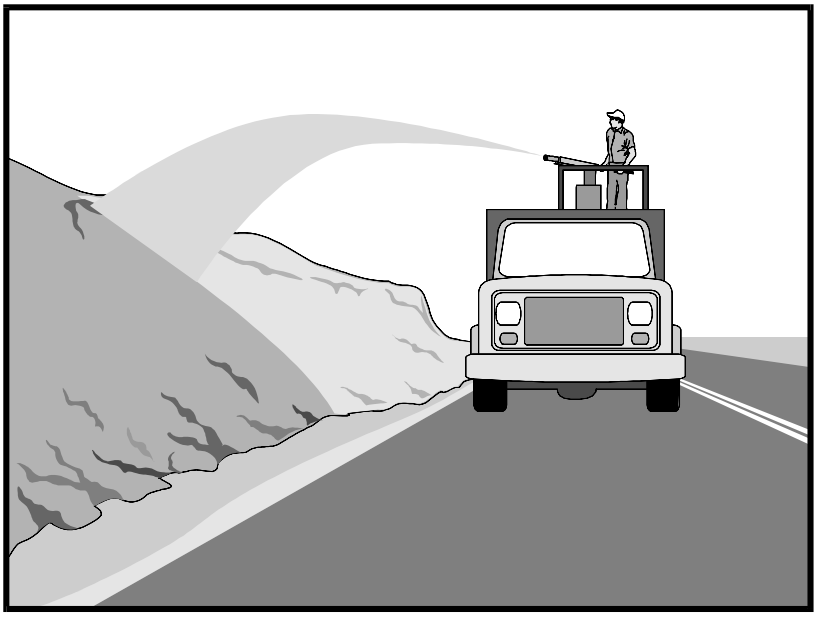
County of Sacramento Tree Preservation Ordinance, September 1981.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for The Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Hydraulic Mulch EC-3



Description and Purpose

Hydraulic Mulch consists of various types of fibrous materials mixed with water and sprayed onto the soil surface in slurry form to provide a layer of temporary protection from wind and water erosion.

Suitable Applications

Hydraulic mulch as a temporary, stand alone, erosion control BMP is suitable for disturbed areas that require temporary protection from wind and water erosion until permanent soil stabilization activities commence. Examples include:

- Rough-graded areas that will remain inactive for longer than permit-required thresholds (e.g., 14 days) or otherwise require stabilization to minimize erosion or prevent sediment discharges.
- Soil stockpiles.
- Slopes with exposed soil between existing vegetation such as trees or shrubs.
- Slopes planted with live, container-grown vegetation or plugs.
- Slopes burned by wildfire.

Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-4 Hydroseeding

EC-5 Soil Binders

EC-6 Straw Mulch

EC-7 Geotextiles and Mats

EC-8 Wood Mulching

EC-14 Compost Blanket

EC-16 Non-Vegetative Stabilization

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Hydraulic mulch can also be applied to augment other erosion control BMPs such as:

- In conjunction with straw mulch (see EC-6 Straw Mulch) where the rate of hydraulic mulch is reduced to 100-500 lbs per acre and the slurry is applied over the straw as a tackifying agent to hold the straw in place.
- Supplemental application of soil amendments, such as fertilizer, lime, gypsum, soil bio-stimulants or compost.

Limitations

In general, hydraulic mulch is not limited by slope length, gradient or soil type. However, the following limitations typically apply:

- Most hydraulic mulch applications, particularly bonded fiber matrices (BFMs), require at least 24 hours to dry before rainfall occurs.
- Temporary applications (i.e., without a vegetative component) may require a second application in order to remain effective for an entire rainy season.
- Treatment areas must be accessible to hydraulic mulching equipment.
- Availability of water sources in remote areas for mixing and application.
- As a stand-alone temporary BMP, hydraulic mulches may need to be re-applied to maintain their erosion control effectiveness, typically after 6-12 months depending on the type of mulch used.
- Availability of hydraulic mulching equipment may be limited just prior to the rainy season and prior to storms due to high demand.
- Cellulose fiber mulches alone may not perform well on steep slopes or in course soils.
- This BMP consists of a mixture of several constituents (e.g., fibers/mulches, tackifiers, and other chemical constituents), some of which may be proprietary and may come pre-mixed by the manufacturer. The water quality impacts of these constituents are relatively unknown and some may have water quality impacts due to their chemical makeup. Refer to specific chemical properties identified in the product Material Safety Data Sheet; products should be evaluated for project-specific implementation by the SWPPP Preparer. Refer to factsheet EC-05 for further guidance on selecting soil binders.

Implementation

- Where feasible, it is preferable to prepare soil surfaces prior to application by roughening embankments and fill areas with a crimping or punching type roller or by track walking.
- The majority of hydraulic mulch applications do not necessarily require surface/soil preparation (See EC-15 Soil Preparation) although in almost every case where re-vegetation is included as part of the practice, soil preparation can be beneficial. One of the advantages of hydraulic mulch over other erosion control methods is that it can be applied in areas where soil preparation is precluded by site conditions, such as steep slopes, rocky soils, or inaccessibility.

- Avoid mulch over spray onto roads, sidewalks, drainage channels, existing vegetation, etc.
- Hydraulic mulching is generally performed utilizing specialized machines that have a large water-holding/mixing tank and some form of mechanical agitation or other recirculation method to keep water, mulch and soil amendments in suspension. The mixed hydraulic slurry can be applied from a tower sprayer on top of the machine or by extending a hose to areas remote from the machine.
- Where possible apply hydraulic mulch from multiple directions to adequately cover the soil. Application from a single direction can result in shadowing, uneven coverage and failure of the BMP.
- Hydraulic mulch can also include a vegetative component, such as seed, rhizomes, or stolons (see EC-4 Hydraulic Seed).
- Typical hydraulic mulch application rates range from 2,000 pounds per acre for standard mulches (SMs) to 3,500 pounds per acre for BFMs. However, the required amount of hydraulic mulch to provide adequate coverage of exposed topsoil may appear to exceed the standard rates when the roughness of the soil surface is changed due to soil preparation methods (see EC-15 Soil Preparation) or by slope gradient.
- Other factors such as existing soil moisture and soil texture can have a profound effect on the amount of hydraulic mulch required (i.e. application rate) applied to achieve an erosion-resistant covering.
- Avoid use of mulch without a tackifier component, especially on slopes.
- Mulches used in the hydraulic mulch slurry can include:
  - Cellulose fiber
  - Thermally-processed wood fibers
  - Cotton
  - Synthetics
  - Compost (see EC-14, Compost Blanket)
- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

Categories of Hydraulic Mulches

Standard Hydraulic Mulch (SM)

Standard hydraulic mulches are generally applied at a rate of 2,000 pounds per acre and are manufactured containing around 5% tackifier (i.e. soil binder), usually a plant-derived guar or psyllium type. Most standard mulches are green in color derived from food-color based dyes.

Hydraulic Matrices (HM) and Stabilized Fiber Matrices (SFM)

Hydraulic matrices and stabilized fiber matrices are slurries which contain increased levels of tackifiers/soil binders; usually 10% or more by weight. HMs and SFMs have improved performance compared to a standard hydraulic mulch (SM) because of the additional percentage of tackifier and because of their higher application rates, typically 2,500 – 4,000 pounds per acre. Hydraulic matrices can include a mixture of fibers, for example, a 50/50 blend of paper and wood fiber. In the case of an SFM, the tackifier/soil binder is specified as a polyacrylamide (PAM).

Bonded Fiber Matrix (BFM)

Bonded fiber matrices (BFMs) are hydraulically-applied systems of fibers, adhesives (typically guar based) and chemical cross-links. Upon drying, the slurry forms an erosion-resistant blanket that prevents soil erosion and promotes vegetation establishment. The cross-linked adhesive in the BFM should be biodegradable and should not dissolve or disperse upon re-wetting. BFMs are typically applied at rates from 3,000 to 4,000 lbs/acre based on the manufacturer's recommendation. BFMs should not be applied immediately before, during or immediately after rainfall or if the soil is saturated. Depending on the product, BFMs typically require 12 to 24 hours to dry and become effective.

Mechanically-Bonded Fiber Matrices (MBFM)

Mechanically-bonded fiber matrices (MBFMs) are hydraulically applied systems similar to BFM that use crimped synthetic fibers and PAM and are typically applied to a slope at a higher application rate than a standard BFM.

Hydraulic Compost Matrix (HCM)

Hydraulic compost matrix (HCM) is a field-derived practice whereby finely graded or sifted compost is introduced into the hydraulic mulch slurry. A guar-type tackifier can be added for steeper slope applications as well as any specified seed mixtures. A HCM can help to accelerate seed germination and growth. HCMs are particularly useful as an in-fill for three-dimensional re-vegetation geocomposites, such as turf reinforcement mats (TRM) (see EC-7 Geotextiles and Mats).

Costs

Average installed costs for hydraulic mulch categories are is provided in Table 1, below.

Table 1
HYDRAULIC MULCH BMPs
INSTALLED COSTS

BMP	Installed Cost/Acre
Standard Hydraulic Mulching (SM)	$1,700 - $3,600 per acre
Hydraulic Matrices (HM) and Stabilized Fiber Matrices	
Guar-based	$2,000 - $4,000 per acre
PAM-based	$2,500 - $5,610 per acre
Bonded Fiber Matrix (BFM)	$3,900 - $6,900 per acre
Mechanically Bonded Fiber Matrix (MBFM)	$4,500 - $6,000 per acre
Hydraulic Compost Matrix (HCM)	$3,000 - $3,500 per acre

Source: Cost information received from individual product manufacturers solicited by Geosyntec Consultants (2004)

Inspection and Maintenance

- Maintain an unbroken, temporary mulched ground cover throughout the period of construction when the soils are not being reworked.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Areas where erosion is evident should be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- Compare the number of bags or weight of applied mulch to the area treated to determine actual application rates and compliance with specifications.

References

Soil Stabilization BMP Research for Erosion and Sediment Controls: Cost Survey Technical Memorandum, State of California Department of Transportation (Caltrans), July 2007.

Controlling Erosion of Construction Sites, Agricultural Information #347, U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service – SCS).

Guides for Erosion and Sediment Control in California, USDA Soils Conservation Service, January 1991.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Sedimentation and Erosion Control, An Inventory of Current Practices Draft, US EPA, April 1990.

Soil Erosion by Water, Agriculture Information Bulletin #513, U.S. Department of Agriculture, Soil Conservation Service.

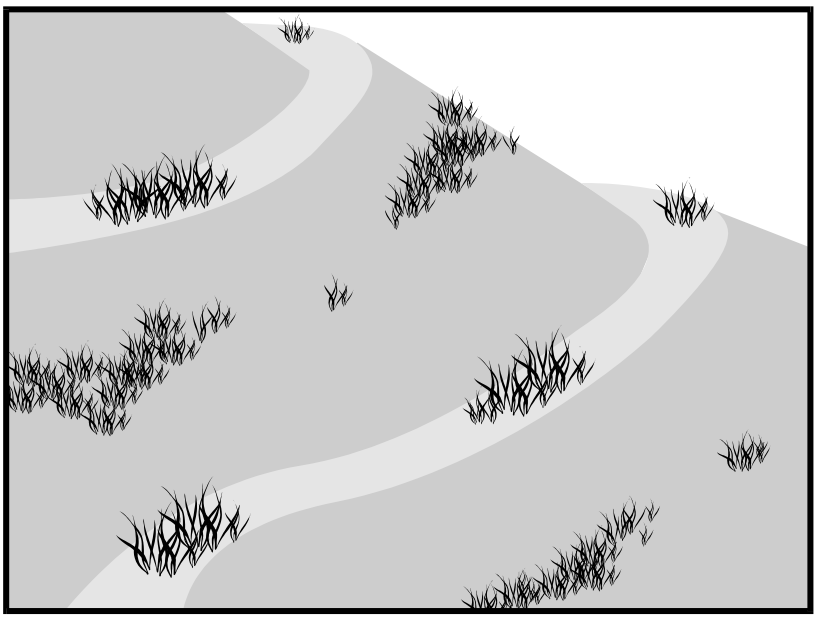
Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Hydroseeding EC-4



Description and Purpose

Hydroseeding typically consists of applying a mixture of a hydraulic mulch, seed, fertilizer, and stabilizing emulsion with a hydraulic mulcher, to temporarily protect exposed soils from erosion by water and wind. Hydraulic seeding, or hydroseeding, is simply the method by which temporary or permanent seed is applied to the soil surface.

Suitable Applications

Hydroseeding is suitable for disturbed areas requiring temporary protection until permanent stabilization is established, for disturbed areas that will be re-disturbed following an extended period of inactivity, or to apply permanent stabilization measures. Hydroseeding without mulch or other cover (e.g. EC-7, Erosion Control Blanket) is not a stand-alone erosion control BMP and should be combined with additional measures until vegetation establishment.

Typical applications for hydroseeding include:

- Disturbed soil/graded areas where permanent stabilization or continued earthwork is not anticipated prior to seed germination.
- Cleared and graded areas exposed to seasonal rains or temporary irrigation.
- Areas not subject to heavy wear by construction equipment or high traffic.

Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch
EC-5 Soil Binders
EC-6 Straw Mulch
EC-7 Geotextiles and Mats
EC-8 Wood Mulching
EC-14 Compost Blanket
EC-16 Non-Vegetative Stabilization

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Limitations

- Availability of hydroseeding equipment may be limited just prior to the rainy season and prior to storms due to high demand.
- Hydraulic seed should be applied with hydraulic mulch or a stand-alone hydroseed application should be followed by one of the following:
    - Straw mulch (see Straw Mulch EC-6)
    - Rolled erosion control products (see Geotextiles and Mats EC-7)
    - Application of Compost Blanket (see Compost Blanket EC-14)

  Hydraulic seed may be used alone only on small flat surfaces when there is sufficient time in the season to ensure adequate vegetation establishment and coverage to provide adequate erosion control.
- Hydraulic seed without mulch does not provide immediate erosion control.
- Temporary seeding may not be appropriate for steep slopes (i.e., slopes readily prone to rill erosion or without sufficient topsoil).
- Temporary seeding may not be appropriate in dry periods without supplemental irrigation.
- Temporary vegetation may have to be removed before permanent vegetation is applied.
- Temporary vegetation may not be appropriate for short term inactivity (i.e. less than 3-6 months).
- This BMP consists of a mixture of several constituents (e.g., fibers/mulches, tackifiers, and other chemical constituents), some of which may be proprietary and may come pre-mixed by the manufacturer. The water quality impacts of these constituents are relatively unknown and some may have water quality impacts due to their chemical makeup. Additionally these constituents may require non-visible pollutant monitoring. Refer to specific chemical properties identified in the product Material Safety Data Sheet; products should be evaluated for project-specific implementation by the SWPPP Preparer. Refer to factsheet EC-05 for further guidance on selecting soil binders.

Implementation

In order to select appropriate hydraulic seed mixtures, an evaluation of site conditions should be performed with respect to:

- Soil conditions
- Site topography and exposure (sun/wind)
- Season and climate
- Vegetation types
- Maintenance requirements
- Sensitive adjacent areas
- Water availability
- Plans for permanent vegetation

The local office of the U.S.D.A. Natural Resources Conservation Service (NRCS), Resource Conservation Districts and Agricultural Extension Service can provide information on appropriate seed mixes.

The following steps should be followed for implementation:

- Where appropriate or feasible, soil should be prepared to receive the seed by disking or otherwise scarifying (See EC-15, Soil Preparation) the surface to eliminate crust, improve air and water infiltration and create a more favorable environment for germination and growth.
- Avoid use of hydraulic seed in areas where the BMP would be incompatible with future earthwork activities.
- Hydraulic seed can be applied using a multiple step or one step process.
  - In a multiple step process, hydraulic seed is applied first, followed by mulch or a Rolled Erosion Control Product (RECP).
  - In the one step process, hydraulic seed is applied with hydraulic mulch in a hydraulic matrix. When the one step process is used to apply the mixture of fiber, seed, etc., the seed rate should be increased to compensate for all seeds not having direct contact with the soil.
- All hydraulically seeded areas should have mulch, or alternate erosion control cover to keep seeds in place and to moderate soil moisture and temperature until the seeds germinate and grow.
- All seeds should be in conformance with the California State Seed Law of the Department of Agriculture. Each seed bag should be delivered to the site sealed and clearly marked as to species, purity, percent germination, dealer's guarantee, and dates of test. The container should be labeled to clearly reflect the amount of Pure Live Seed (PLS) contained. All legume seed should be pellet inoculated. Inoculant sources should be species specific and should be applied at a rate of 2 lb of inoculant per 100 lb seed.
- Commercial fertilizer should conform to the requirements of the California Food and Agricultural Code, which can be found at http://www.leginfo.ca.gov/.html/fac_table_of_contents.html. Fertilizer should be pelleted or granular form.
- Follow up applications should be made as needed to cover areas of poor coverage or germination/vegetation establishment and to maintain adequate soil protection.
- Avoid over spray onto roads, sidewalks, drainage channels, existing vegetation, etc.
- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

Costs

Average cost for installation and maintenance may vary from as low as $1,900 per acre for flat slopes and stable soils, to $4,000 per acre for moderate to steep slopes and/or erosive soils. Cost of seed mixtures vary based on types of required vegetation.

BMP	Installed Cost per Acre
Hydraulic Seed	$1,900-$4,000

Source: Cost information received from individual product manufacturers solicited by Geosyntec Consultants (2004).

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Areas where erosion is evident should be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- Where seeds fail to germinate, or they germinate and die, the area must be re-seeded, fertilized, and mulched within the planting season, using not less than half the original application rates.
- Irrigation systems, if applicable, should be inspected daily while in use to identify system malfunctions and line breaks. When line breaks are detected, the system must be shut down immediately and breaks repaired before the system is put back into operation.
- Irrigation systems should be inspected for complete coverage and adjusted as needed to maintain complete coverage.

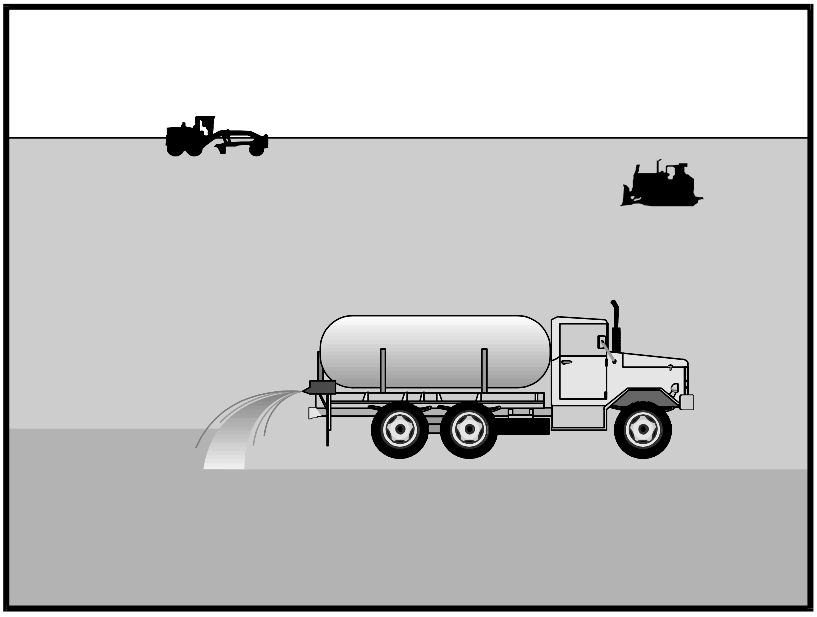
References

Soil Stabilization BMP Research for Erosion and Sediment Controls: Cost Survey Technical Memorandum, State of California Department of Transportation (Caltrans), July 2007.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999.

Soil Binders EC-5



Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch
EC-4 Hydroseeding
EC-6 Straw Mulch
EC-7 Geotextiles and Mats
EC-8 Wood Mulching

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Soil binding consists of application and maintenance of a soil stabilizer to exposed soil surfaces. Soil binders are materials applied to the soil surface to temporarily prevent water and wind induced erosion of exposed soils on construction sites.

Suitable Applications

Soil binders are typically applied to disturbed areas requiring temporary protection. Because soil binders, when used as a stand-alone practice, can often be incorporated into the soil, they are a good alternative to mulches in areas where grading activities will soon resume. Soil binders are commonly used in the following areas:

- Rough graded soils that will be inactive for a short period of time
- Soil stockpiles
- Temporary haul roads prior to placement of crushed rock
- Compacted soil road base
- Construction staging, materials storage, and layout areas

Limitations

- Soil binders are temporary in nature and may need reapplication.
- Soil binders require a minimum curing time until fully effective, as prescribed by the manufacturer. Curing time

may be 24 hours or longer. Soil binders may need reapplication after a storm event.

- Soil binders will generally experience spot failures during heavy rainfall events. If runoff penetrates the soil at the top of a slope treated with a soil binder, it is likely that the runoff will undercut the stabilized soil layer and discharge at a point further down slope.
- Plant-material-based soil binders do not generally hold up to pedestrian or vehicular traffic across treated areas as well as polymeric emulsion blends or cementitious-based binders.
- Soil binders may not sufficiently penetrate compacted soils.
- Some soil binders are soil texture specific in terms of their effectiveness. For example, polyacrylamides (PAMs) work very well on silt and clayey soils but their performance decreases dramatically in sandy soils.
- Some soil binders may not perform well with low relative humidity. Under rainy conditions, some agents may become slippery or leach out of the soil.
- Soil binders may not cure if low temperatures occur within 24 hours of application.
- The water quality impacts of some chemical soil binders are relatively unknown and some may have water quality impacts due to their chemical makeup. Additionally, these chemical may require non-visible pollutant monitoring. Products should be evaluated for project-specific implementation by the SWPPP Preparer. Refer to the product Material Safety Data Sheet for chemical properties.

Implementation

General Considerations

- Soil binders should conform to local municipality specifications and requirements.
- Site soil types will dictate appropriate soil binders to be used.
- A soil binder must be environmentally benign (non-toxic to plant and animal life), easy to apply, easy to maintain, economical, and should not stain paved or painted surfaces. Soil binders should not pollute stormwater when cured. Obtain a Material Safety Data Sheet (MSDS) from the manufacturer to ensure non-toxicity.
- Stormwater runoff from PAM treated soils should pass through one of the following sediment control BMP prior to discharging to surface waters.
    - When the total drainage area is greater than or equal to 5 acres, PAM treated areas should drain to a sediment basin.
    - Areas less than 5 acres should drain to sediment control BMPs, such as a sediment trap, or a series of check dams. The total number of check dams used should be maximized to achieve the greatest amount of settlement of sediment prior to discharging from the site. Each check dam should be spaced evenly in the drainage channel through which stormwater flows are discharged off site.

- Performance of soil binders depends on temperature, humidity, and traffic across treated areas.
- Avoid over spray onto roads, sidewalks, drainage channels, existing vegetation, etc.
- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

Selecting a Soil Binder

Properties of common soil binders used for erosion control are provided on Table 1 at the end of this Fact Sheet. Use Table 1 to select an appropriate soil binder. Refer to WE-1, Wind Erosion Control, for dust control soil binders.

Factors to consider when selecting a soil binder include the following:

- Suitability to situation - Consider where the soil binder will be applied, if it needs a high resistance to leaching or abrasion, and whether it needs to be compatible with any existing vegetation. Determine the length of time soil stabilization will be needed, and if the soil binder will be placed in an area where it will degrade rapidly. In general, slope steepness is not a discriminating factor for the listed soil binders.
- Soil types and surface materials - Fines and moisture content are key properties of surface materials. Consider a soil binder's ability to penetrate, likelihood of leaching, and ability to form a surface crust on the surface materials.
- Frequency of application - The frequency of application is related to the functional longevity of the binder, which can be affected by subgrade conditions, surface type, climate, and maintenance schedule.
- Frequent applications could lead to high costs. Application frequency may be minimized if the soil binder has good penetration, low evaporation, and good longevity. Consider also that frequent application will require frequent equipment clean up.

Plant-Material-Based (Short Lived, <6 months) Binders

Guar: Guar is a non-toxic, biodegradable, natural galactomannan-based hydrocolloid treated with dispersant agents for easy field mixing. It should be mixed with water at the rate of 11 to 15 lb per 1,000 gallons. Recommended minimum application rates are as follows:

Application Rates for Guar Soil Stabilizer

Slope (H:V):	Flat	4:1	3:1	2:1	1:1
lb/acre:	40	45	50	60	70

Psyllium: Psyllium is composed of the finely ground muciloid coating of plantago seeds that is applied as a dry powder or in a wet slurry to the surface of the soil. It dries to form a firm but rewettable membrane that binds soil particles together, but permits germination and growth of seed. Psyllium requires 12 to 18 hours drying time. Application rates should be from 80 to 200 lb/acre, with enough water in solution to allow for a uniform slurry flow.

Starch: Starch is non-ionic, cold water soluble (pre-gelatinized) granular cornstarch. The material is mixed with water and applied at the rate of 150 lb/acre. Approximate drying time is 9 to 12 hours.

Plant-Material-Based (Long Lived, 6-12 months) Binders

Pitch and Rosin Emulsion: Generally, a non-ionic pitch and rosin emulsion has a minimum solids content of 48%. The rosin should be a minimum of 26% of the total solids content. The soil stabilizer should be non-corrosive, water dilutable emulsion that upon application cures to a water insoluble binding and cementing agent. For soil erosion control applications, the emulsion is diluted and should be applied as follows:

- For clayey soil: 5 parts water to 1 part emulsion
- For sandy soil: 10 parts water to 1 part emulsion

Application can be by water truck or hydraulic seeder with the emulsion and product mixture applied at the rate specified by the manufacturer.

Polymeric Emulsion Blend Binders

Acrylic Copolymers and Polymers: Polymeric soil stabilizers should consist of a liquid or solid polymer or copolymer with an acrylic base that contains a minimum of 55% solids. The polymeric compound should be handled and mixed in a manner that will not cause foaming or should contain an anti-foaming agent. The polymeric emulsion should not exceed its shelf life or expiration date; manufacturers should provide the expiration date. Polymeric soil stabilizer should be readily miscible in water, non-injurious to seed or animal life, non-flammable, should provide surface soil stabilization for various soil types without totally inhibiting water infiltration, and should not re-emulsify when cured. The applied compound typically requires 12 to 24 hours drying time. Liquid copolymer should be diluted at a rate of 10 parts water to 1 part polymer and the mixture applied to soil at a rate of 1,175 gallons/acre.

Liquid Polymers of Methacrylates and Acrylates: This material consists of a tackifier/sealer that is a liquid polymer of methacrylates and acrylates. It is an aqueous 100% acrylic emulsion blend of 40% solids by volume that is free from styrene, acetate, vinyl, ethoxylated surfactants or silicates. For soil stabilization applications, it is diluted with water in accordance with the manufacturer's recommendations, and applied with a hydraulic seeder at the rate of 20 gallons/acre. Drying time is 12 to 18 hours after application.

Copolymers of Sodium Acrylates and Acrylamides: These materials are non-toxic, dry powders that are copolymers of sodium acrylate and acrylamide. They are mixed with water and applied to the soil surface for erosion control at rates that are determined by slope gradient:

Slope Gradient (H:V)	lb/acre
Flat to 5:1	3.0 – 5.0
5:1 to 3:1	5.0 – 10.0
2:1 to 1:1	10.0 – 20.0

Poly-Acrylamide (PAM) and Copolymer of Acrylamide**:** Linear copolymer polyacrylamide for use as a soil binder is packaged as a dry flowable solid, as a liquid. Refer to the manufacturer's recommendation for dilution and application rates as they vary based on liquid or dry form, site conditions and climate.

- Limitations specific to PAM are as follows:
  - Do not use PAM on a slope that flows into a water body without passing through a sediment trap or sediment basin.
  - The specific PAM copolymer formulation must be anionic. Cationic PAM should not be used in any application because of known aquatic toxicity problems. Only the highest drinking water grade PAM, certified for compliance with ANSI/NSF Standard 60 for drinking water treatment, should be used for soil applications.
  - PAM designated for erosion and sediment control should be "water soluble" or "linear" or "non-cross linked".
  - PAM should not be used as a stand-alone BMP to protect against water-based erosion. When combined with mulch, its effectiveness increases dramatically.

Hydro-Colloid Polymers: Hydro-Colloid Polymers are various combinations of dry flowable poly-acrylamides, copolymers and hydro-colloid polymers that are mixed with water and applied to the soil surface at rates of 55 to 60 lb/acre. Drying times are 0 to 4 hours.

Cementitious-Based Binders

Gypsum: This is a formulated gypsum based product that readily mixes with water and mulch to form a thin protective crust on the soil surface. It is composed of high purity gypsum that is ground, calcined and processed into calcium sulfate hemihydrate with a minimum purity of 86%. It is mixed in a hydraulic seeder and applied at rates 4,000 to 12,000 lb/acre. Drying time is 4 to 8 hours.

Applying Soil Binders

After selecting an appropriate soil binder, the untreated soil surface must be prepared before applying the soil binder. The untreated soil surface must contain sufficient moisture to assist the agent in achieving uniform distribution. In general, the following steps should be followed:

- Follow manufacturer's written recommendations for application rates, pre-wetting of application area, and cleaning of equipment after use.
- Prior to application, roughen embankment and fill areas.
- Consider the drying time for the selected soil binder and apply with sufficient time before anticipated rainfall. Soil binders should not be applied during or immediately before rainfall.
- Avoid over spray onto roads, sidewalks, drainage channels, sound walls, existing vegetation, etc.

- Soil binders should not be applied to frozen soil, areas with standing water, under freezing or rainy conditions, or when the temperature is below 40°F during the curing period.
- More than one treatment is often necessary, although the second treatment may be diluted or have a lower application rate.
- Generally, soil binders require a minimum curing time of 24 hours before they are fully effective. Refer to manufacturer's instructions for specific cure time.
- For liquid agents:
  - Crown or slope ground to avoid ponding.
  - Uniformly pre-wet ground at 0.03 to 0.3 gal/yd^2 or according to manufacturer's recommendations.
  - Apply solution under pressure. Overlap solution 6 to 12 in.
  - Allow treated area to cure for the time recommended by the manufacturer; typically at least 24 hours.
  - Apply second treatment before first treatment becomes ineffective, using 50% application rate.
  - In low humidities, reactivate chemicals by re-wetting with water at 0.1 to 0.2 gal/yd^2.

Costs

Costs vary according to the soil stabilizer selected for implementation. The following are approximate installed costs:

Soil Binder	Cost per Acre (2004)[1]	Estimated Cost per Acre (2009)[2]
Plant-Material-Based (Short Lived) Binders	$700-$900	$770-$990
Plant-Material-Based (Long Lived) Binders	$1,200-$1,500	$1,320-$1,650
Polymeric Emulsion Blend Binders	$700 -$1,500	$770-$1,650
Cementitious-Based Binders	$800-$1,200	$880-$1,350

1. Source: Cost information received from individual product manufacturers solicited by Geosyntec Consultants (2004).

2. 2009 costs reflect a 10% escalation over year 2004 costs. Escalation based on informal survey of industry trends. Note: Expected cost increase is offset by competitive economic conditions.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Areas where erosion is evident should be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- Reapply the selected soil binder as needed to maintain effectiveness.

Table 1 Properties of Soil Binders for Erosion Control

Evaluation Criteria	Binder Type			
	Plant Material Based (Short Lived)	**Plant Material Based (Long Lived)**	**Polymeric Emulsion Blends**	**Cementitious-Based Binders**
Relative Cost	Low	Moderate to High	Low to High	Low to Moderate
Resistance to Leaching	High	High	Low to Moderate	Moderate
Resistance to Abrasion	Moderate	Low	Moderate to High	Moderate to High
Longevity	Short to Medium	Medium	Medium to Long	Medium
Minimum Curing Time before Rain	9 to 18 hours	19 to 24 hours	0 to 24 hours	4 to 8 hours
Compatibility with Existing Vegetation	Good	Poor	Poor	Poor
Mode of Degradation	Biodegradable	Biodegradable	Photodegradable/ Chemically Degradable	Photodegradable/ Chemically Degradable
Labor Intensive	No	No	No	No
Specialized Application Equipment	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher
Liquid/Powder	Powder	Liquid	Liquid/Powder	Powder
Surface Crusting	Yes, but dissolves on rewetting	Yes	Yes, but dissolves on rewetting	Yes
Clean Up	Water	Water	Water	Water
Erosion Control Application Rate	Varies (1)	Varies (1)	Varies (1)	4,000 to 12,000 lbs/acre

(1) See Implementation for specific rates.

References

Erosion Control Pilot Study Report, State of California Department of Transportation (Caltrans), June 2000.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

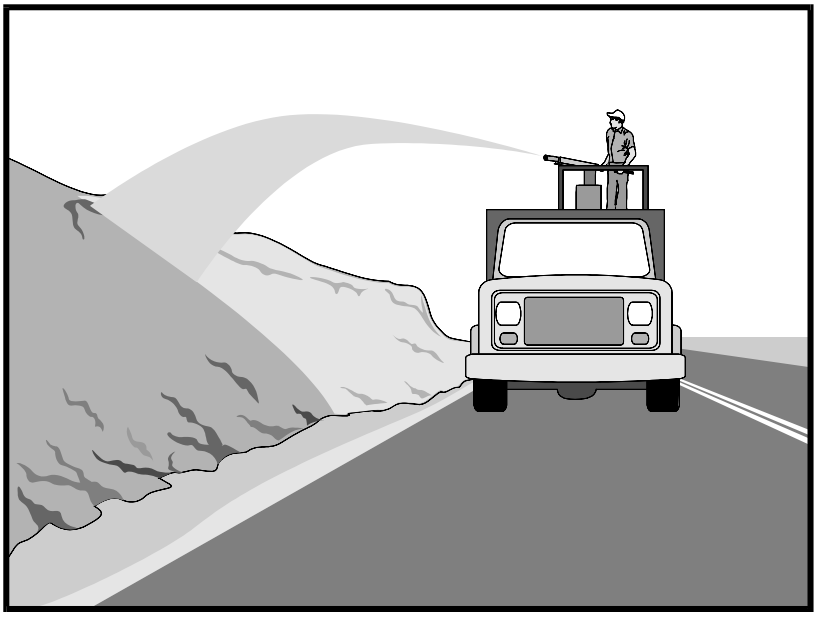
Sedimentation and Erosion Control, An Inventory of Current Practices Draft, US EPA, April 1990.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Straw Mulch EC-6



Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch
EC-4 Hydroseeding
EC-5 Soil Binders
EC-7 Geotextiles and Mats
EC-8 Wood Mulching
EC-14 Compost Blanket

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Straw mulch consists of placing a uniform layer of straw and incorporating it into the soil with a studded roller or crimper, or anchoring it with a tackifier or stabilizing emulsion. Straw mulch protects the soil surface from the impact of rain drops, preventing soil particles from becoming dislodged.

Suitable Applications

Straw mulch is suitable for disturbed areas requiring temporary protection until permanent stabilization is established. Straw mulch can be specified for the following applications:

- As a stand-alone BMP on disturbed areas until soils can be prepared for permanent vegetation. The longevity of straw mulch is typically less than six months.
- Applied in combination with temporary seeding strategies
- Applied in combination with permanent seeding strategies to enhance plant establishment and final soil stabilization
- Applied around containerized plantings to control erosion until the plants become established to provide permanent stabilization

Limitations

Availability of straw and straw blowing equipment may be limited just prior to the rainy season and prior to storms due to high demand.

- There is a potential for introduction of weed seed and unwanted plant material if weed-free agricultural straw is not specified.
- Straw mulch applied by hand is more time intensive and potentially costly.
- Wind may limit application of straw and blow straw into undesired locations.
- May have to be removed prior to permanent seeding or prior to further earthwork.
- "Punching" of straw does not work in sandy soils, necessitating the use of tackifiers.
- Potential fugitive dust control issues associated with straw applications can occur. Application of a stabilizing emulsion or a water stream at the same time straw is being blown can reduce this problem.
- Use of plastic netting should be avoided in areas where wildlife may be entrapped and may be prohibited for projects in certain areas with sensitive wildlife species, especially reptiles and amphibians.

Implementation

- Straw should be derived from weed-free wheat, rice, or barley. Where required by the plans, specifications, permits, or environmental documents, native grass straw should be used.
- Use tackifier to anchor straw mulch to the soil on slopes.
- Crimping, punch roller-type rollers, or track walking may also be used to incorporate straw mulch into the soil on slopes. Track walking can be used where other methods are impractical.
- Avoid placing straw onto roads, sidewalks, drainage channels, sound walls, existing vegetation, etc.
- Straw mulch with tackifier should not be applied during or immediately before rainfall.
- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

Application Procedures

- When using a tackifier to anchor the straw mulch, roughen embankment or fill areas by rolling with a crimping or punching-type roller or by track walking before placing the straw mulch. Track walking should only be used where rolling is impractical.
- Apply straw at a rate of between 3,000 and 4,000 lb/acre, either by machine or by hand distribution and provide 100% ground cover. A lighter application is used for flat surfaces and a heavier application is used for slopes.
- Evenly distribute straw mulch on the soil surface.
- Anchoring straw mulch to the soil surface by "punching" it into the soil mechanically (incorporating) can be used in lieu of a tackifier.

- Methods for holding the straw mulch in place depend upon the slope steepness, accessibility, soil conditions, and longevity.

  - A tackifier acts to glue the straw fibers together and to the soil surface. The tackifier should be selected based on longevity and ability to hold the fibers in place. A tackifier is typically applied at a rate of 125 lb/acre. In windy conditions, the rates are typically 180 lb/acre.

  - On very small areas, a spade or shovel can be used to punch in straw mulch.

  - On slopes with soils that are stable enough and of sufficient gradient to safely support construction equipment without contributing to compaction and instability problems, straw can be "punched" into the ground using a knife blade roller or a straight bladed coulter, known commercially as a "crimper."

Costs

Average annual cost for installation and maintenance is included in the table below. Application by hand is more time intensive and potentially more costly.

BMP	Unit Cost per Acre
Straw mulch, crimped or punched	$2,458-$5,375
Straw mulch with tackifier	$1,823-$4,802

Source: Cost information received from individual product suppliers solicited by Geosyntec Consultants (2004).

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Areas where erosion is evident should be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.

- The key consideration in inspection and maintenance is that the straw needs to last long enough to achieve erosion control objectives. Straw mulch as a stand-alone BMP is temporary and is not suited for long-term erosion control.

- Maintain an unbroken, temporary mulched ground cover while disturbed soil areas are inactive. Repair any damaged ground cover and re-mulch exposed areas.

- Reapplication of straw mulch and tackifier may be required to maintain effective soil stabilization over disturbed areas and slopes.

References

Soil Stabilization BMP Research for Erosion and Sediment Controls: Cost Survey Technical Memorandum, State of California Department of Transportation (Caltrans), July 2007.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Controlling Erosion of Construction Sites, Agricultural Information Bulletin #347, U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service – SCS).

Guides for Erosion and Sediment Control in California, USDA Soils Conservation Service, January 1991.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

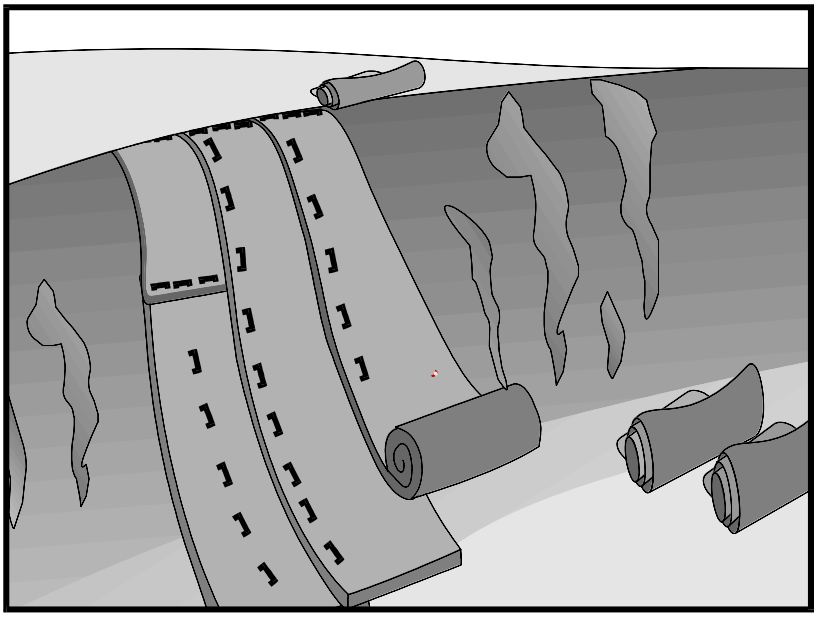
Soil Erosion by Water, Agricultural Information Bulletin #513, U.S. Department of Agriculture, Soil Conservation Service.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Geotextiles and Mats EC-7



Categories		
EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch

EC-4 Hydroseeding

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Mattings, or Rolled Erosion Control Products (RECPs), can be made of natural or synthetic materials or a combination of the two. RECPs are used to cover the soil surface to reduce erosion from rainfall impact, hold soil in place, and absorb and hold moisture near the soil surface. Additionally, RECPs may be used to stabilize soils until vegetation is established or to reinforce non-woody surface vegetation.

Suitable Applications

RECPs are typically applied on slopes where erosion hazard is high and vegetation will be slow to establish. Mattings are also used on stream banks, swales and other drainage channels where moving water at velocities between 3 ft/s and 6 ft/s are likely to cause scour and wash out new vegetation, and in areas where the soil surface is disturbed and where existing vegetation has been removed. RECPs may also be used when seeding cannot occur (e.g., late season construction and/or the arrival of an early rain season). RECPs should be considered when the soils are fine grained and potentially erosive. RECPs should be considered in the following situations.

- Steep slopes, generally steeper than 3:1 (H:V)
- Slopes where the erosion potential is high
- Slopes and disturbed soils where mulch must be anchored
- Disturbed areas where plants are slow to develop

- Channels with flows exceeding 3.3 ft/s
- Channels to be vegetated
- Stockpiles
- Slopes adjacent to water bodies

Limitations

- RECP installed costs are generally higher than other erosion control BMPs, limiting their use to areas where other BMPs are ineffective (e.g. channels, steep slopes).
- RECPs may delay seed germination, due to reduction in soil temperature.
- RECPs are generally not suitable for excessively rocky sites or areas where the final vegetation will be mowed (since staples and netting can catch in mowers). If a staple or pin cannot be driven into the soil because the underlying soil is too hard or rocky, then an alternative BMP should be selected.
- If used for temporary erosion control, RECPs should be removed and disposed of prior to application of permanent soil stabilization measures.
- The use of plastic should be limited to covering stockpiles or very small graded areas for short periods of time (such as through one imminent storm event) until more environmentally friendly measures, such as seeding and mulching, may be installed.
    - Plastic sheeting is easily vandalized, easily torn, photodegradable, and must be disposed of at a landfill.
    - Plastic sheeting results in 100% runoff, which may cause serious erosion problems in the areas receiving the increased flow.
- RECPs may have limitations based on soil type, slope gradient, or channel flow rate; consult the manufacturer for proper selection.
- Not suitable for areas that have foot traffic (tripping hazard) – e.g., pad areas around buildings under construction.
- RECPs that incorporate a plastic netting (e.g. straw blanket typically uses a plastic netting to hold the straw in place) may not be suitable near known wildlife habitat. Wildlife can become trapped in the plastic netting.
- RECPs may have limitations in extremely windy climates. However, when RECPs are properly trenched at the top and bottom and stapled in accordance with the manufacturer's recommendations, problems with wind can be minimized.

Implementation

Material Selection

- Natural RECPs have been found to be effective where re-vegetation will be provided by re-seeding. The choice of material should be based on the size of area, side slopes, surface conditions such as hardness, moisture, weed growth, and availability of materials.

- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

- The following natural and synthetic RECPs are commonly used:

Geotextiles

- Material can be a woven or a non-woven polypropylene fabric with minimum thickness of 0.06 in., minimum width of 12 ft and should have minimum tensile strength of 150 lbs (warp), 80 lbs (fill) in conformance with the requirements in ASTM Designation: D 4632. The permittivity of the fabric should be approximately 0.07 sec^{-1} in conformance with the requirements in ASTM Designation: D4491. The fabric should have an ultraviolet (UV) stability of 70 percent in conformance with the requirements in ASTM designation: D4355. Geotextile blankets must be secured in place with wire staples or sandbags and by keying into tops of slopes to prevent infiltration of surface waters under geotextile. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- Geotextiles may be reused if they are suitable for the use intended.

Plastic Covers

- Generally plastic sheeting should only be used as stockpile covering or for very small graded areas for short periods of time (such as through one imminent storm event). If plastic sheeting must be used, choose a plastic that will withstand photo degradation.

- Plastic sheeting should have a minimum thickness of 6 mils, and must be keyed in at the top of slope (when used as a temporary slope protection) and firmly held in place with sandbags or other weights placed no more than 10 ft apart. Seams are typically taped or weighted down their entire length, and there should be at least a 12 in. to 24 in. overlap of all seams. Edges should be embedded a minimum of 6 in. in soil (when used as a temporary slope protection).

- All sheeting must be inspected periodically after installation and after significant rainstorms to check for erosion, undermining, and anchorage failure. Any failures must be repaired immediately. If washout or breakages occur, the material should be re-installed after repairing the damage to the slope.

Erosion Control Blankets/Mats

- Biodegradable RECPs are typically composed of jute fibers, curled wood fibers, straw, coconut fiber, or a combination of these materials. In order for an RECP to be considered 100% biodegradable, the netting, sewing or adhesive system that holds the biodegradable mulch fibers together must also be biodegradable. See typical installation details at the end of this fact sheet.

- **Jute** is a natural fiber that is made into a yarn that is loosely woven into a biodegradable mesh. The performance of jute as a stand-alone RECP is low. Most other RECPs outperform jute as a temporary erosion control product and therefore jute is not commonly used. It is designed to be used in conjunction with vegetation. The material is supplied in rolled strips, which should be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Excelsior** (curled wood fiber) blanket material should consist of machine produced mats of curled wood excelsior with 80 percent of the fiber 6 in. or longer. The excelsior blanket should be of consistent thickness. The wood fiber must be evenly distributed over the entire area of the blanket. The top surface of the blanket should be covered with a photodegradable extruded plastic mesh. The blanket should be smolder resistant without the use of chemical additives and should be non-toxic and non-injurious to plant and animal life. Excelsior blankets should be furnished in rolled strips, a minimum of 48 in. wide, and should have an average weight of 0.8 lb/yd^2, ±10 percent, at the time of manufacture. Excelsior blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Straw blanket** should be machine produced mats of straw with a lightweight biodegradable netting top layer. The straw should be attached to the netting with biodegradable thread or glue strips. The straw blanket should be of consistent thickness. The straw should be evenly distributed over the entire area of the blanket. Straw blanket should be furnished in rolled strips a minimum of 6.5 ft wide, a minimum of 80 ft long and a minimum of 0.5 lb/yd^2. Straw blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Wood fiber blanket** is composed of biodegradable fiber mulch with extruded plastic netting held together with adhesives. The material is designed to enhance re-vegetation. The material is furnished in rolled strips, which must be secured to the ground with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Coconut fiber blanket** should be a machine produced mat of 100 percent coconut fiber with biodegradable netting on the top and bottom. The coconut fiber should be attached to the netting with biodegradable thread or glue strips. The coconut fiber blanket should be of consistent thickness. The coconut fiber should be evenly distributed over the entire area of the blanket. Coconut fiber blanket should be furnished in rolled strips with a minimum of 6.5 ft wide, a minimum of 80 ft. long and a minimum of 0.5 lb/yd^2. Coconut fiber blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Coconut fiber mesh** is a thin permeable membrane made from coconut or corn fiber that is spun into a yarn and woven into a biodegradable mat. It is designed to be used in conjunction with vegetation and typically has longevity of several years. The material is supplied in rolled strips, which must be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Straw coconut fiber blanket** should be machine produced mats of 70 percent straw and 30 percent coconut fiber with a biodegradable netting top layer and a biodegradable bottom net. The straw and coconut fiber should be attached to the netting with biodegradable thread or glue strips. The straw coconut fiber blanket should be of consistent thickness. The straw and coconut fiber should be evenly distributed over the entire area of the blanket. Straw coconut fiber blanket should be furnished in rolled strips a minimum of 6.5 ft wide, a minimum of 80 ft long and a minimum of 0.5 lb/yd^2. Straw coconut fiber blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- Non-biodegradable RECPs are typically composed of polypropylene, polyethylene, nylon or other synthetic fibers. In some cases, a combination of biodegradable and synthetic fibers is used to construct the RECP. Netting used to hold these fibers together is typically non-biodegradable as well.

  - **Plastic netting** is a lightweight biaxially oriented netting designed for securing loose mulches like straw or paper to soil surfaces to establish vegetation. The netting is photodegradable. The netting is supplied in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

  - **Plastic mesh** is an open weave geotextile that is composed of an extruded synthetic fiber woven into a mesh with an opening size of less than ¼ in. It is used with re-vegetation or may be used to secure loose fiber such as straw to the ground. The material is supplied in rolled strips, which must be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

  - **Synthetic fiber with netting** is a mat that is composed of durable synthetic fibers treated to resist chemicals and ultraviolet light. The mat is a dense, three dimensional mesh of synthetic (typically polyolefin) fibers stitched between two polypropylene nets. The mats are designed to be re-vegetated and provide a permanent composite system of soil, roots, and geomatrix. The material is furnished in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

  - **Bonded synthetic fibers** consist of a three dimensional geomatrix nylon (or other synthetic) matting. Typically it has more than 90 percent open area, which facilitates root growth. It's tough root reinforcing system anchors vegetation and protects against hydraulic lift and shear forces created by high volume discharges. It can be installed over prepared soil, followed by seeding into the mat. Once vegetated, it becomes an invisible composite system of soil, roots, and geomatrix. The material is furnished in rolled strips that must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

  - **Combination synthetic and biodegradable RECPs** consist of biodegradable fibers, such as wood fiber or coconut fiber, with a heavy polypropylene net stitched to the top and a high strength continuous filament geomatrix or net stitched to the bottom. The material is designed to enhance re-vegetation. The material is furnished in rolled strips,

which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

Site Preparation

- Proper soil preparation is essential to ensure complete contact of the RECP with the soil. Soil Roughening is not recommended in areas where RECPs will be installed.
- Grade and shape the area of installation.
- Remove all rocks, clods, vegetation or other obstructions so that the installed blankets or mats will have complete, direct contact with the soil.
- Prepare seedbed by loosening 2 to 3 in. of topsoil.

Seeding/Planting

Seed the area before blanket installation for erosion control and re-vegetation. Seeding after mat installation is often specified for turf reinforcement application. When seeding prior to blanket installation, all areas disturbed during blanket installation must be re-seeded. Where soil filling is specified for turf reinforcement mats (TRMs), seed the matting and the entire disturbed area after installation and prior to filling the mat with soil.

Fertilize and seed in accordance with seeding specifications or other types of landscaping plans. The protective matting can be laid over areas where grass has been planted and the seedlings have emerged. Where vines or other ground covers are to be planted, lay the protective matting first and then plant through matting according to design of planting.

Check Slots

Check slots shall be installed as required by the manufacturer.

Laying and Securing Matting

- Before laying the matting, all check slots should be installed and the seedbed should be friable, made free from clods, rocks, and roots. The surface should be compacted and finished according to the requirements of the manufacturer's recommendations.
- Mechanical or manual lay down equipment should be capable of handling full rolls of fabric and laying the fabric smoothly without wrinkles or folds. The equipment should meet the fabric manufacturer's recommendations or equivalent standards.

Anchoring

- U-shaped wire staples, metal geotextile stake pins, or triangular wooden stakes can be used to anchor mats and blankets to the ground surface.
- Wire staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.
- Metal stake pins should be 0.188 in. diameter steel with a 1.5 in. steel washer at the head of the pin, and 8 in. in length.
- Wire staples and metal stakes should be driven flush to the soil surface.

Installation on Slopes

Installation should be in accordance with the manufacturer's recommendations. In general, these will be as follows:

- Begin at the top of the slope and anchor the blanket in a 6 in. deep by 6 in. wide trench. Backfill trench and tamp earth firmly.
- Unroll blanket down slope in the direction of water flow.
- Overlap the edges of adjacent parallel rolls 2 to 3 in. and staple every 3 ft (or greater, per manufacturer's specifications).
- When blankets must be spliced, place blankets end over end (shingle style) with 6 in. overlap. Staple through overlapped area, approximately 12 in. apart.
- Lay blankets loosely and maintain direct contact with the soil. Do not stretch.
- Staple blankets sufficiently to anchor blanket and maintain contact with the soil. Staples should be placed down the center and staggered with the staples placed along the edges. Steep slopes, 1:1 (H:V) to 2:1 (H:V), require a minimum of 2 staples/yd^2. Moderate slopes, 2:1 (H:V) to 3:1 (H:V), require a minimum of 1 ½ staples/yd^2. Check manufacturer's specifications to determine if a higher density staple pattern is required.

Installation in Channels

Installation should be in accordance with the manufacturer's recommendations. In general, these will be as follows:

- Dig initial anchor trench 12 in. deep and 6 in. wide across the channel at the lower end of the project area.
- Excavate intermittent check slots, 6 in. deep and 6 in. wide across the channel at 25 to 30 ft intervals along the channels.
- Cut longitudinal channel anchor trenches 4 in. deep and 4 in. wide along each side of the installation to bury edges of matting, whenever possible extend matting 2 to 3 in. above the crest of the channel side slopes.
- Beginning at the downstream end and in the center of the channel, place the initial end of the first roll in the anchor trench and secure with fastening devices at 12 in. intervals. Note: matting will initially be upside down in anchor trench.
- In the same manner, position adjacent rolls in anchor trench, overlapping the preceding roll a minimum of 3 in.
- Secure these initial ends of mats with anchors at 12 in. intervals, backfill and compact soil.
- Unroll center strip of matting upstream. Stop at next check slot or terminal anchor trench. Unroll adjacent mats upstream in similar fashion, maintaining a 3 in. overlap.

- Fold and secure all rolls of matting snugly into all transverse check slots. Lay mat in the bottom of the slot then fold back against itself. Anchor through both layers of mat at 12 in. intervals, then backfill and compact soil. Continue rolling all mat widths upstream to the next check slot or terminal anchor trench.
- Alternate method for non-critical installations: Place two rows of anchors on 6 in. centers at 25 to 30 ft. intervals in lieu of excavated check slots.
- Staple shingled lap spliced ends a minimum of 12 in. apart on 12 in. intervals.
- Place edges of outside mats in previously excavated longitudinal slots; anchor using prescribed staple pattern, backfill, and compact soil.
- Anchor, fill, and compact upstream end of mat in a 12 in. by 6 in. terminal trench.
- Secure mat to ground surface using U-shaped wire staples, geotextile pins, or wooden stakes.
- Seed and fill turf reinforcement matting with soil, if specified.

Soil Filling (if specified for turf reinforcement mat (TRM))

Installation should be in accordance with the manufacturer's recommendations. Typical installation guidelines are as follows:

- After seeding, spread and lightly rake ½-3/4 inches of fine topsoil into the TRM apertures to completely fill TRM thickness. Use backside of rake or other flat implement.
- Alternatively, if allowed by product specifications, spread topsoil using lightweight loader, backhoe, or other power equipment. Avoid sharp turns with equipment.
- Always consult the manufacturer's recommendations for installation.
- Do not drive tracked or heavy equipment over mat.
- Avoid any traffic over matting if loose or wet soil conditions exist.
- Use shovels, rakes, or brooms for fine grading and touch up.
- Smooth out soil filling just exposing top netting of mat.

Temporary Soil Stabilization Removal

- Temporary soil stabilization removed from the site of the work must be disposed of if necessary.

Costs

Installed costs can be relatively high compared to other BMPs. Approximate costs for installed materials are shown below:

Rolled Erosion Control Products		Installed Cost per Acre (2004)[1]	Estimated Cost per Acre (2009)[2]
Biodegradable	Jute Mesh	$6,000-$7,000	$6,600-$7,700
	Curled Wood Fiber	$8,000-$10,500	$8,800-$11,050
	Straw	$8,000-$10,500	$8,800-$11,050
	Wood Fiber	$8,000-$10,500	$8,800-$11,050
	Coconut Fiber	$13,000-$14,000	$14,300-$15,400
	Coconut Fiber Mesh	$30,000-$33,000	$33,000-$36,300
	Straw Coconut Fiber	$10,000-$12,000	$11,000-$13,200
Non-Biodegradable	Plastic Netting	$2,000-$2,200	$2,200-$2,220
	Plastic Mesh	$3,000-$3,500	$3,300-$3,850
	Synthetic Fiber with Netting	$34,000-$40,000	$37,400-$44,000
	Bonded Synthetic Fibers	$45,000-$55,000	$49,500-$60,500
	Combination with Biodegradable	$30,000-$36,000	$33,000-$39,600

1. Source: Cost information received from individual product manufacturers solicited by Geosyntec Consultants (2004).

2. 2009 costs reflect a 10% escalation over year 2004 costs. Escalation based on informal survey of industry trends. Note: Expected cost increase is offset by competitive economic conditions.

Inspection and Maintenance

- RECPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Areas where erosion is evident shall be repaired and BMPs reapplied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require reapplication of BMPs.
- If washout or breakage occurs, re-install the material after repairing the damage to the slope or channel.
- Make sure matting is uniformly in contact with the soil.
- Check that all the lap joints are secure.
- Check that staples are flush with the ground.

References

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005

Erosion Control Pilot Study Report, State of California Department of Transportation (Caltrans), June 2000.

Guides for Erosion and Sediment Controls in California, USDA Soils Conservation Service, January 1991.

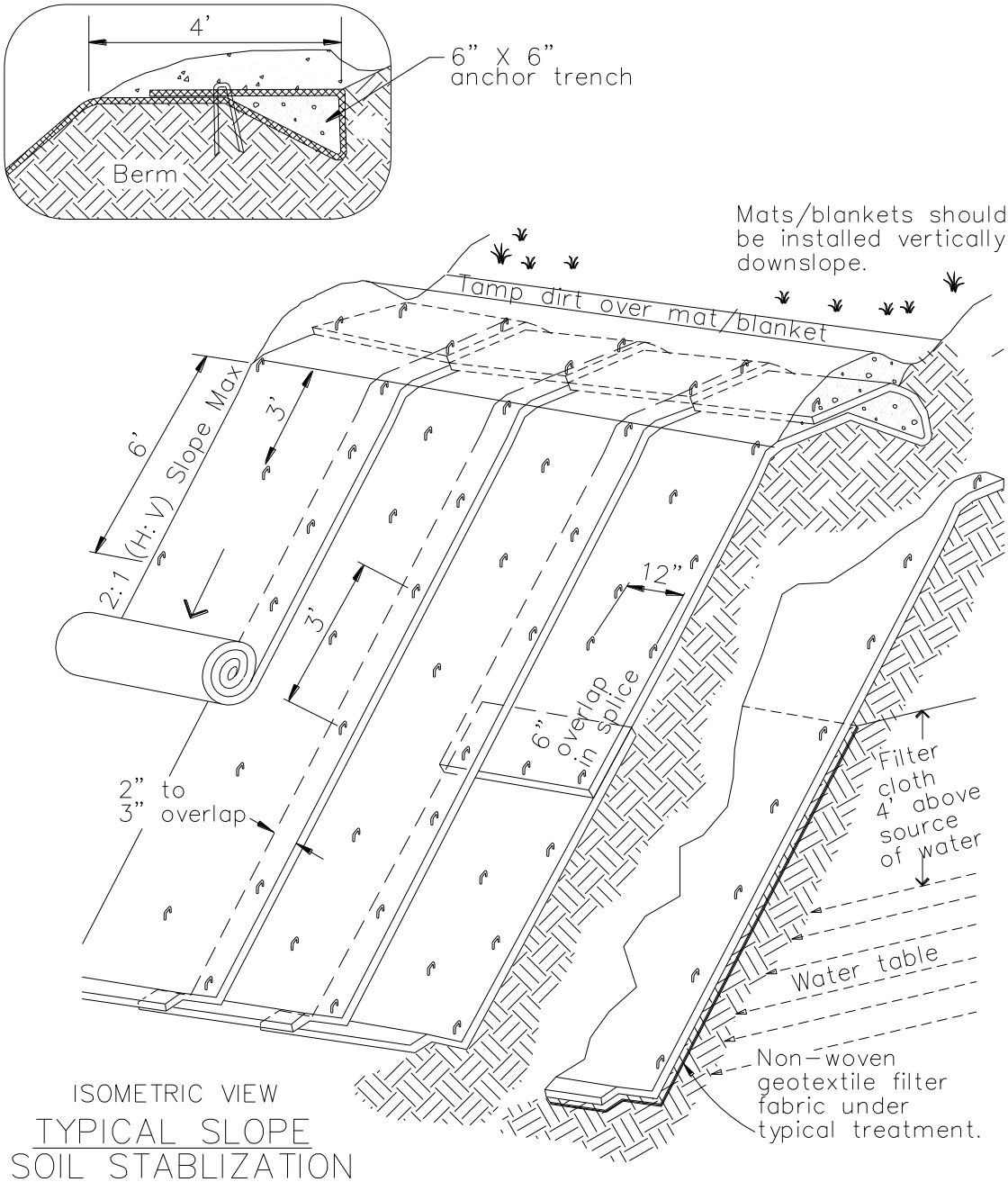
National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for The Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



ISOMETRIC VIEW

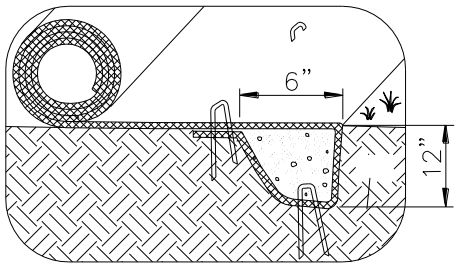
TYPICAL SLOPE
SOIL STABLIZATION
NTS

WET SLOPE LINING
NTS

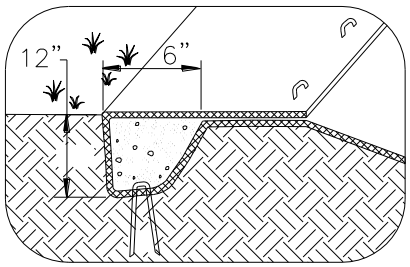
NOTES:

1. Slope surface shall be free of rocks, clods, sticks and grass. Mats/blankets shall have good soil contact.
2. Lay blankets loosely and stake or staple to maintain direct contact with the soil. Do not stretch.
3. Install per manufacturer's recommendations

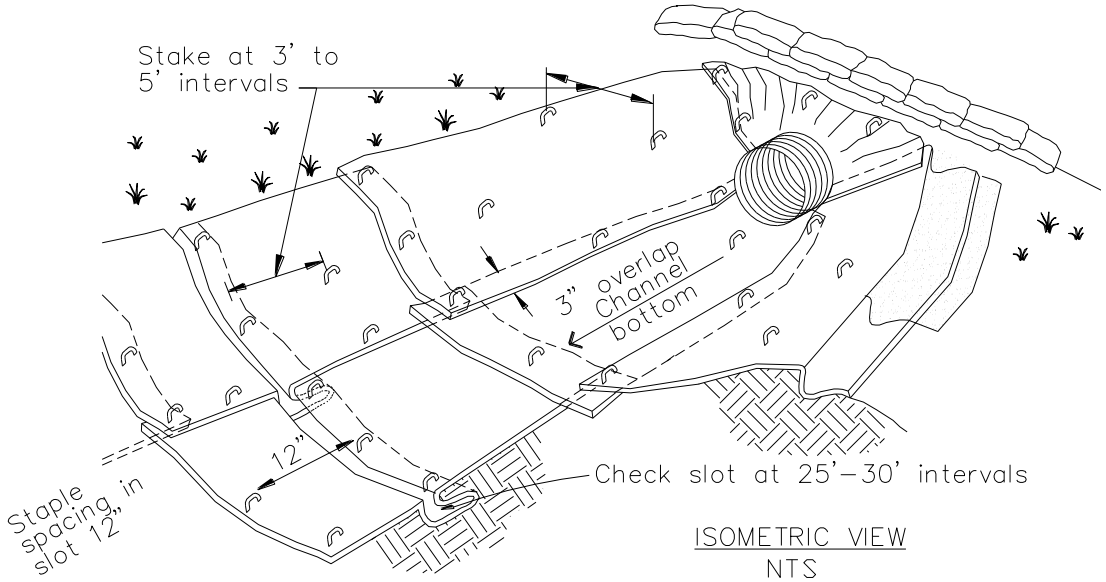
TYPICAL INSTALLATION DETAIL



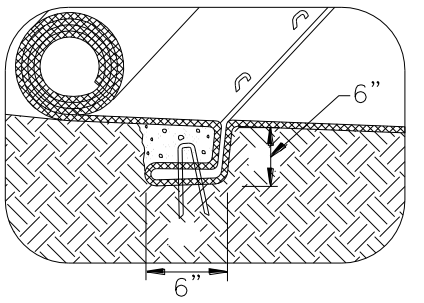
INITIAL CHANNEL ANCHOR TRENCH
NTS



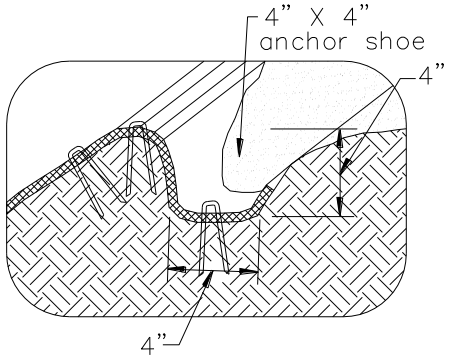
TERMINAL SLOPE AND CHANNEL ANCHOR TRENCH
NTS



ISOMETRIC VIEW
NTS



INTERMITTENT CHECK SLOT
NTS



LONGITUDINAL ANCHOR TRENCH
NTS

NOTES:
1. Check slots to be constructed per manufacturers specifications.
2. Staking or stapling layout per manufacturers specifications.
3. Install per manufacturer's recommendations

TYPICAL INSTALLATION DETAIL

Wood Mulching EC-8



Description and Purpose

Wood mulching consists of applying a mixture of shredded wood mulch, bark or compost to disturbed soils. The primary function of wood mulching is to reduce erosion by protecting bare soil from rainfall impact, increasing infiltration, and reducing runoff.

Suitable Applications

Wood mulching is suitable for disturbed soil areas requiring temporary protection until permanent stabilization is established.

Limitations

- Not suitable for use on slopes steeper than 3:1 (H:V). Best suited to flat areas or gentle slopes or 5:1 (H:V) or flatter.
- Wood mulch and compost may introduce unwanted species.
- Not suitable for areas exposed to concentrated flows.
- May need to be removed prior to further earthwork.

Implementation

Mulch Selection

There are many types of mulches. Selection of the appropriate type of mulch should be based on the type of application, site conditions, and compatibility with planned or future uses.

Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch

EC-4 Hydroseeding

EC-5 Soil Binders

EC-6 Straw Mulch

EC-7 Geotextiles and Mats

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Application Procedures

Prior to application, after existing vegetation has been removed, roughen embankment and fill areas by rolling with a device such as a punching type roller or by track walking. The construction application procedures for mulches vary significantly depending upon the type of mulching method specified. Two methods are highlighted here:

- Green Material: This type of mulch is produced by the recycling of vegetation trimmings such as grass, shredded shrubs, and trees. Methods of application are generally by hand although pneumatic methods are available.
  - Green material can be used as a temporary ground cover with or without seeding.
  - The green material should be evenly distributed on site to a depth of not more than 2 in.
- Shredded Wood: Suitable for ground cover in ornamental or revegetated plantings.
  - Shredded wood/bark is conditionally suitable. See note under limitations.
  - Distribute by hand or use pneumatic methods.
  - Evenly distribute the mulch across the soil surface to a depth of 2 to 3 in.
- Avoid mulch placement onto roads, sidewalks, drainage channels, existing vegetation, etc.

Costs

Average annual cost for installation and maintenance (3-4 months useful life) is around $4,000 per acre, but cost can increase if the source is not close to the project site.

Inspection and Maintenance

- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Areas where erosion is evident shall be repaired and BMPs reapplied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require reapplication of BMPs.
- Regardless of the mulching technique selected, the key consideration in inspection and maintenance is that the mulch needs to last long enough to achieve erosion control objectives. If the mulch is applied as a stand alone erosion control method over disturbed areas (without seed), it should last the length of time the site will remain barren or until final re-grading and revegetation.
- Where vegetation is not the ultimate cover, such as ornamental and landscape applications of bark or wood chips, inspection and maintenance should focus on longevity and integrity of the mulch.
- Reapply mulch when bare earth becomes visible.

References

Controlling Erosion of Construction Sites Agriculture Information Bulletin #347, U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service – SCS).

Guides for Erosion and Sediment Control in California, USDA Soils Conservation Service, January 1991.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group Working Paper, USEPA, April 1992.

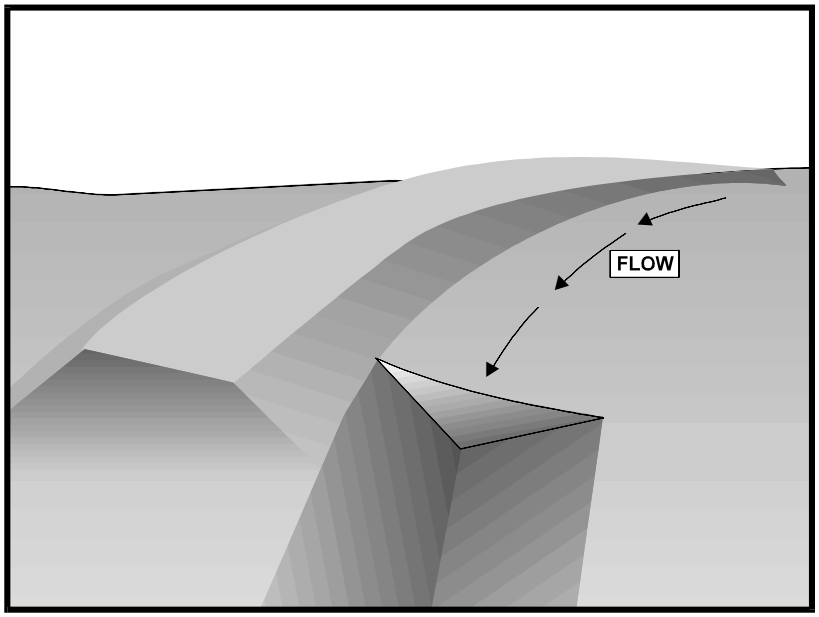
Sedimentation and Erosion Control, An Inventory of Current Practices Draft, U.S. EPA, April 1990.

Soil Erosion by Water Agricultural Information Bulletin #513, U.S. Department of Agriculture, Soil Conservation Service.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Earth Dikes and Drainage Swales EC-9



Description and Purpose

An earth dike is a temporary berm or ridge of compacted soil used to divert runoff or channel water to a desired location. A drainage swale is a shaped and sloped depression in the soil surface used to convey runoff to a desired location. Earth dikes and drainage swales are used to divert off site runoff around the construction site, divert runoff from stabilized areas and disturbed areas, and direct runoff into sediment basins or traps.

Suitable Applications

Earth dikes and drainage swales are suitable for use, individually or together, where runoff needs to be diverted from one area and conveyed to another.

- Earth dikes and drainage swales may be used:
  - To convey surface runoff down sloping land
  - To intercept and divert runoff to avoid sheet flow over sloped surfaces
  - To divert and direct runoff towards a stabilized watercourse, drainage pipe or channel
  - To intercept runoff from paved surfaces
  - Below steep grades where runoff begins to concentrate
  - Along roadways and facility improvements subject to flood drainage

Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- At the top of slopes to divert runon from adjacent or undisturbed slopes
- At bottom and mid slope locations to intercept sheet flow and convey concentrated flows
- Divert sediment laden runoff into sediment basins or traps

Limitations

Dikes should not be used for drainage areas greater than 10 acres or along slopes greater than 10 percent. For larger areas more permanent drainage structures should be built. All drainage structures should be built in compliance with local municipal requirements.

- Earth dikes may create more disturbed area on site and become barriers to construction equipment.
- Earth dikes must be stabilized immediately, which adds cost and maintenance concerns.
- Diverted stormwater may cause downstream flood damage.
- Dikes should not be constructed of soils that may be easily eroded.
- Regrading the site to remove the dike may add additional cost.
- Temporary drains and swales or any other diversion of runoff should not adversely impact upstream or downstream properties.
- Temporary drains and swales must conform to local floodplain management requirements.
- Earth dikes/drainage swales are not suitable as sediment trapping devices.
- It may be necessary to use other soil stabilization and sediment controls such as check dams, plastics, and blankets, to prevent scour and erosion in newly graded dikes, swales, and ditches.
- Sediment accumulation, scour depressions, and/or persistent non-stormwater discharges can result in areas of standing water suitable for mosquito production in drainage swales.

Implementation

The temporary earth dike is a berm or ridge of compacted soil, located in such a manner as to divert stormwater to a sediment trapping device or a stabilized outlet, thereby reducing the potential for erosion and offsite sedimentation. Earth dikes can also be used to divert runoff from off site and from undisturbed areas away from disturbed areas and to divert sheet flows away from unprotected slopes.

An earth dike does not itself control erosion or remove sediment from runoff. A dike prevents erosion by directing runoff to an erosion control device such as a sediment trap or directing runoff away from an erodible area. Temporary diversion dikes should not adversely impact adjacent properties and must conform to local floodplain management regulations, and should not be used in areas with slopes steeper than 10%.

Slopes that are formed during cut and fill operations should be protected from erosion by runoff. A combination of a temporary drainage swale and an earth dike at the top of a slope can divert

runoff to a location where it can be brought to the bottom of the slope (see EC-11, Slope Drains). A combination dike and swale is easily constructed by a single pass of a bulldozer or grader and compacted by a second pass of the tracks or wheels over the ridge. Diversion structures should be installed when the site is initially graded and remain in place until post construction BMPs are installed and the slopes are stabilized.

Diversion practices concentrate surface runoff, increasing its velocity and erosive force. Thus, the flow out of the drain or swale must be directed onto a stabilized area or into a grade stabilization structure. If significant erosion will occur, a swale should be stabilized using vegetation, chemical treatment, rock rip-rap, matting, or other physical means of stabilization. Any drain or swale that conveys sediment laden runoff must be diverted into a sediment basin or trap before it is discharged from the site.

General

- Care must be applied to correctly size and locate earth dikes, drainage swales. Excessively steep, unlined dikes, and swales are subject to erosion and gully formation.
- Conveyances should be stabilized.
- Use a lined ditch for high flow velocities.
- Select flow velocity based on careful evaluation of the risks due to erosion of the measure, soil types, overtopping, flow backups, washout, and drainage flow patterns for each project site.
- Compact any fills to prevent unequal settlement.
- Do not divert runoff onto other property without securing written authorization from the property owner.
- When possible, install and utilize permanent dikes, swales, and ditches early in the construction process.
- Provide stabilized outlets.

Earth Dikes

Temporary earth dikes are a practical, inexpensive BMP used to divert stormwater runoff. Temporary diversion dikes should be installed in the following manner:

- All dikes should be compacted by earth moving equipment.
- All dikes should have positive drainage to an outlet.
- All dikes should have 2:1 or flatter side slopes, 18 in. minimum height, and a minimum top width of 24 in. Wide top widths and flat slopes are usually needed at crossings for construction traffic.
- The outlet from the earth dike must function with a minimum of erosion. Runoff should be conveyed to a sediment trapping device such as a Sediment Trap (SE-3) or Sediment Basin

(SE-2) when either the dike channel or the drainage area above the dike are not adequately stabilized.

- Temporary stabilization may be achieved using seed and mulching for slopes less than 5% and either rip-rap or sod for slopes in excess of 5%. In either case, stabilization of the earth dike should be completed immediately after construction or prior to the first rain.
- If riprap is used to stabilize the channel formed along the toe of the dike, the following typical specifications apply:

Channel Grade	Riprap Stabilization
0.5-1.0%	4 in. Rock
1.1-2.0%	6 in. Rock
2.1-4.0%	8 in. Rock
4.1-5.0%	8 in. -12 in. Riprap

- The stone riprap, recycled concrete, etc. used for stabilization should be pressed into the soil with construction equipment.
- Filter cloth may be used to cover dikes in use for long periods.
- Construction activity on the earth dike should be kept to a minimum.

Drainage Swales

Drainage swales are only effective if they are properly installed. Swales are more effective than dikes because they tend to be more stable. The combination of a swale with a dike on the downhill side is the most cost effective diversion.

Standard engineering design criteria for small open channel and closed conveyance systems should be used (see the local drainage design manual). Unless local drainage design criteria state otherwise, drainage swales should be designed as follows:

- No more than 5 acres may drain to a temporary drainage swale.
- Place drainage swales above or below, not on, a cut or fill slope.
- Swale bottom width should be at least 2 ft
- Depth of the swale should be at least 18 in.
- Side slopes should be 2:1 or flatter.
- Drainage or swales should be laid at a grade of at least 1 percent, but not more than 15 percent.
- The swale must not be overtopped by the peak discharge from a 10-year storm, irrespective of the design criteria stated above.

- Remove all trees, stumps, obstructions, and other objectionable material from the swale when it is built.
- Compact any fill material along the path of the swale.
- Stabilize all swales immediately. Seed and mulch swales at a slope of less than 5 percent, and use rip-rap or sod for swales with a slope between 5 and 15 percent. For temporary swales, geotextiles and mats (EC-7) may provide immediate stabilization.
- Irrigation may be required to establish sufficient vegetation to prevent erosion.
- Do not operate construction vehicles across a swale unless a stabilized crossing is provided.
- Permanent drainage facilities must be designed by a professional engineer (see the local drainage design criteria for proper design).
- At a minimum, the drainage swale should conform to predevelopment drainage patterns and capacities.
- Construct the drainage swale with a positive grade to a stabilized outlet.
- Provide erosion protection or energy dissipation measures if the flow out of the drainage swale can reach an erosive velocity.

Costs

- Cost ranges from $15 to $55 per ft for both earthwork and stabilization and depends on availability of material, site location, and access.
- Small dikes: $2.50 - $6.50/linear ft; Large dikes: $2.50/yd^3.
- The cost of a drainage swale increases with drainage area and slope. Typical swales for controlling internal erosion are inexpensive, as they are quickly formed during routine earthwork.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspect ditches and berms for washouts. Replace lost riprap, damaged linings or soil stabilizers as needed.
- Inspect channel linings, embankments, and beds of ditches and berms for erosion and accumulation of debris and sediment. Remove debris and sediment and repair linings and embankments as needed.
- Temporary conveyances should be completely removed as soon as the surrounding drainage area has been stabilized or at the completion of construction

References

Erosion and Sediment Control Handbook, S.J. Goldman, K. Jackson, T.A. Bursetynsky, P.E., McGraw Hill Book Company, 1986.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Metzger, M.E. 2004. Managing mosquitoes in stormwater treatment devices. University of California Division of Agriculture and Natural Resources, Publication 8125. On-line: http://anrcatalog.ucdavis.edu/pdf/8125.pdf

National Association of Home Builders (NAHB). Stormwater Runoff & Nonpoint Source Pollution Control Guide for Builders and Developers. National Association of Home Builders, Washington, D.C., 1995

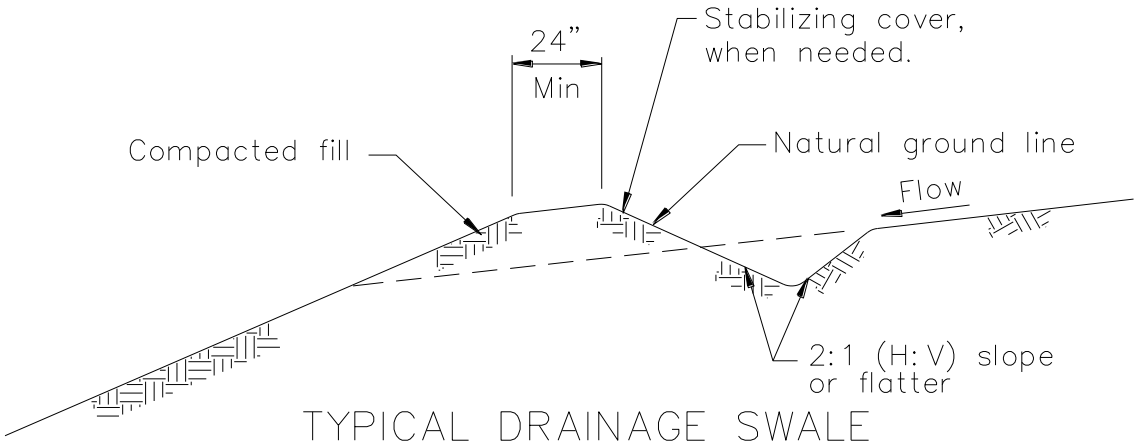
National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Southeastern Wisconsin Regional Planning Commission (SWRPC). Costs of Urban Nonpoint Source Water Pollution Control Measures. Technical Report No. 31. Southeastern Wisconsin Regional Planning Commission, Waukesha, WI. 1991

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

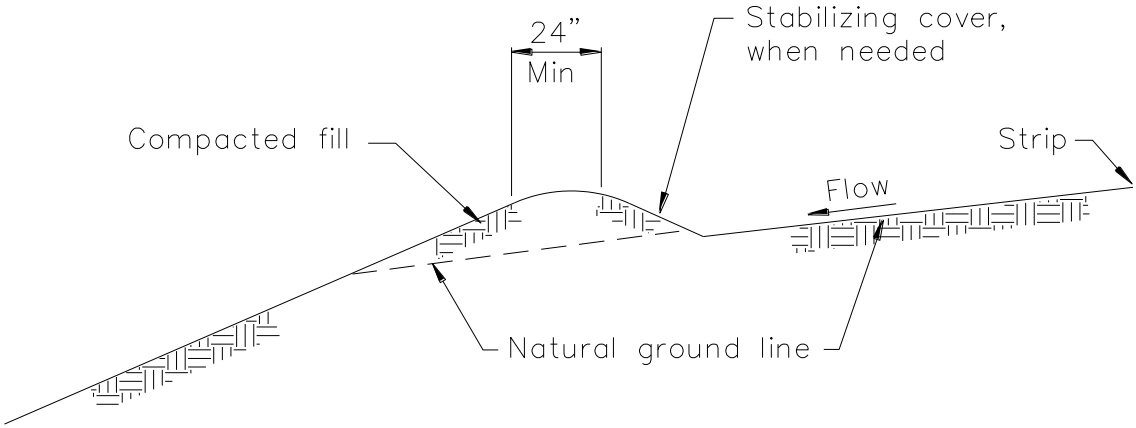
Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



TYPICAL DRAINAGE SWALE
NOT TO SCALE

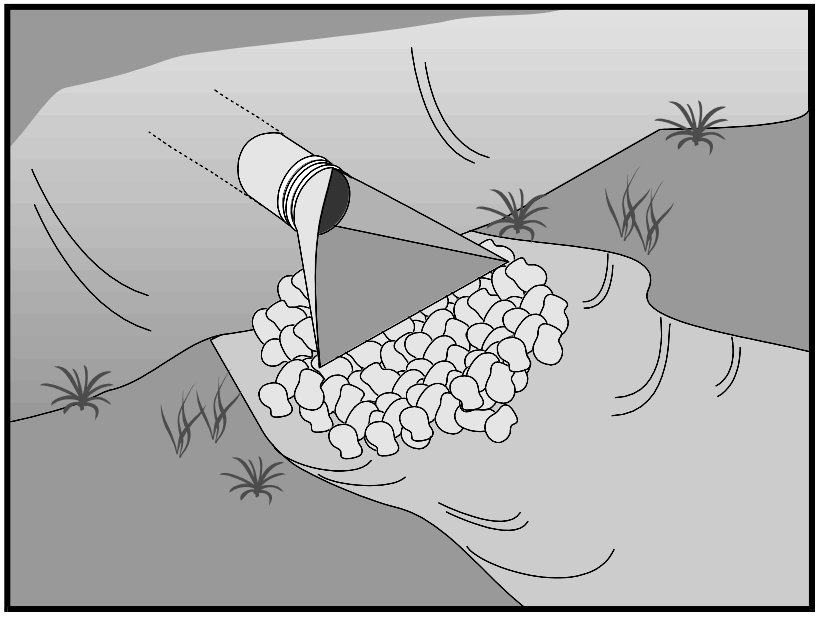
NOTES:

1. Stabilize inlet, outlets and slopes.
2. Properly compact the subgrade.



TYPICAL EARTH DIKE
NOT TO SCALE

Velocity Dissipation Devices EC-10



Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Outlet protection is a physical device composed of rock, grouted riprap, or concrete rubble, which is placed at the outlet of a pipe or channel to prevent scour of the soil caused by concentrated, high velocity flows.

Suitable Applications

Whenever discharge velocities and energies at the outlets of culverts, conduits, or channels are sufficient to erode the next downstream reach. This includes temporary diversion structures to divert runon during construction.

- These devices may be used at the following locations:
  - Outlets of pipes, drains, culverts, slope drains, diversion ditches, swales, conduits, or channels.
  - Outlets located at the bottom of mild to steep slopes.
  - Discharge outlets that carry continuous flows of water.
  - Outlets subject to short, intense flows of water, such as flash floods.
  - Points where lined conveyances discharge to unlined conveyances

Limitations

- Large storms or high flows can wash away the rock outlet protection and leave the area susceptible to erosion.

- Sediment captured by the rock outlet protection may be difficult to remove without removing the rock.
- Outlet protection may negatively impact the channel habitat.
- Grouted riprap may break up in areas of freeze and thaw.
- If there is not adequate drainage, and water builds up behind grouted riprap, it may cause the grouted riprap to break up due to the resulting hydrostatic pressure.
- Sediment accumulation, scour depressions, and/or persistent non-stormwater discharges can result in areas of standing water suitable for mosquito production in velocity dissipation devices.

Implementation

General

Outlet protection is needed where discharge velocities and energies at the outlets of culverts, conduits or channels are sufficient to erode the immediate downstream reach. This practice protects the outlet from developing small eroded pools (plange pools), and protects against gully erosion resulting from scouring at a culvert mouth.

Design and Layout

As with most channel design projects, depth of flow, roughness, gradient, side slopes, discharge rate, and velocity should be considered in the outlet design. Compliance to local and state regulations should also be considered while working in environmentally sensitive streambeds. General recommendations for rock size and length of outlet protection mat are shown in the rock outlet protection figure in this BMP and should be considered minimums. The apron length and rock size gradation are determined using a combination of the discharge pipe diameter and estimate discharge rate: Select the longest apron length and largest rock size suggested by the pipe size and discharge rate. Where flows are conveyed in open channels such as ditches and swales, use the estimated discharge rate for selecting the apron length and rock size. Flows should be same as the culvert or channel design flow but never the less than the peak 5 year flow for temporary structures planned for one rainy season, or the 10 year peak flow for temporary structures planned for two or three rainy seasons.

- There are many types of energy dissipaters, with rock being the one that is represented in the attached figure.
- Best results are obtained when sound, durable, and angular rock is used.
- Install riprap, grouted riprap, or concrete apron at selected outlet. Riprap aprons are best suited for temporary use during construction. Grouted or wired tied rock riprap can minimize maintenance requirements.
- Rock outlet protection is usually less expensive and easier to install than concrete aprons or energy dissipaters. It also serves to trap sediment and reduce flow velocities.
- Carefully place riprap to avoid damaging the filter fabric.

- Stone 4 in. to 6 in. may be carefully dumped onto filter fabric from a height not to exceed 12 in.

- Stone 8 in. to 12 in. must be hand placed onto filter fabric, or the filter fabric may be covered with 4 in. of gravel and the 8 in. to 12 in. rock may be dumped from a height not to exceed 16 in.

- Stone greater than 12 in. shall only be dumped onto filter fabric protected with a layer of gravel with a thickness equal to one half the D_{50} rock size, and the dump height limited to twice the depth of the gravel protection layer thickness.

- For proper operation of apron: Align apron with receiving stream and keep straight throughout its length. If a curve is needed to fit site conditions, place it in upper section of apron.

- Outlets on slopes steeper than 10 percent should have additional protection.

Costs

Costs are low if material is readily available. If material is imported, costs will be higher. Average installed cost is $150 per device.

Inspection and Maintenance

- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Inspect BMPs subjected to non-stormwater discharges daily while non-stormwater discharges occur. Minimize areas of standing water by removing sediment blockages and filling scour depressions.

- Inspect apron for displacement of the riprap and damage to the underlying fabric. Repair fabric and replace riprap that has washed away. If riprap continues to wash away, consider using larger material.

- Inspect for scour beneath the riprap and around the outlet. Repair damage to slopes or underlying filter fabric immediately.

- Temporary devices should be completely removed as soon as the surrounding drainage area has been stabilized or at the completion of construction.

References

County of Sacramento Improvement Standards, Sacramento County, May 1989.

Erosion and Sediment Control Handbook, S.J. Goldman, K. Jackson, T.A. Bursztynsky, P.E., McGraw Hill Book Company, 1986.

Handbook of Steel Drainage & Highway Construction, American Iron and Steel Institute, 1983.

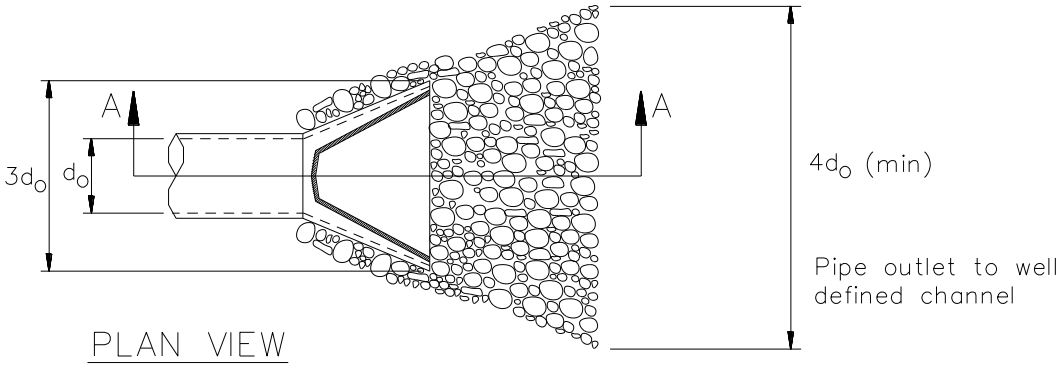
Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Metzger, M.E. 2004. Managing mosquitoes in stormwater treatment devices. University of California Division of Agriculture and Natural Resources, Publication 8125. On-line: http://anrcatalog.ucdavis.edu/pdf/8125.pdf

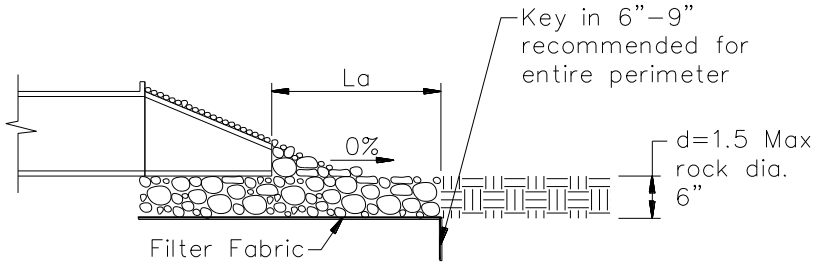
Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, state of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



PLAN VIEW

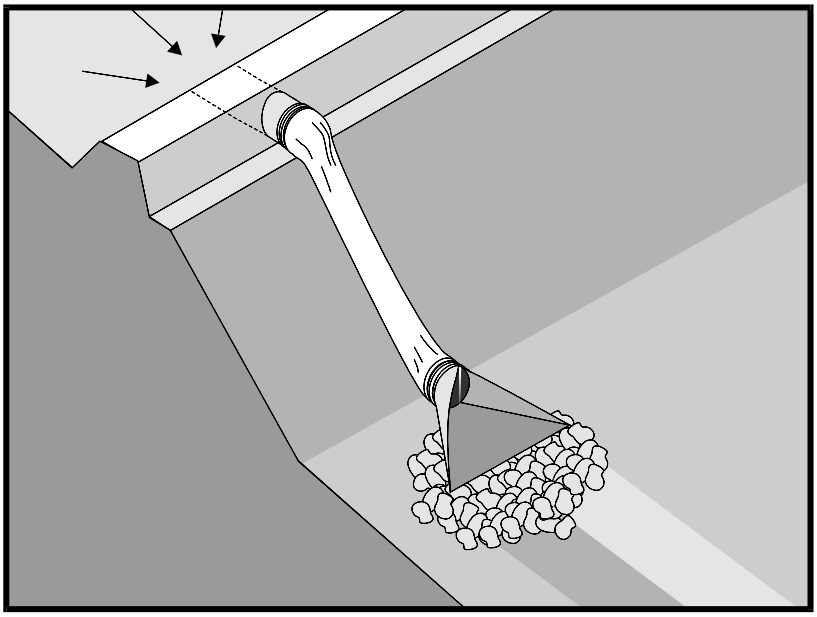


SECTION A–A

Pipe Diameter inches	Discharge ft³/s	Apron Length, La ft	Rip Rap D_{50} Diameter Min inches
12	5	10	4
	10	13	6
18	10	10	6
	20	16	8
	30	23	12
	40	26	16
24	30	16	8
	40	26	8
	50	26	12
	60	30	16

For larger or higher flows consult a Registered Civil Engineer
Source: USDA - SCS

Slope Drains EC-11



Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-9 Earth Dike, Drainage Swales

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

A slope drain is a pipe used to intercept and direct surface runoff or groundwater into a stabilized watercourse, trapping device, or stabilized area. Slope drains are used with earth dikes and drainage ditches to intercept and direct surface flow away from slope areas to protect cut or fill slopes.

Suitable Applications

- Where concentrated flow of surface runoff must be conveyed down a slope in order to prevent erosion.
- Drainage for top of slope diversion dikes or swales.
- Drainage for top of cut and fill slopes where water can accumulate.
- Emergency spillway for a sediment basin.

Limitations

Installation is critical for effective use of the pipe slope drain to minimize potential gully erosion.

- Maximum drainage area per slope drain is 10 acres. (For large areas use a paved chute, rock lined channel, or additional pipes.)
- Severe erosion may result when slope drains fail by overtopping, piping, or pipe separation.

- During large storms, pipe slope drains may become clogged or over charged, forcing water around the pipe and causing extreme slope erosion.
- If the sectional downdrain is not sized correctly, the runoff can spill over the drain sides causing gully erosion and potential failure of the structure.

- Dissipation of high flow velocities at the pipe outlet is required to avoid downstream erosion.
- Sediment accumulation, scour depressions, and/or persistent non-stormwater discharges can result in areas of standing water suitable for mosquito production in energy dissipaters associated with slope drain outlets.

Implementation

General

The slope drain is applicable for any construction site where concentrated surface runoff can accumulate and must be conveyed down the slope in order to prevent erosion. The slope drain is effective because it prevents the stormwater from flowing directly down the slope by confining all the runoff into an enclosed pipe or channel. Due to the time lag between grading slopes and installation of permanent stormwater collection systems and slope stabilization measures, temporary provisions to intercept runoff are sometimes necessary. Particularly in steep terrain, slope drains can protect unstabilized areas from erosion.

Installation

The slope drain may be a rigid pipe, such as corrugated metal, a flexible conduit, or a lined terrace drain with the inlet placed on the top of a slope and the outlet at the bottom of the slope. This BMP typically is used in combination with a diversion control, such as an earth dike or drainage swale at the top of the slope.

The following criteria must be considered when siting slope drains.

- Permanent structures included in the project plans can often serve as construction BMPs if implemented early. However, the permanent structure must meet or exceed the criteria for the temporary structure.
- Inlet structures must be securely entrenched and compacted to avoid severe gully erosion.
- Slope drains must be securely anchored to the slope and must be adequately sized to carry the capacity of the design storm and associated forces.
- Outlets must be stabilized with riprap, concrete or other type of energy dissipator, or directed into a stable sediment trap or basin. See EC-10, Velocity Dissipation Devices.
- Debris racks are recommended at the inlet. Debris racks located several feet upstream of the inlet can usually be larger than racks at the inlet, and thus provide enhanced debris protection and less plugging.
- Safety racks are also recommended at the inlet and outlet of pipes where children or animals could become entrapped.
- Secure inlet and surround with dikes to prevent gully erosion and anchor pipe to slope.

- When using slope drains, limit drainage area to 10 acres per pipe. For larger areas, use a rock lined channel or a series of pipes.
- Size to convey at least the peak flow of a 10-year storm. The design storm is conservative due to the potential impact of system failures.
- Maximum slope generally limited to 2:1 (H:V) as energy dissipation below steeper slopes is difficult.
- Direct surface runoff to slope drains with interceptor dikes. See BMP EC-9, Earth Dikes and Drainage Swales. Top of interceptor dikes should be 12 in. higher than the top of the slope drain.
- Slope drains can be placed on or buried underneath the slope surface.
- Recommended materials include both metal and plastic pipe, either corrugated or smooth wall. Concrete pipe can also be used.
- When installing slope drains:
  - Install slope drains perpendicular to slope contours.
  - Compact soil around and under entrance, outlet, and along length of pipe.
  - Securely anchor and stabilize pipe and appurtenances into soil.
  - Check to ensure that pipe connections are watertight.
  - Protect area around inlet with filter cloth. Protect outlet with riprap or other energy dissipation device. For high energy discharges, reinforce riprap with concrete or use reinforced concrete device.
  - Protect outlet of slope drains using a flared end section when outlet discharges to a flexible energy dissipation device.
  - A flared end section installed at the inlet will improve flow into the slope drain and prevent erosion at the pipe entrance. Use a flared end section with a 6 in. minimum toe plate to help prevent undercutting. The flared section should slope towards the pipe inlet.

Design and Layout

The capacity for temporary drains should be sufficient to convey at least the peak runoff from a 10-year rainfall event. The pipe size may be computed using the Rational Method or a method established by the local municipality. Higher flows must be safely stored or routed to prevent any offsite concentration of flow and any erosion of the slope. The design storm is purposely conservative due to the potential impacts associated with system failures.

As a guide, temporary pipe slope drains should not be sized smaller than shown in the following table:

Minimum Pipe Diameter (Inches)	Maximum Drainage Area (Acres)
12	1.0
18	3.0
21	5.0
24	7.0
30	10.0

Larger drainage areas can be treated if the area can be subdivided into areas of 10 acres or less and each area is treated as a separate drainage. Drainage areas exceeding 10 acres must be designed by a Registered Civil Engineer and approved by the agency that issued the grading permit.

Materials:

Soil type, rainfall patterns, construction schedule, local requirements, and available supply are some of the factors to be considered when selecting materials. The following types of slope drains are commonly used:

- **Rigid Pipe:** This type of slope drain is also known as a pipe drop. The pipe usually consists of corrugated metal pipe or rigid plastic pipe. The pipe is placed on undisturbed or compacted soil and secured onto the slope surface or buried in a trench. Concrete thrust blocks must be used when warranted by the calculated thrust forces. Collars should be properly installed and secured with metal strappings or watertight collars.

- **Flexible Pipe**: The flexible pipe slope drain consists of a flexible tube of heavy duty plastic, rubber, or composite material. The tube material is securely anchored onto the slope surface. The tube should be securely fastened to the metal inlet and outlet conduit sections with metal strappings or watertight collars.

- **Section Downdrains**: The section downdrain consists of pre-fabricated, section conduit of half round or third round material. The sectional downdrain performs similar to a flume or chute. The pipe must be placed on undisturbed or compacted soil and secured into the slope.

- **Concrete-lined Terrace Drain:** This is a concrete channel for draining water from a terrace on a slope to the next level. These drains are typically specified as permanent structures and if installed early, can serve as slope drains during construction, which should be designed according to local drainage design criteria.

Costs

- Cost varies based on pipe selection and selected outlet protection.

Corrugated Steel Pipes, Per Foot	
Size	Supplied and Installed Cost (No Trenching Included)
12”	$19.60 per LF
15”	$22.00
18”	$26.00
24”	$32.00
30”	$50.00
PVC Pipes, Per Foot	
Size	Supplied and Installed Cost (No Trenching Included)
12”	$24.50
14”	$49.00
16”	$51.00
18”	$54.00
20”	$66.00
24”	$93.00
30”	$130.00

Inspection and Maintenance

- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subjected to non-stormwater discharges daily while non-stormwater discharges occur. Minimize areas of standing water by removing sediment blockages and filling scour depressions.
- Inspect outlet for erosion and downstream scour. If eroded, repair damage and install additional energy dissipation measures. If downstream scour is occurring, it may be necessary to reduce flows being discharged into the channel unless other preventative measures are implemented.
- Insert inlet for clogging or undercutting. Remove debris from inlet to maintain flows. Repair undercutting at inlet and if needed, install flared section or rip rap around the inlet to prevent further undercutting.
- Inspect pipes for leakage. Repair leaks and restore damaged slopes.
- Inspect slope drainage for accumulations of debris and sediment.

- Remove built up sediment from entrances and outlets as required. Flush drains if necessary; capture and settle out sediment from discharge.
- Make sure water is not ponding onto inappropriate areas (e.g., active traffic lanes, material storage areas, etc.).
- Pipe anchors must be checked to ensure that the pipe remains anchored to the slope. Install additional anchors if pipe movement is detected.

References

Draft – Sedimentation and Erosion Control, An Inventory of Current Practices, U.S.E.P.A., April 1990.

Metzger, M.E. 2004. Managing mosquitoes in stormwater treatment devices. University of California Division of Agriculture and Natural Resources, Publication 8125. On-line: http://anrcatalog.ucdavis.edu/pdf/8125.pdf

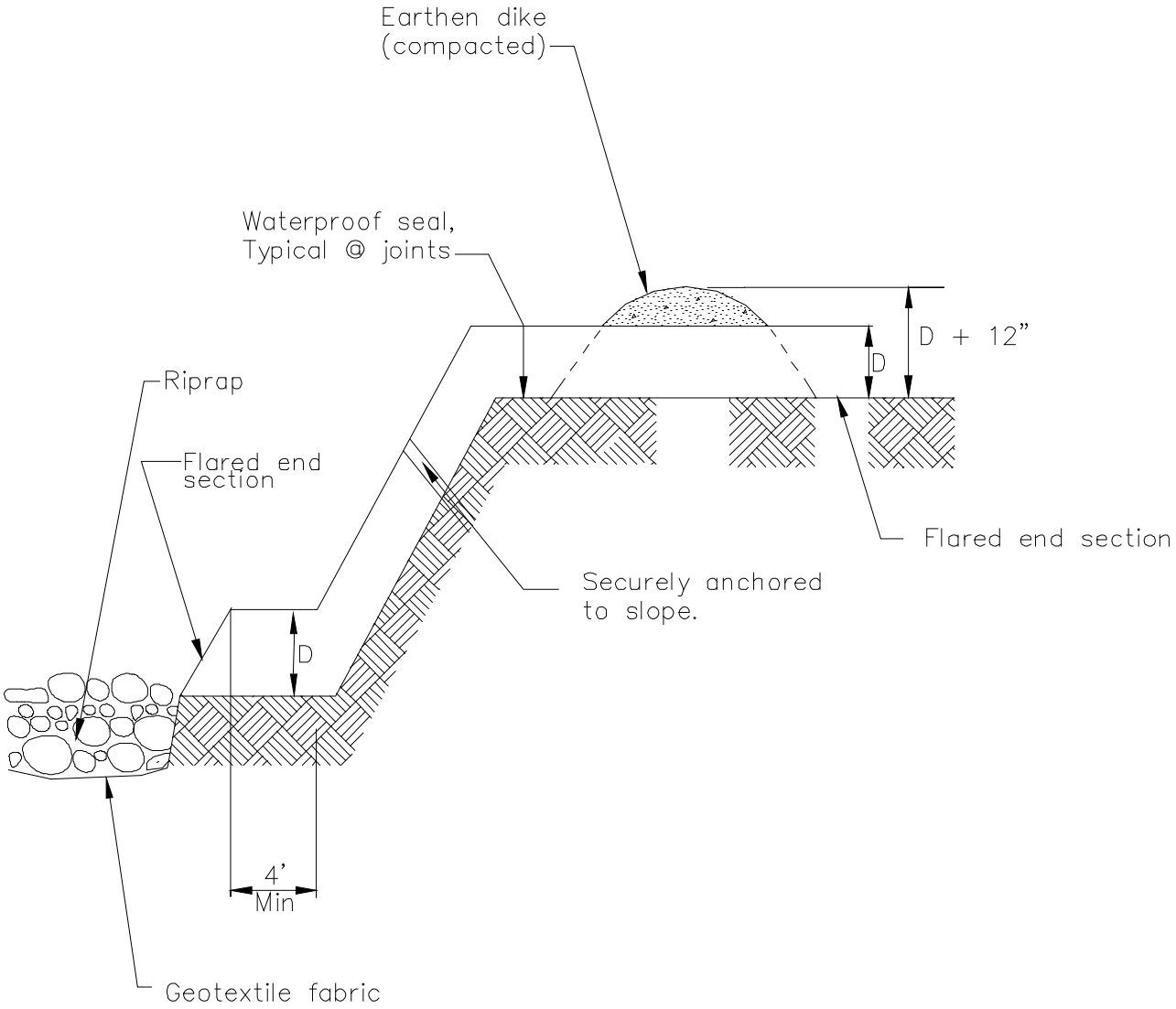
National Association of Home Builders (NAHB). Stormwater Runoff & Nonpoint Source Pollution Control Guide for Builders and Developers. National Association of Home Builders, Washington, D.C., 1995

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



TYPICAL SLOPE DRAIN
NOT TO SCALE

Streambank Stabilization EC-12



Categories

EC	Erosion Control	☑
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☒
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

Combination of erosion and sediment controls.

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Stream channels, streambanks, and associated riparian areas are dynamic and sensitive ecosystems that respond to changes in land use activity. Streambank and channel disturbance resulting from construction activities can increase the stream's sediment load, which can cause channel erosion or sedimentation and have adverse affects on the biotic system. BMPs can reduce the discharge of sediment and other pollutants to minimize the impact of construction activities on watercourses. Streams on the 303(d) list and listed for sediment may require numerous measures to prevent any increases in sediment load to the stream.

Suitable Applications

These procedures typically apply to all construction projects that disturb or occur within stream channels and their associated riparian areas.

Limitations

Specific permit requirements or mitigation measures such as Regional Water Quality Control Board (RWQCB) 401 Certification, U.S. Army Corps of Engineers 404 permit and approval by California Department of Fish and Game supercede the guidance in this BMP.

- If numerical based water quality standards are mentioned in any of these and other related permits, testing and sampling may be required. Streams listed as 303(d) impaired for sediment, silt, or turbidity, are required to

conduct sampling to verify that there is no net increase in sediment load due to construction activities.

Implementation

Planning

- Proper planning, design, and construction techniques can minimize impacts normally associated with in stream construction activities. Poor planning can adversely affect soil, fish, wildlife resources, land uses, or land users. Planning should take into account: scheduling; avoidance of in-stream construction; minimizing disturbance area and construction time period; using pre-disturbed areas; selecting crossing location; and selecting equipment.

Scheduling

- Construction activities should be scheduled according to the relative sensitivity of the environmental concerns and in accordance with EC-1, Scheduling. Scheduling considerations will be different when working near perennial streams vs. ephemeral streams and are as follows.

- When in-stream construction is conducted in a perennial stream, work should optimally be performed during the rainy season. This is because in the summer, any sediment-containing water that is discharged into the watercourse will cause a large change in both water clarity and water chemistry. During the rainy season, there is typically more and faster flowing water in the stream so discharges are diluted faster. However, should in-stream work be scheduled for summer, establishing an isolation area, or diverting the stream, will significantly decrease the amount of sediment stirred up by construction work. Construction work near perennial streams should optimally be performed during the dry season (see below).

- When working in or near ephemeral streams, work should be performed during the dry season. By their very nature, ephemeral streams are usually dry in the summer, and therefore, in-stream construction activities will not cause significant water quality problems. However, when tying up the site at the end of the project, wash any fines (see Washing Fines) that accumulated in the channel back into the bed material, to decrease pollution from the first rainstorm of the season.

- When working near ephemeral or perennial streams, erosion and sediment controls (see silt fences, straw bale barriers, etc.) should be implemented to keep sediment out of stream channel.

Minimize Disturbance

- Minimize disturbance through: selection of the narrowest crossing location; limiting the number of equipment trips across a stream during construction; and, minimizing the number and size of work areas (equipment staging areas and spoil storage areas). Place work areas at least 50 ft from stream channel. Field reconnaissance should be conducted during the planning stage to identify work areas.

Use of Pre-Disturbed Areas

- Locate project sites and work areas in areas disturbed by prior construction or other activity when possible.

Selection of Project Site

- Avoid steep and unstable banks, highly erodible or saturated soils, or highly fractured rock.
- Select project site that minimizes disturbance to aquatic species or habitat.

Equipment Selection

- Select equipment that reduces the amount of pressure exerted on the ground surface, and therefore, reduces erosion potential and/or use overhead or aerial access for transporting equipment across drainage channels. Use equipment that exerts ground pressures of less than 5 or 6 lb/in^2, where possible. Low ground pressure equipment includes: wide or high flotation tires (34 to 72 in. wide); dual tires; bogie axle systems; tracked machines; lightweight equipment; and, central tire inflation systems.

Streambank Stabilization

Preservation of Existing Vegetation

- Preserve existing vegetation in accordance with EC-2, Preservation of Existing Vegetation. In a streambank environment, preservation of existing vegetation provides the following benefits.

Water Quality Protection

- Vegetated buffers on slopes trap sediment and promote groundwater recharge. The buffer width needed to maintain water quality ranges from 15 to 100 ft. On gradual slopes, most of the filtering occurs within the first 30 ft. Steeper slopes require a greater width of vegetative buffer to provide water quality benefits.

Streambank Stabilization

- The root system of riparian vegetation stabilizes streambanks by increasing tensile strength in the soil. The presence of vegetation modifies the moisture condition of slopes (infiltration, evapo transpiration, interception) and increases bank stability.

Riparian Habitat

- Buffers of diverse riparian vegetation provide food and shelter for riparian and aquatic organisms. Minimizing impacts to fisheries habitat is a major concern when working near streams and rivers. Riparian vegetation provides shade, shelter, organic matter (leaf detritus and large woody debris), and other nutrients that are necessary for fish and other aquatic organisms. Buffer widths for habitat concerns are typically wider than those recommended for water quality concerns (100 to 1500 ft).
- When working near watercourses, it is important to understand the work site's placement in the watershed. Riparian vegetation in headwater streams has a greater impact on overall water quality than vegetation in downstream reaches. Preserving existing vegetation upstream is necessary to maintain water quality, minimize bank failure, and maximize riparian habitat, downstream of the work site.

Limitations

- Local county and municipal ordinances regarding width, extent and type of vegetative buffer required may exceed the specifications provided here; these ordinances should be investigated prior to construction.

Streambank Stabilization Specific Installation

- As a general rule, the width of a buffer strip between a road and the stream is recommended to be 50 ft plus four times the percent slope of the land, measured between the road and the top of stream bank.

Hydraulic Mulch

- Apply hydraulic mulch on disturbed streambanks above mean high water level in accordance with EC-3, Hydraulic Mulch to provide temporary soil stabilization.

Limitations

- Do not place hydraulic mulch or tackifiers below the mean high water level, as these materials could wash into the channel and impact water quality or possibly cause eutrophication (eutrophication is an algal bloom caused by excessively high nutrient levels in the water).

Hydroseeding

- Hydroseed disturbed streambanks in accordance with EC-4, Hydroseeding.

Limitations

- Do not place tackifiers or fertilizers below the mean high water level, as these materials could wash into the channel and impact water quality or possibly cause eutrophication.

Soil Binders

- Apply soil binders to disturbed streambanks in accordance with EC-5, Soil Binders.

Limitations

- Do not place soil binders below the mean high water level. Soil binder must be environmentally benign and non-toxic to aquatic organisms.

Straw Mulch

- Apply straw mulch to disturbed streambanks in accordance with EC-6, Straw Mulch.

Limitations

- Do not place straw mulch below the mean high water level, as this material could wash into the channel and impact water quality or possibly cause eutrophication.

Geotextiles and Mats

- Install geotextiles and mats as described in EC-7, Geotextiles and Mats, to stabilize disturbed channels and streambanks. Not all applications should be in the channel, for example, certain geotextile netting may snag fish gills and are not appropriate in fish bearing streams. Geotextile fabrics that are not biodegradable are not appropriate for in stream use. Additionally, geotextile fabric or blankets placed in channels must be adequate to sustain anticipated hydraulic forces.

Earth Dikes, Drainage Swales, and Lined Ditches

- Convey, intercept, or divert runoff from disturbed streambanks using EC-9, Earth Dikes and Drainage Swales.

Limitations

- Do not place earth dikes in watercourses, as these structures are only suited for intercepting sheet flow, and should not be used to intercept concentrated flow.

- Appropriately sized velocity dissipation devices (EC-10) must be placed at outlets to minimize erosion and scour.

Velocity Dissipation Devices

- Place velocity dissipation devices at outlets of pipes, drains, culverts, slope drains, diversion ditches, swales, conduits or channels in accordance with EC-10, Velocity Dissipation Devices.

Slope Drains

- Use slope drains to intercept and direct surface runoff or groundwater into a stabilized watercourse, trapping device or stabilized area in accordance with EC-11, Slope Drains.

Limitations

- Appropriately sized outlet protection and velocity dissipation devices (EC-10) must be placed at outlets to minimize erosion and scour.

Streambank Sediment Control

Silt Fences

- Install silt fences in accordance with SE-1, Silt Fence, to control sediment. Silt fences should only be installed where sediment laden water can pond, thus allowing the sediment to settle out.

Fiber Rolls

- Install fiber rolls in accordance with SE-5, Fiber Rolls, along contour of slopes above the high water level to intercept runoff, reduce flow velocity, release the runoff as sheet flow and provide removal of sediment from the runoff. In a stream environment, fiber rolls should be used in conjunction with other sediment control methods such as SE-1, Silt Fence or SE-9 Straw Bale Barrier. Install silt fence, straw bale barrier, or other erosion control method along toe of slope above the high water level.

Gravel Bag Berm

- A gravel bag berm or barrier can be utilized to intercept and slow the flow of sediment laden sheet flow runoff in accordance with SE-6, Gravel Bag Berm. In a stream environment gravel bag barriers can allow sediment to settle from runoff before water leaves the construction site and can be used to isolate the work area from the live stream.

Limitations

- Gravel bag barriers are not recommended as a perimeter sediment control practice around streams.

Straw Bale Barrier

- Install straw bale barriers in accordance with SE-9, Straw Bale Barrier, to control sediment. Straw bale barriers should only be installed where sediment laden water can pond, thus allowing the sediment to settle out. Install a silt fence in accordance with SE-1, Silt Fence,

on down slope side of straw bale barrier closest to stream channel to provide added sediment control.

Rock Filter

Description and Purpose

Rock filters are temporary erosion control barriers composed of rock that is anchored in place. Rock filters detain the sediment laden runoff, retain the sediment, and release the water as sheet flow at a reduced velocity. Typical rock filter installations are illustrated at the end of this BMP.

Applications

- Near the toe of slopes that may be subject to flow and rill erosion.

Limitations

- Inappropriate for contributing drainage areas greater than 5 acres.
- Requires sufficient space for ponded water.
- Ineffective for diverting runoff because filters allow water to slowly seep through.
- Rock filter berms are difficult to remove when construction is complete.
- Unsuitable in developed areas or locations where aesthetics is a concern.

Specifications

- Rock: open graded rock, 0.75 to 5 in. for concentrated flow applications.
- Woven wire sheathing: 1 in. diameter, hexagonal mesh, galvanized 20gauge (used with rock filters in areas of concentrated flow).
- In construction traffic areas, maximum rock berm heights should be 12 in. Berms should be constructed every 300 ft on slopes less than 5%, every 200 ft on slopes between 5% and 10%, and every 100 ft on slopes greater than 10%.

Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Reshape berms as needed and replace lost or dislodged rock, and filter fabric.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.

K-rail

Description and Purpose

This is temporary sediment control that uses K-rails to form the sediment deposition area, or to isolate the near bank construction area. Install K-rails at toe of slope in accordance with procedures described in NS-5, Clear Water Diversion.

Barriers are placed end to end in a pre-designed configuration and gravel filled bags are used at the toe of the barrier and at their abutting ends to seal and prevent movement of sediment beneath or through the barrier walls.

Appropriate Applications

- This technique is useful at the toe of embankments, cuts or fills slopes.

Limitations

- The K-rail method should not be used to dewater a project site, as the barrier is not watertight.

Implementation

- Refer to NS-5, Clear Water Diversion, for implementation requirements.

Instream Construction Sediment Control

There are three different options currently available for reducing turbidity while working in a stream or river. The stream can be isolated from the area in which work is occurring by means of a water barrier, the stream can be diverted around the work site through a pipe or temporary channel, or one can employ construction practices that minimize sediment suspension.

Whatever technique is implemented, an important thing to remember is that dilution can sometimes be the solution. A probable "worst time" to release high TSS into a stream system might be when the stream is very low; summer low flow, for example. During these times, the flow may be low while the biological activity in the stream is very high. Conversely, the addition of high TSS or sediment during a big storm discharge might have a relatively low impact, because the stream is already turbid, and the stream energy is capable of transporting both suspended solids, and large quantities of bedload through the system. The optimum time to "pull" in-stream structures may be during the rising limb of a storm hydrograph.

Techniques to minimize Total Suspended Solids (TSS)

- **Padding** - Padding laid in the stream below the work site may trap some solids that are deposited in the stream during construction. After work is done, the padding is removed from the stream, and placed on the bank to assist in re-vegetation.

- **Clean, washed gravel** - Using clean, washed gravel decreases solid suspension, as there are fewer small particles deposited in the stream.

- **Excavation using a large bucket** - Each time a bucket of soil is placed in the stream, a portion is suspended. Approximately the same amount is suspended whether a small amount of soil is placed in the stream, or a large amount. Therefore, using a large excavator bucket instead of a small one, will reduce the total amount of soil that washes downstream.

- **Use of dozer for backfilling** - Using a dozer for backfilling instead of a backhoe follows the same principles – the fewer times soil is deposited in the stream, the less soil will be suspended.

- **Partial dewatering with a pump** - Partially dewatering a stream with a pump reduces the amount of water, and thus the amount of water that can suspend sediment.

Washing Fines

Definition and Purpose

- Washing fines is an "in-channel" sediment control method, which uses water, either from a water truck or hydrant, to wash stream fines that were brought to the surface of the channel bed during restoration, back into the interstitial spaces of the gravel and cobbles.

- The purpose of this technique is to reduce or eliminate the discharge of sediment from the channel bottom during the first seasonal flow. Sediment should not be allowed into stream channels; however, occasionally in-channel restoration work will involve moving or otherwise disturbing fines (sand and silt sized particles) that are already in the stream, usually below bankfull discharge elevation. Subsequent re-watering of the channel can result in a plume of turbidity and sedimentation.

- This technique washes the fines back into the channel bed. Bedload materials, including gravel cobbles, boulders and those fines, are naturally mobilized during higher storm flows. This technique is intended to delay the discharge until the fines would naturally be mobilized.

Appropriate Applications

- This technique should be used when construction work is required in channels. It is especially useful in intermittent or ephemeral streams in which work is performed "in the dry", and which subsequently become re-watered.

Limitations

- The stream must have sufficient gravel and cobble substrate composition.

- The use of this technique requires consideration of time of year and timing of expected stream flows.

- The optimum time for the use of this technique is in the fall, prior to winter flows.

- Consultation with, and approval from the Department of Fish and Game and the Regional Water Quality Control Board may be required.

Implementation

- Apply sufficient water to wash fines, but not cause further erosion or runoff.

- Apply water slowly and evenly to prevent runoff and erosion.

- Consult with Department of Fish and Game and the Regional Water Quality Control Board for specific water quality requirements of applied water (e.g. chlorine).

Inspection and Maintenance

- None necessary

Costs

Cost may vary according to the combination of practices implemented.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events until final stabilization is achieved.

- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.

- Inspect and repair equipment (for damaged hoses, fittings, and gaskets).

References

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

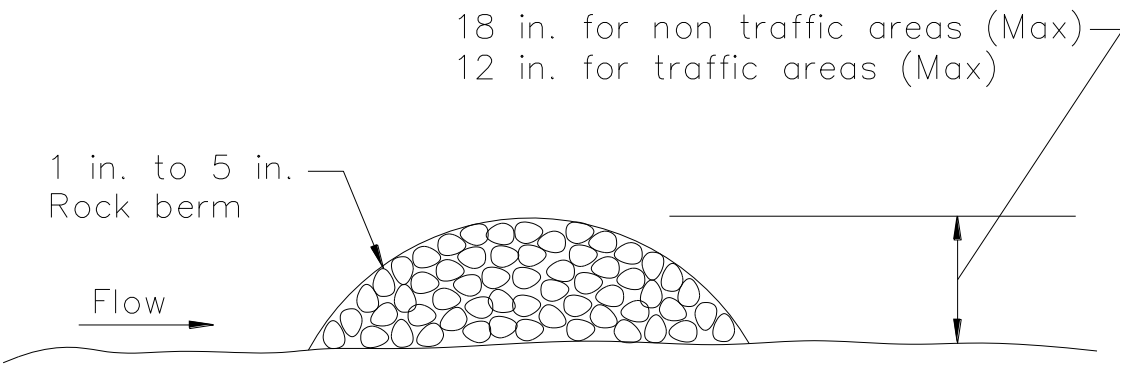
Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group Working Paper, USEPA, April 1992.

Sedimentation and Erosion Control Practices, An Inventory of Current Practices (Draft), UESPA, 1990.

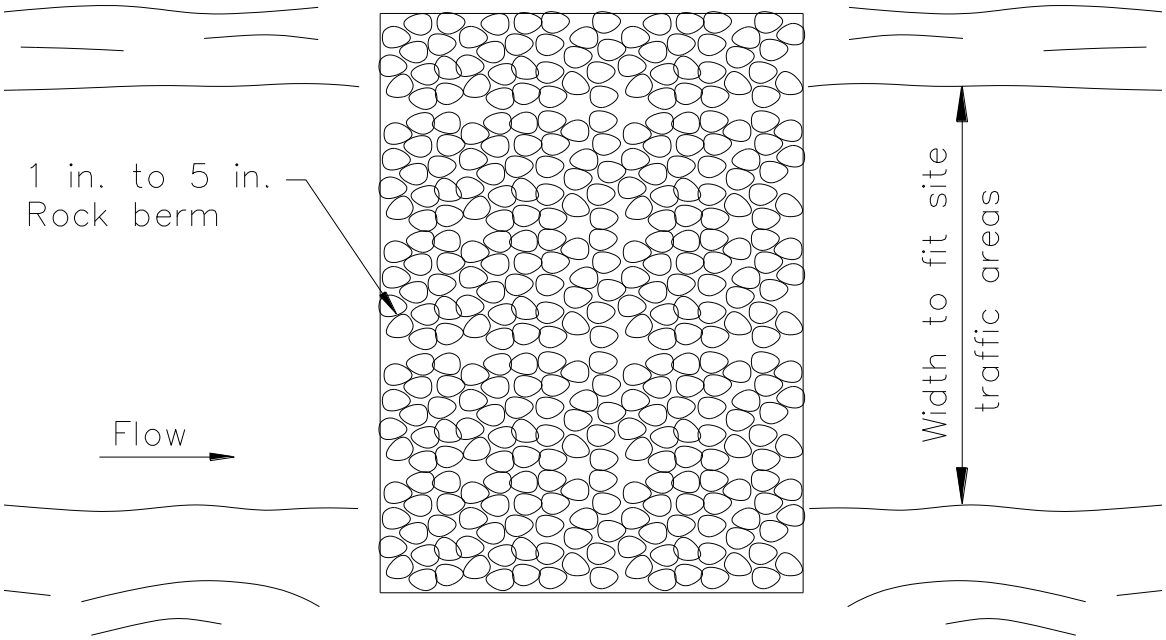
Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



SECTION



PLAN

TYPICAL ROCK FILTER
NOT TO SCALE

Reserved EC-13

BMP Factsheet removed in 2009.
Formerly PAM. See SE-11, Active Treatment Systems.

Categories

EC	Erosion Control
SE	Sediment Control
TC	Tracking Control
WE	Wind Erosion Control
NS	Non-Stormwater Management Control
WM	Waste Management and Materials Pollution Control

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment
Nutrients
Trash
Metals
Bacteria
Oil and Grease
Organics

Potential Alternatives

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Compost Blanket EC-14



Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch

EC-4 Hydroseeding

EC-5 Soil Binders

EC-7 Geotextiles and Mats

EC-8 Wood Mulching

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

A compost blanket is applied to slopes and earth disturbed areas to prevent erosion, and in some cases, increase infiltration and/or establish vegetation. The compost blanket can be applied by hand, conveyor system, compost spreader, or pneumatic delivery (blower) system. The blanket thickness is determined from the slope steepness and anticipated precipitation. A compost blanket protects the soil surface from raindrop erosion, particularly rills and gullies that may form under other methods of erosion control.

A compost blanket, if properly installed, can be very successful at vegetation establishment, weed suppression and erosion control. The compost blanket comes into direct contact with the underlying soil, reducing rill formation. Furthermore, compost provides organic matter and nutrients important for vegetation growth. The compost blanket provides soil structure that allows water to infiltrate the soil surface and retain moisture, which also promotes seed germination and vegetation growth, in addition to reducing runoff.

Compost is typically derived from combinations of feedstocks, biosolids, leaf and yard trimmings, manure, wood, or mixed solid waste. Many types of compost are products of municipal recycle or "Greenwaste" programs. Compost is organic and biodegradable and can be left onsite. There are many types of compost with a variety of properties with specific functions, and accordingly, compost selection is an important design consideration in the application of this type of erosion control.

Suitable Applications

A compost blanket is appropriate for slopes and earth disturbed areas requiring protection until permanent stabilization is established. A compost blanket can also used in combination with temporary and/or permanent seeding strategies to enhance plant establishment. Examples include:

- Rough-graded areas that will remain inactive for longer than 14 days
- Soil stockpiles
- Slopes with exposed soil between existing vegetation such as trees or shrubs
- Slopes planted with live, container-grown vegetation
- Disturbed areas where plants are slow to develop

A compost blanket is typically used on slopes of 2:1 (H:V) or gentler. However, a compost blanket can be effective when applied to slopes as steep as 1:1 (H:V) with appropriate design considerations including slope length, blanket thickness, adding components such as a tackifier, or using compost blankets in conjunction with other techniques, such as compost socks and berms or fiber rolls.

Compost can be pre-seeded prior to application to the soil (recommended by the EPA for construction site stormwater runoff control) or seeded after the blanket has been installed. The compost medium can also remove pollutants in stormwater including heavy metals; oil and grease; and hydrocarbons (USEPA, 1998).

Limitations

- Compost can potentially leach nutrients (dissolved phosphorus and nitrogen) into runoff and potentially impact water quality. Compost should not be used directly upstream from nutrient impaired waterbodies (Adams et. al, 2008).
- Compost may also contain other undesirable constituents that are detrimental to water quality. Carefully consider the qualifications and experience of any compost producer/supplier.
- A compost blanket applied by hand is more time intensive and potentially costly. Using a pneumatic blower truck is the recommended cost effective method of application.
- When blowers are used, the treatment areas should be within 300 ft of a road or surface capable of supporting trucks.
- Wind may limit application of compost and result in application to undesired locations.
- Compost blankets should not be applied in areas of concentrated flows.
- Steeper slopes may require additional blanket thickness and other stability measures such as using tackifiers or slope interruption devices (compost socks and berms, or fiber rolls). The same applies for sites with high precipitation totals or during the rainy season.

Implementation

- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

Compost Materials

- California Compost Regulations (Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7, Section 17868.3) define and require a quality of compost for application. Compost should comply with all physical and chemical requirements. Specific requirements are provided in Table 1 below, taken from Caltrans Standard Special Provision 10-1 (SSP 10-1), Erosion Control (Compost Blanket).

- The compost producer should be fully permitted as specified under the California Integrated Waste Management Board, Local Enforcement Agencies and any other State and Local Agencies that regulate Solid Waste Facilities. If exempt from State permitting requirements, the composting facility should certify that it follows guidelines and procedures for production of compost meeting the environmental health standards of Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7.

- The compost producer should be a participant in United States Composting Council's Seal of Testing Assurance program.

- Compost moisture should be considered for composition quality and application purposes. A range of 30-50% is typical. Compost that is too dry is hard to apply and compost that is too wet is more difficult (and more expensive) to transport. For arid or semi-arid areas, or for application during the dry season, use compost with greater moisture content than areas with wetter climates. For wetter or more humid climates or for application during the wet season, drier composts can be used as the compost will absorb moisture from the ambient air.

- Organic content of the compost is also important and should range from 30 to 65% depending on site conditions.

- Compost should be high-quality mature compost. Immature compost can potentially leach nutrients.

- Compost should not be derived from mixed municipal solid waste and should be free of visible contaminants.

- Compost should not contain paint, petroleum products, pesticides or any other chemical residues harmful to animal life or plant growth. Metal concentrations in compost should not exceed the maximum metal concentrations listed under Title 14, California Code of Regulations, Division 7, Chapter 3.1, Section 17868.2.

- Compost should not possess objectionable odors.

- Compost should be weed free.

Table 1. Physical/Chemical Requirements of Compost
Reference - Caltrans SSP-10 Erosion Control Blanket (Compost)

Property	Test Method	Requirement
pH	*TMECC 04.11-A Elastometric pH 1:5 Slurry Method pH Units	6.0–8.0
Soluble Salts	TMECC 04.10-A Electrical Conductivity 1:5 Slurry Method dS/m (mmhos/cm)	0-10.0
Moisture Content	TMECC 03.09-A Total Solids & Moisture at 70+/- 5 deg C % Wet Weight Basis	30-60
Organic Matter Content	TMECC 05.07-A Loss-On-Ignition Organic Matter Method (LOI) % Dry Weight Basis	30–65
Maturity	TMECC 05.05-A Germination and Vigor Seed Emergence Seedling Vigor % Relative to Positive Control	 80 or Above 80 or Above
Stability	TMECC 05.08-B Carbon Dioxide Evolution Rate mg CO_2-C/g OM per day	8 or below
Particle Size	TMECC 02.02-B Sample Sieving for Aggregate Size Classification % Dry Weight Basis	100% Passing, 3 inch 90-100% Passing, 1 inch 65-100% Passing, 3/4 inch 0 - 75% Passing, 1/4 inch Maximum length 6 inches
Pathogen	TMECC 07.01-B Fecal Coliform Bacteria < 1000 MPN/gram dry wt.	Pass
Pathogen	TMECC 07.01-B Salmonella < 3 MPN/4 grams dry wt.	Pass
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Plastic, Glass and Metal % > 4mm fraction	Combined Total: < 1.0
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Sharps (Sewing needles, straight pins and hypodermic needles) % > 4mm fraction	None Detected

*TMECC refers to "Test Methods for the Examination of Composting and Compost," published by the United States Department of Agriculture and the United States Compost Council (USCC).

Installation

- Prior to compost application, prepare the slope by removing loose rocks, roots, stumps, and other debris greater than 2" in diameter. Prepare the slope area surface by scarifying or track walking/roughening if necessary.
- Select method to apply the compost blanket. A pneumatic blower is most cost effective and most adaptive in applying compost to steep, rough terrain, and hard to reach locations.
- A compost blanket thickness of 1" to 4" should be applied to slopes of 2:1 (H:V) or gentler, based on site-specific conditions. Increase blanket thickness with increased slope steepness and/or during installation during the rainy season (for example, 2" to 3" should be used for a

3:1 slope, while 1" to 2" can be used for a 4:1 slope). Erosion control using a compost blanket is not recommended for slopes greater than 1:1 (H:V).

- For steeper slopes, tackifiers should be utilized and/or other stabilization techniques employed. For example, compost socks or berms can be installed at intervals over the compost blanket (in a similar manner as Fiber Rolls, SE-5).
- Compost socks or berms (or equivalent linear sediment control BMP) should be placed at the top and/or bottom of the slope for additional erosion control performance.
- For optimum vegetation establishment, a blanket thickness of 1" to 2" is recommended. If vegetation establishment is not the primary function of the compost blanket, a thicker blanket may be recommended based on slope or rainfall conditions.
- Evenly distribute compost on the soil surface to the desired blanket thickness (1/2" to 4" as calculated prior based on site conditions and objectives). Even distribution is an important factor in preventing future rill and gully erosion.
- The compost blanket should extend 3 to 6 feet over the top of the shoulder of the slope. A compost sock or compost berm can be used at the top of the slope as an auxiliary technique to prevent runoff from flowing underneath the compost blanket.
- Use additional anchoring and erosion control BMPs in conjunction of the compost blanket as needed.

Costs

The cost associated with a compost blanket is similar to that of a straw mat and generally less expensive than a geotextile blanket (USEPA, 2009). Caltrans has provided a recent estimate for $5,000 to $8,000 per acre for application of an unseeded 1 inch compost blanket (Caltrans Compost Specifications, 2009). Recently obtained vendor costs indicate that proprietary blends of compost that are seeded and contain a nutrient rich "tackifier" can cost approximately $0.35 per square foot, or approximately $15,000 per acre for a 2 inch blanket. Application by hand is more time intensive and likely more costly.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Areas where erosion is evident, another layer of compost should be reapplied as soon as possible. It may be necessary to install an additional type of stormwater BMP at the top of slope or as a slope interrupter to control flow, such as a fiber roll (SE-5) or compost sock (SE-11).
- Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require reapplication of BMPs.
- Limit or prohibit foot traffic to minimize damage to BMP or impede vegetation establishment.

References

An Analysis of Composting as an Environmental Remediation Technology, U.S. Environmental Protection Agency (USEPA), Solid Waste and Emergency Response (5305W), EPA530-R-8-008, 1998.

Characteristics of Compost: Moisture Holding and Water Quality Improvement, Center for Research in Water Resources, Kirchoff, C., Malina, J., and Barrett, M., 2003.

Compost Utilization for Erosion Control, The University of Georgia College of Agricultural and Environmental Sciences, pubs.caes.uga.edu/caespubs/pubcd/B1200.htm, Faucette, B. and Risse, M., 2009.

Demonstration Project Using Yard Debris Compost for Erosion Control, Final Report, presented to Metropolitan Service District, W&H Pacific, 1993.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, 2005.

Standard Special Provision 10-1, Erosion Control (Compost Blanket), California Department of Transportation (Caltrans). 2007 Update.

Evaluation of Environmental Benefits and Impacts of Compost and Industry Standard Erosion and Sediment Controls Measures Used in Construction Activities, Dissertation, Institute of Ecology, University of Georgia, Faucette, B., 2004.

Filter Sock Presentation provided at Erosion, Sediment Control and Stormwater Management with Compost BMPs Workshop, U.S. Composting Council 13th Annual Conference and Trade Show, McCoy, S., 2005.

National Pollutant Discharge Elimination System (NPDES), Compost Blankets, U.S. Environmental Protection Agency (USEPA). http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=118, 2009.

Standard Specifications for Transportation Materials and Methods of Sampling and Testing Designation M10-03, Compost for Erosion/Sediment Control (Compost Blankets), Provisional, American Association of State Highway Transportation Officials (AASHTO), 2003.

Stormwater Best Management Practices (BMPs) Field Trials of Erosion Control Compost in Reclamation of Rock Quarry Operations, Nonpoint Source Protection Program CWA §319(h), Texas Commission on Environmental Quality, Adams, T., McFarland, A., Hauck, L., Barrett, M., and Eck, B., 2008.

Soil Preparation/Roughening EC-15



Description and Purpose

Soil Preparation/Roughening involves assessment and preparation of surface soils for BMP installation. This can include soil testing (for seed base, soil characteristics, or nutrients), as well as roughening surface soils by mechanical methods (including sheepsfoot rolling, track walking, scarifying, stair stepping, and imprinting) to prepare soil for additional BMPs, or to break up sheet flow. Soil Preparation can also involve tilling topsoil to prepare a seed bed and/or incorporation of soil amendments, to enhance vegetative establishment.

Suitable Applications

Soil preparation: Soil preparation is essential to proper vegetative establishment. In particular, soil preparation (i.e. tilling, raking, and amendment) is suitable for use in combination with any soil stabilization method, including RECPs or sod. Soil preparation should not be confused with roughening.

Roughening: Soil roughening is generally referred to as track walking (sometimes called imprinting) a slope, where treads from heavy equipment run parallel to the contours of the slope and act as mini terraces. Soil preparation is most effective when used in combination with erosion controls. Soil Roughening is suitable for use as a complementary process for controlling erosion on a site. Roughening is not intended to be used as a stand-alone BMP, and should be used with perimeter controls, additional erosion control measures, grade breaks, and vegetative establishment for maximum effectiveness. Roughening is intended to only affect surface soils and should not compromise slope stability or overall compaction. Suitable applications for soil roughening include:

Categories

EC	Erosion Control	☑
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch

EC-5 Soil Binders

EC-7 Geotextiles and Mats

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Along any disturbed slopes, including temporary stockpiles, sediment basins, or compacted soil diversion berms and swales.

- Roughening should be used in combination with hydraulically applied stabilization methods, compost blanket, or straw mulch; but should not be used in combination with RECPs or sod because roughening is intended to leave terraces on the slope.

Limitations

- Preparation and roughening must take place prior to installing other erosion controls (such as hydraulically applied stabilizers) or sediment controls (such as fiber rolls) on the faces of slopes.

- In such cases where slope preparation is minimal, erosion control/revegetation BMPs that do not require extensive soil preparation - such as hydraulic mulching and seeding applications - should be employed.

- Consideration should be given to the type of erosion control BMP that follows surface preparation, as some BMPs are not designed to be installed over various types of tillage/roughening, i.e., RECPs (erosion control blankets) should not be used with soil roughening due to a "bridging" effect, which suspends the blanket above the seed bed.

- Surface roughness has an effect on the amount of mulch material that needs to be applied, which shows up as a general increase in mulch material due to an increase in surface area (Topographic Index -see EC-3 Hydraulic Mulching).

Implementation

- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

General

A roughened surface can significantly reduce erosion. Based on tests done at the San Diego State Erosion Research Laboratory, various roughening techniques on slopes can result in a 12 - 76% reduction in the erosion rate versus smooth slopes.

Materials

Minimal materials are required unless amendments and/or seed are added to the soil. The majority of soil roughening/preparation can be done with equipment that is on hand at a normal construction site, such as bull dozers and compaction equipment.

Installation Guidelines

Soil Preparation

- Where appropriate or feasible, soil should be prepared to receive the seed by disking or otherwise scarifying the surface to eliminate crust, improve air and water infiltration and create a more favorable environment for germination and growth.

- Based upon soil testing conducted, apply additional soil amendments (e.g. fertilizers, additional seed) to the soil to help with germination. Follow EC-4, Hydroseeding, when selecting and applying seed and fertilizers.

Cut Slope Roughening:

- Stair-step grade or groove the cut slopes that are steeper than 3:1.
- Use stair-step grading on any erodible material soft enough to be ripped with a bulldozer. Slopes consisting of soft rock with some subsoil are particularly suited to stair-step grading.
- Make the vertical cut distance less than the horizontal distance, and slightly slope the horizontal position of the "step" in toward the vertical wall.
- Do not make individual vertical cuts more than 2 feet (0.6 m) high in soft materials or more than 3 feet (0.9 m) high in rocky materials.
- Groove the slope using machinery to create a series of ridges and depressions that run across the slope, on the contour.

Fill Slope Roughening:

- Place on fill slopes with a gradient steeper than 3:1 in lifts not to exceed 8 inches (0.2 m), and make sure each lift is properly compacted.
- Ensure that the face of the slope consists of loose, uncompacted fill 4-6 inches (0.1-0.2 m) deep.
- Use grooving or tracking to roughen the face of the slopes, if necessary.
- Do not blade or scrape the final slope face.

Roughening for Slopes to be Mowed:

- Slopes which require mowing activities should not be steeper than 3:1.
- Roughen these areas to shallow grooves by track walking, scarifying, sheepsfoot rolling, or imprinting.
- Make grooves close together (less than 10 inches), and not less than 1 inch deep, and perpendicular to the direction of runoff (i.e., parallel to the slope contours).
- Excessive roughness is undesirable where mowing is planned.

Roughening With Tracked Machinery:

- Limit roughening with tracked machinery to soils with a sandy textural component to avoid undue compaction of the soil surface.
- Operate tracked machinery up and down the slope to leave horizontal depressions in the soil. Do not back-blade during the final grading operation.
- Seed and mulch roughened areas as soon as possible to obtain optimum seed germination and growth.

Costs

Costs are based on the additional labor of tracking or preparation of the slope plus the cost of any required soil amendment materials.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Check the seeded slopes for signs of erosion such as rills and gullies. Fill these areas slightly above the original grade, then reseed and mulch as soon as possible.
- Inspect BMPs weekly during normal operations, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

References

Soil Stabilization BMP Research for Erosion and Sediment Controls: Cost Survey Technical Memorandum, State of California Department of Transportation (Caltrans), July 2007.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Non-Vegetative Stabilization EC-16



Description and Purpose

Non-vegetative stabilization methods are used for temporary or permanent stabilization of areas prone to erosion and should be used only where vegetative options are not feasible; examples include:

- Areas of vehicular or pedestrian traffic such as roads or paths;
- Arid environments where vegetation would not provide timely ground coverage, or would require excessive irrigation;
- Rocky substrate, infertile or droughty soils where vegetation would be difficult to establish; and
- Areas where vegetation will not grow adequately within the construction time frame.

There are several non-vegetative stabilization methods and selection should be based on site-specific conditions.

Decomposed Granite (DG) is a permanent erosion protection method that consists of a layer of stabilized decomposed granite placed over an erodible surface.

Degradable Mulches of various types (see EC-3, EC-6, EC-8) can be used for temporary non-vegetative stabilization; examples include straw mulch, compost, wood chips or hydraulic mulch.

Geotextiles and Mats can be used for temporary non-vegetative stabilization (see EC-7). These BMPs are typically manufactured from degradable or synthetic materials and are

Categories

EC	Erosion Control	☑
SE	Sediment Control	☒
TR	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

designed and specified based on their functional longevity, i.e., how long they will persist and provide erosion protection. All geotextiles and mats should be replaced when they exceed their functional longevity or when permanent stabilization methods are instituted.

Gravel Mulch is a non-degradable erosion control product that is composed of washed and screened coarse to very coarse gravel, 16 mm to 64 mm (0.6" - 2.5"), similar to an AASHTO No. 3 coarse aggregate.

Rock Slope Protection consists of utilizing large rock or rip-rap (4"- 24") to stabilize slopes with a high erosion potential and those subject to scour along waterways.

Soil Binders can be used for temporary non-vegetative stabilization (see EC-5). The key to their use is functional longevity. In most cases, the soil binder will need to be routinely monitored and re-applied to maintain an erosion-resistant coverage.

Suitable Applications

Non-vegetated stabilization methods are suitable for use on disturbed soil areas and on material stockpiles that need to be temporarily or permanently protected from erosion by water and wind. Non-vegetated stabilization should only be utilized when vegetation cannot be established in the required timeframe, due to soil or climactic conditions, or where vegetation may be a potential fire hazard.

Decomposed Granite (DG) and Gravel Mulch are suitable for use in areas where vegetation establishment is difficult, on flat surfaces, trails and pathways, and when used in conjunction with a stabilizer or tackifier, on shallow slopes (i.e., 10:1 [H:V]). DG and gravel can also be used on shallow rocky slopes where vegetation cannot be established for permanent erosion control.

Degradable Mulches can be used to cover and protect soil surfaces from erosion both in temporary and permanent applications. In many cases, the use of mulches by themselves requires routine inspection and re-application. See EC-3 Hydraulic Mulch, EC-6 Straw Mulch, EC-8 Wood Mulch, or EC-14 Compost Blankets for more information.

Geotextiles and Mats can be used as a temporary stand-alone soil stabilization method. Depending on material selection, geotextiles and mats can be a short-term (3 mos – 1 year) or long-term (1-2 years) temporary stabilization method. For more information on geotextiles and mats see EC-7 Geotextiles and Mats.

Rock Slope Protection can be used when the slopes are subject to scour or have a high erosion potential, such as slopes adjacent to flowing waterways or slopes subject to overflow from detention facilities (spillways).

Soil Binders can be used for temporary stabilization of stockpiles and disturbed areas not subject to heavy traffic. See EC-5 Soil Binders for more information.

Limitations

General

- Refer to EC-3, EC-6, EC-8, and EC-14 for limitations on use of mulches. Refer to EC-7 for limitations on use of geotextiles and mats. Refer to EC-5 for limitations on use of Soil Binders.

Decomposed Granite

- Not available in some geographic regions.
- If not tackified, material may be susceptible to erosion even on slight slopes (e.g., 30:1 [H:V]).
- Installed costs may be more expensive than vegetative stabilization methods.

Gravel Mulch

- Availability is limited in some geographic regions.
- If not properly screened and washed, can contain fine material that can erode and/or create dust problems.
- If inadequately sized, material may be susceptible to erosion on sloped areas.
- Pore spaces fill with dirt and debris over time; may provide a growing medium for weeds.

Rock Slope Protection

- Installation is labor intensive.
- Installed costs can be significantly higher than vegetative stabilization methods.
- Rounded stones may not be used on slopes greater than 2:1 [H:V].

Implementation

General

Non-vegetated stabilization should be used in accordance with the following general guidance:

- Should be used in conjunction with other BMPs, including drainage, erosion controls and sediment controls.
- Refer to EC-3, EC-6, EC-8, and EC-14 for implementation details for mulches. Refer to EC-7 for implementation details for geotextiles and mats. Refer to EC-5 for implementation details for soil binders.
- Non-vegetated stabilization measures should be implemented as soon as the disturbance in the areas they are intended to protect has ceased.
- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

Decomposed Granite Stabilization

- If used for a road or path should be installed on a prepared base.
- Should be mixed with a stabilizer if used for roads or pathways, or on slope applications.
- Though porous it is recommended to prevent standing water on or next to a decomposed granite road or pathway.

Gravel Mulch

- Should be sized based on slope, rainfall, and upgradient run-on conditions. Stone size should be increased as potential for erosion increases (steeper slopes, high intensity rainfall).
- If permanent, a weed control fabric should be placed prior to installation.
- Should be installed at a minimum 2" depth.
- Should completely cover all exposed surfaces.

Rock Slope Protection

- Rock slope protection installation should follow Caltrans Standard Specification 72-2: Rock Slope Protection. Refer to the specification for rock conformity requirements and installation methods.
- When using rock slope protection, rock size and installation method should be specified by an Engineer.
- A geotextile fabric should be placed prior to installation.

Costs

- Costs are highly variable depending not only on technique chosen, but also on materials chosen within specific techniques. In addition, availability of certain materials will vary by region/location, which will also affect the cost. Costs of mulches, geotextiles and mats, and soil binders are presented in their respective fact sheets. Costs for decomposed granite, gravel mulch stabilization and rock slope protection may be higher depending on location and availability of materials. Caltrans has provided an estimate for gravel mulch of \$10 - \$15/yd^2 in flat areas and \$11 - \$23/yd^2 on side slopes.

Inspection and Maintenance

General

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- For permanent installation, require inspection periodically and after major storm events to look for signs of erosion or damage to the stabilization.
- All damage should be repaired immediately.
- Refer to EC-3, EC-6, EC-8, and EC-14 for inspection and maintenance requirements for mulches. Refer to EC-7 for inspection and maintenance requirements for geotextiles and mats. Refer to EC-5 for inspection and maintenance requirements for soil binders.

Decomposed Granite and Gravel Mulch Stabilization

- Rake out and add decomposed granite or gravel as needed to areas subject to rill erosion. Inspect upgradient drainage controls and repair/modify as necessary.

- Should remain stable under loose surface material. Any significant problem areas should be repaired to restore uniformity to the installation.

References

Arid Zone Forestry: A Guide for Field Technicians. Food and Agriculture Organization of the United Nations, 1989.

Design of Roadside Channels with Flexible Linings, Hydraulic Engineering Circular Number 15, Third Edition, Federal Highway Administration, 2007.

Design Standards for Urban Infrastructure - Soft Landscape Design, Department of Territory and Municipal Services - Australian Capital Territory http://www.tams.act.gov.au/work/standards_and_procedures/design_standards_for_urban_infrastructure

Erosion and Sediment Control Handbook: A Guide for Protection of State Waters through the use of Best Management Practices during Land Disturbing Activities, Tennessee Department of Environment and Conservation, 2002.

Gravel Mulch, Landscape Architecture Non-Standard Specification 10-2, California Department of Transportation (Caltrans), http://www.dot.ca.gov/hq/LandArch/roadside/detail-gm.htm

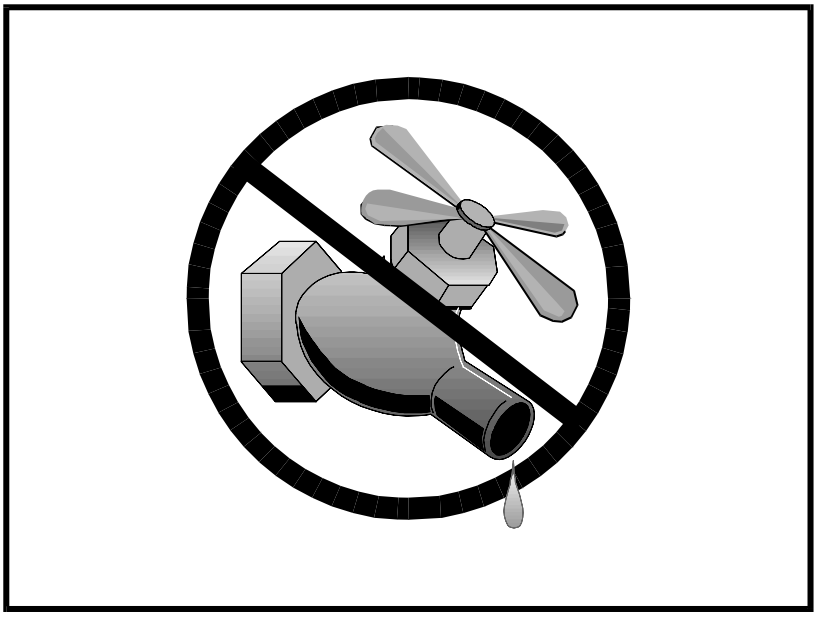
Maine Erosion and Sediment Control BMPs, DEPLW0588, Maine Department of Environmental Protection: Bureau of Land and Water Quality, 2003.

National Menu of Best Management Practices, US Environmental Protection Agency, 2006.

Standard Specification 72-2: Rock Slope Protection. California Department of Transportation, 2006.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Water Conservation Practices NS-1



Categories		
EC	Erosion Control	☒
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Objective**
☒ **Secondary Objective**

Description and Purpose

Water conservation practices are activities that use water during the construction of a project in a manner that avoids causing erosion and the transport of pollutants offsite. These practices can reduce or eliminate non-stormwater discharges.

Suitable Applications

Water conservation practices are suitable for all construction sites where water is used, including piped water, metered water, trucked water, and water from a reservoir.

Limitations

- None identified.

Implementation

- Keep water equipment in good working condition.
- Stabilize water truck filling area.
- Repair water leaks promptly.
- Washing of vehicles and equipment on the construction site is discouraged.
- Avoid using water to clean construction areas. If water must be used for cleaning or surface preparation, surface should be swept and vacuumed first to remove dirt. This will minimize amount of water required.

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Direct construction water runoff to areas where it can soak into the ground or be collected and reused.
- Authorized non-stormwater discharges to the storm drain system, channels, or receiving waters are acceptable with the implementation of appropriate BMPs.
- Lock water tank valves to prevent unauthorized use.

Costs

The cost is small to none compared to the benefits of conserving water.

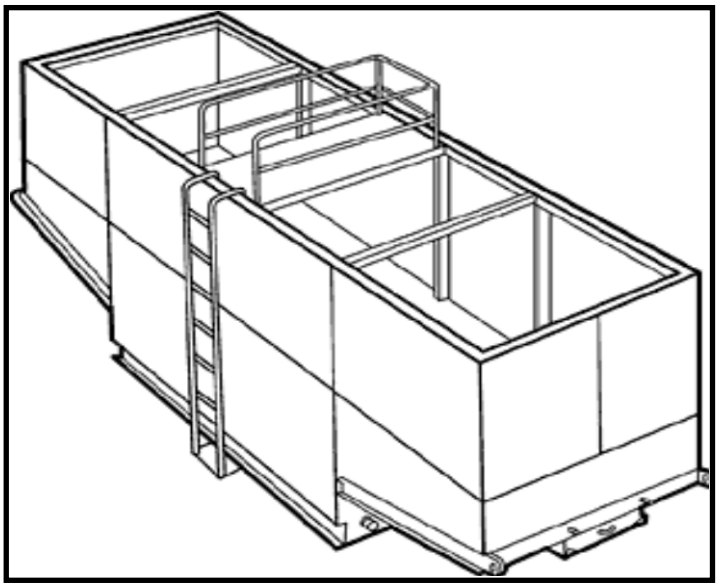
Inspection and Maintenance

- Inspect and verify that activity based BMPs are in place prior to the commencement of authorized non-stormwater discharges.
- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges are occuring.
- Repair water equipment as needed to prevent unintended discharges.
  - Water trucks
  - Water reservoirs (water buffalos)
  - Irrigation systems
  - Hydrant connections

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Dewatering Operations NS-2



Categories		
EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

SE-5: Fiber Roll

SE-6: Gravel Bag Berm

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Dewatering operations are practices that manage the discharge of pollutants when non-stormwater and accumulated precipitation (stormwater) must be removed from a work location to proceed with construction work or to provide vector control.

The General Permit incorporates Numeric Action Levels (NAL) for turbidity (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements).

Discharges from dewatering operations can contain high levels of fine sediment that, if not properly treated, could lead to exceedances of the General Permit requirements or Basin Plan standards.

The dewatering operations described in this fact sheet are not Active Treatment Systems (ATS) and do not include the use of chemical coagulations, chemical flocculation or electrocoagulation.

Suitable Applications

These practices are implemented for discharges of non-stormwater from construction sites. Non-stormwaters include, but are not limited to, groundwater, water from cofferdams, water diversions, and waters used during construction activities that must be removed from a work area to facilitate construction.

Practices identified in this section are also appropriate for implementation when managing the removal of accumulated

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

precipitation (stormwater) from depressed areas at a construction site.

Stormwater mixed with non-stormwater should be managed as non-stormwater.

Limitations

- Dewatering operations will require, and should comply with applicable local and project-specific permits and regulations. In some areas, all dewatering activities, regardless of the discharge volume, require a dewatering permit.
- Site conditions will dictate design and use of dewatering operations.
- The controls discussed in this fact sheet primarily address sediment. Other secondary pollutant removal benefits are discussed where applicable.
- The controls detailed in this fact sheet only allow for minimal settling time for sediment particles. Use only when site conditions restrict the use of the other control methods.
- Avoid dewatering discharges where possible by using the water for dust control.

Implementation

- A Construction Site Monitoring Plan (CSMP) should be included in the project Stormwater Pollution Prevention Plan (SWPPP).
- Regional Water Quality Control Board (RWQCB) Regions may require notification and approval prior to any discharge of water from construction sites.
- The destination of discharge from dewatering activities will typically determine the type of permit required for the discharge. For example, when discharging to a water of the U.S., a dewatering permit may be required through the site's governing RWQCB. When discharging to a sanitary sewer or Municipal Separate Storm Sewer System (MS4), a permit may need to be obtained from the owner of the sanitary sewer or MS4 in addition to obtaining an RWQCB dewatering permit. Additional permits or permissions from other agencies may be required for dewatering cofferdams or diversions.
- Dewatering discharges should not cause erosion at the discharge point. Appropriate BMPs should be implemented to maintain compliance with all applicable permits.
- Maintain dewatering records in accordance with all local and project-specific permits and regulations.

Sediment Treatment

A variety of methods can be used to treat water during dewatering operations. Several devices are presented below and provide options to achieve sediment removal. The sediment particle size and permit or receiving water limitations on sediment or turbidity are key considerations for selecting sediment treatment option(s); in some cases, the use of multiple devices may be appropriate. Use of other enhanced treatment methods (i.e., introduction of chemicals or electric current to enhance flocculation and removal of sediment) must comply with: 1) for storm drain or surface water discharges, the requirements for Active Treatment Systems (see SE-11); or 2) for sanitary sewer discharges, the requirements of applicable sanitary sewer discharge permits.

Sediment Basin (see also SE-2)

Description:

- A sediment basin is a temporary basin with a controlled release structure that is formed by excavation or construction of an embankment to detain sediment-laden runoff and allow sediment to settle out before discharging. Sediment basins are generally larger than Sediment Traps (SE-3) and have a designed outlet structure.

Appropriate Applications:

- Effective for the removal of trash, gravel, sand, silt, some metals that settle out with the sediment.

Implementation:

- Excavation and construction of related facilities is required.
- Temporary sediment basins should be fenced if safety is a concern.
- Outlet protection is required to prevent erosion at the outfall location.

Maintenance:

- Maintenance is required for safety fencing, vegetation, embankment, inlet and outlet, as well as other features.
- Removal of sediment is required when the storage volume is reduced by one-third.

Sediment Trap (See also SE-3)

Description:

- A sediment trap is a temporary basin formed by excavation and/or construction of an earthen embankment across a waterway or low drainage area to detain sediment-laden runoff and allow sediment to settle out before discharging. Sediment traps are generally smaller than Sediment Basins (SE-2) and do not have a designed outlet (but do have a spillway or overflow).

Appropriate Applications:

Effective for the removal of large and medium sized particles (sand and gravel) and some metals that settle out with the sediment.

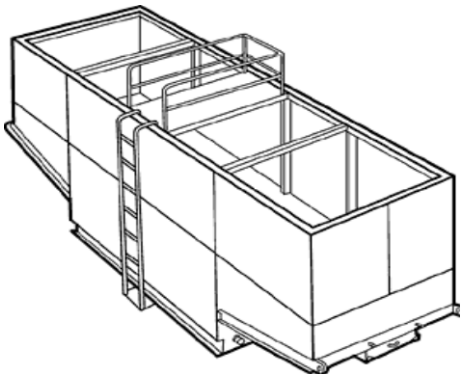
Implementation:

- Excavation and construction of related facilities is required.
- Trap inlets should be located to maximize the travel distance to the trap outlet.
- Use rock or vegetation to protect the trap outlets against erosion.

Maintenance:

- Maintenance is required for vegetation, embankment, inlet and outfall structures, as well as other features.
- Removal of sediment is required when the storage volume is reduced by one-third.

Weir Tanks



Description:

- A weir tank separates water and waste by using weirs. The configuration of the weirs (over and under weirs) maximizes the residence time in the tank and determines the waste to be removed from the water, such as oil, grease, and sediments.

Appropriate Applications:

- The tank removes trash, some settleable solids (gravel, sand, and silt), some visible oil and grease, and some metals (removed with sediment). To achieve high levels of flow, multiple tanks can be used in parallel. If additional treatment is desired, the tanks can be placed in series or as pre-treatment for other methods.

Implementation:

- Tanks are delivered to the site by the vendor, who can provide assistance with set-up and operation.
- Tank size will depend on flow volume, constituents of concern, and residency period required. Vendors should be consulted to appropriately size tank.
- Treatment capacity (i.e., volume and number of tanks) should provide at a minimum the required volume for discrete particle settling for treatment design flows.

Maintenance:

- Periodic cleaning is required based on visual inspection or reduced flow.
- Oil and grease disposal should be conducted by a licensed waste disposal company.

Dewatering Tanks



Description:

- A dewatering tank removes debris and sediment. Flow enters the tank through the top, passes through a fabric filter, and is discharged through the bottom of the tank. The filter separates the solids from the liquids.

Appropriate Applications:

- The tank removes trash, gravel, sand, and silt, some visible oil and grease, and some metals (removed with sediment). To achieve high levels of flow, multiple tanks can be used in parallel. If additional treatment is desired, the tanks can be placed in series or as pre-treatment for other methods.

Implementation:

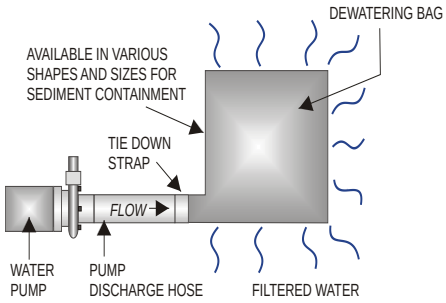
- Tanks are delivered to the site by the vendor, who can provide assistance with set-up and operation.
- Tank size will depend on flow volume, constituents of concern, and residency period required. Vendors should be consulted to appropriately size tank.

Maintenance:

- Periodic cleaning is required based on visual inspection or reduced flow.
- Oil and grease disposal should be conducted by licensed waste disposal company.

Gravity Bag Filter





Description:

- A gravity bag filter, also referred to as a dewatering bag, is a square or rectangular bag made of non-woven geotextile fabric that collects gravel, sand, silt, and fines.

Appropriate Applications:

- Effective for the removal of sediments (gravel, sand, silt, and fines). Some metals are removed with the sediment.

Implementation:

- Water is pumped into one side of the bag and seeps through the top, bottom, and sides of the bag.
- Place filter bag on pavement or a gravel bed or paved surface. Avoid placing a dewatering bag on unprotected bare soil. If placing the bag on bare soil is unavoidable, a secondary barrier should be used, such as a rock filter bed placed beneath and beyond the edges of the bag to, prevent erosion and capture sediments that escape the bag.
- Perimeter control around the downstream end of the bag should be implemented. Secondary sediment controls are important especially in the initial stages of discharge, which tend to allow fines to pass through the bag.

Maintenance:

- Inspection of the flow conditions, bag condition, bag capacity, and the secondary barrier (as applicable) is required.
- Replace the bag when it no longer filters sediment or passes water at a reasonable rate.
- Caution should be taken when removing and disposing of the bag, to prevent the release of captured sediment
- Properly dispose of the bag offsite. If sediment is removed from the bag prior to disposal (bags can potentially be reused depending upon their condition), dispose of sediment in accordance with the general maintenance procedures described at the end of this BMP Fact Sheet.

Sand Media Particulate Filter





Description:

- Water is treated by passing it through canisters filled with sand media. Generally, sand filters provide a final level of treatment. They are often used as a secondary or higher level of treatment after a significant amount of sediment and other pollutants have been removed using other methods.

Appropriate Applications:

- Effective for the removal of trash, gravel, sand, and silt and some metals, as well as the reduction of biochemical oxygen demand (BOD) and turbidity.
- Sand filters can be used for stand-alone treatment or in conjunction with bag and cartridge filtration if further treatment is required.
- Sand filters can also be used to provide additional treatment to water treated via settling or basic filtration.

Implementation:

- The filters require delivery to the site and initial set up. The vendor can provide assistance with installation and operation.

Maintenance:

- The filters require regular service to monitor and maintain the level of the sand media. If subjected to high loading rates, filters can plug quickly.
- Venders generally provide data on maximum head loss through the filter. The filter should be monitored daily while in use, and cleaned when head loss reaches target levels.
- If cleaned by backwashing, the backwash water may need to be hauled away for disposal, or returned to the upper end of the treatment train for another pass through the series of dewatering BMPs.

Pressurized Bag Filter





Description:

- A pressurized bag filter is a unit composed of single filter bags made from polyester felt material. The water filters through the unit and is discharged through a header. Vendors provide bag filters in a variety of configurations. Some units include a combination of bag filters and cartridge filters for enhanced contaminant removal.

Appropriate Applications:

- Effective for the removal of sediment (sand and silt) and some metals, as well as the reduction of BOD, turbidity, and hydrocarbons. Oil absorbent bags are available for hydrocarbon removal.

- Filters can be used to provide secondary treatment to water treated via settling or basic filtration.

Implementation:

- The filters require delivery to the site and initial set up. The vendor can provide assistance with installation and operation.

Maintenance:

- The filter bags require replacement when the pressure differential equals or exceeds the manufacturer's recommendation.

Cartridge Filter



Description:

- Cartridge filters provide a high degree of pollutant removal by utilizing a number of individual cartridges as part of a larger filtering unit. They are often used as a secondary or higher (polishing) level of treatment after a significant amount of sediment and other pollutants are removed. Units come with various cartridge configurations (for use in series with bag filters) or with a larger single cartridge filtration unit (with multiple filters within).

Appropriate Applications:

- Effective for the removal of sediment (sand, silt, and some clays) and metals, as well as the reduction of BOD, turbidity, and hydrocarbons. Hydrocarbons can effectively be removed with special resin cartridges.

- Filters can be used to provide secondary treatment to water treated via settling or basic filtration.

Implementation:

- The filters require delivery to the site and initial set up. The vendor can provide assistance.

Maintenance:

- The cartridges require replacement when the pressure differential equals or exceeds the manufacturer's recommendation.

Costs

- Sediment control costs vary considerably depending on the dewatering and sediment treatment system that is selected. Pressurized filters tend to be more expensive than gravity settling, but are often more effective. Simple tanks are generally rented on a long-term basis (one or more months) and can range from $360 per month for a 1,000 gallon tank to $2,660 per month for a 10,000 gallon tank. Mobilization and demobilization costs vary considerably.

Inspection and Maintenance

- Inspect and verify that dewatering BMPs are in place and functioning prior to the commencement of activities requiring dewatering.

- Inspect dewatering BMPs daily while dewatering activities are being conducted.

- Inspect all equipment before use. Monitor dewatering operations to ensure they do not cause offsite discharge or erosion.
- Sample dewatering discharges as required by the General Permit.
- Unit-specific maintenance requirements are included with the description of each unit.
- Sediment removed during the maintenance of a dewatering device may be either spread onsite and stabilized, or disposed of at a disposal site as approved by the owner.
- Sediment that is commingled with other pollutants should be disposed of in accordance with all applicable laws and regulations and as approved by the owner.

References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

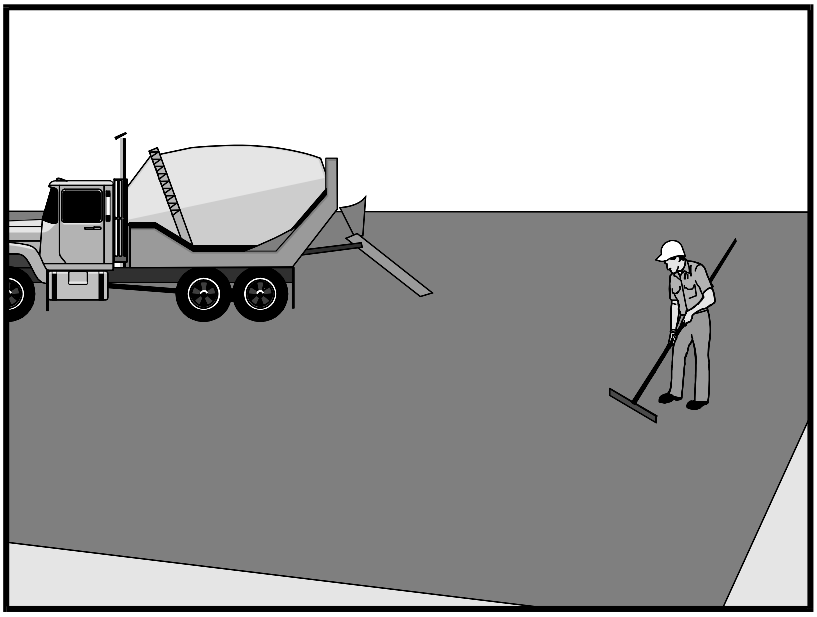
Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003; Updated March 2004.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Labor Surcharge & Equipment Rental Rates, April 1, 2002 through March 31, 2003, California Department of Transportation (Caltrans).

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Paving and Grinding Operations NS-3



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	☒

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Prevent or reduce the discharge of pollutants from paving operations, using measures to prevent runon and runoff pollution, properly disposing of wastes, and training employees and subcontractors.

The General Permit incorporates Numeric Action Levels (NAL) for pH and turbidity (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements).

Many types of construction materials associated with paving and grinding operations, including mortar, concrete, and cement and their associated wastes have basic chemical properties that can raise pH levels outside of the permitted range. Additional care should be taken when managing these materials to prevent them from coming into contact with stormwater flows, which could lead to exceedances of the General Permit requirements.

Suitable Applications

These procedures are implemented where paving, surfacing, resurfacing, or sawcutting, may pollute stormwater runoff or discharge to the storm drain system or watercourses.

Limitations

- Paving opportunities may be limited during wet weather.

  Discharges of freshly paved surfaces may raise pH to environmentally harmful levels and trigger permit violations.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Implementation

General

- Avoid paving during the wet season when feasible.
- Reschedule paving and grinding activities if rain is forecasted.
- Train employees and sub-contractors in pollution prevention and reduction.
- Store materials away from drainage courses to prevent stormwater runon (see WM-1, Material Delivery and Storage).
- Protect drainage courses, particularly in areas with a grade, by employing BMPs to divert runoff or to trap and filter sediment.
- Stockpile material removed from roadways away from drain inlets, drainage ditches, and watercourses. These materials should be stored consistent with WM-3, Stockpile Management.
- Disposal of PCC (Portland cement concrete) and AC (asphalt concrete) waste should be in conformance with WM-8, Concrete Waste Management.

Saw Cutting, Grinding, and Pavement Removal

- Shovel or vacuum saw-cut slurry and remove from site. Cover or barricade storm drains during saw cutting to contain slurry.
- When paving involves AC, the following steps should be implemented to prevent the discharge of grinding residue, uncompacted or loose AC, tack coats, equipment cleaners, or unrelated paving materials:
  - AC grindings, pieces, or chunks used in embankments or shoulder backing should not be allowed to enter any storm drains or watercourses. Install inlet protection and perimeter controls until area is stabilized (i.e. cutting, grinding or other removal activities are complete and loose material has been properly removed and disposed of)or permanent controls are in place. Examples of temporary perimeter controls can be found in EC-9, Earth Dikes and Drainage Swales; SE-1, Silt Fence; SE-5, Fiber Rolls, or SE-13 Compost Socks and Berms
  - Collect and remove all broken asphalt and recycle when practical. Old or spilled asphalt should be recycled or disposed of properly.
- Do not allow saw-cut slurry to enter storm drains or watercourses. Residue from grinding operations should be picked up by a vacuum attachment to the grinding machine, or by sweeping, should not be allowed to flow across the pavement, and should not be left on the surface of the pavement. See also WM-8, Concrete Waste Management, and WM-10, Liquid Waste Management.
- Pavement removal activities should not be conducted in the rain.
- Collect removed pavement material by mechanical or manual methods. This material may be recycled for use as shoulder backing or base material.

- If removed pavement material cannot be recycled, transport the material back to an approved storage site.

Asphaltic Concrete Paving

- If paving involves asphaltic cement concrete, follow these steps:

  - Do not allow sand or gravel placed over new asphalt to wash into storm drains, streets, or creeks. Vacuum or sweep loose sand and gravel and properly dispose of this waste by referring to WM-5, Solid Waste Management.

  - Old asphalt should be disposed of properly. Collect and remove all broken asphalt from the site and recycle whenever possible.

Portland Cement Concrete Paving

- Do not wash sweepings from exposed aggregate concrete into a storm drain system. Collect waste materials by dry methods, such as sweeping or shoveling, and return to aggregate base stockpile or dispose of properly. Allow aggregate rinse to settle. Then, either allow rinse water to dry in a temporary pit as described in WM-8, Concrete Waste Management, or pump the water to the sanitary sewer if authorized by the local wastewater authority.

Sealing Operations

- During chip seal application and sweeping operations, petroleum or petroleum covered aggregate should not be allowed to enter any storm drain or water courses. Apply temporary perimeter controls until structure is stabilized (i.e. all sealing operations are complete and cured and loose materials have been properly removed and disposed).

- Inlet protection (SE-10, Storm Drain Inlet Protection) should be used during application of seal coat, tack coat, slurry seal, and fog seal.

- Seal coat, tack coat, slurry seal, or fog seal should not be applied if rainfall is predicted to occur during the application or curing period.

Paving Equipment

- Leaks and spills from paving equipment can contain toxic levels of heavy metals and oil and grease. Place drip pans or absorbent materials under paving equipment when not in use. Clean up spills with absorbent materials and dispose of in accordance with the applicable regulations. See NS-10, Vehicle and Equipment Maintenance, WM-4, Spill Prevention and Control, and WM-10, Liquid Waste Management.

- Substances used to coat asphalt transport trucks and asphalt spreading equipment should not contain soap and should be non-foaming and non-toxic.

- Paving equipment parked onsite should be parked over plastic to prevent soil contamination.

- Clean asphalt coated equipment offsite whenever possible. When cleaning dry, hardened asphalt from equipment, manage hardened asphalt debris as described in WM-5, Solid Waste Management. Any cleaning onsite should follow NS-8, Vehicle and Equipment Cleaning.

Thermoplastic Striping

- Thermoplastic striper and pre-heater equipment shutoff valves should be inspected to ensure that they are working properly to prevent leaking thermoplastic from entering drain inlets, the stormwater drainage system, or watercourses.
- Pre-heaters should be filled carefully to prevent splashing or spilling of hot thermoplastic. Leave six inches of space at the top of the pre-heater container when filling thermoplastic to allow room for material to move.
- Do not pre-heat, transfer, or load thermoplastic near drain inlets or watercourses.
- Clean truck beds daily of loose debris and melted thermoplastic. When possible, recycle thermoplastic material.

Raised/Recessed Pavement Marker Application and Removal

- Do not transfer or load bituminous material near drain inlets, the stormwater drainage system, or watercourses.
- Melting tanks should be loaded with care and not filled to beyond six inches from the top to leave room for splashing.
- When servicing or filling melting tanks, ensure all pressure is released before removing lids to avoid spills.
- On large-scale projects, use mechanical or manual methods to collect excess bituminous material from the roadway after removal of markers.

Costs

- All of the above are low cost measures.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of paving and grinding operations.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Sample stormwater runoff required by the General Permit.
- Keep ample supplies of drip pans or absorbent materials onsite.
- Inspect and maintain machinery regularly to minimize leaks and drips.

References

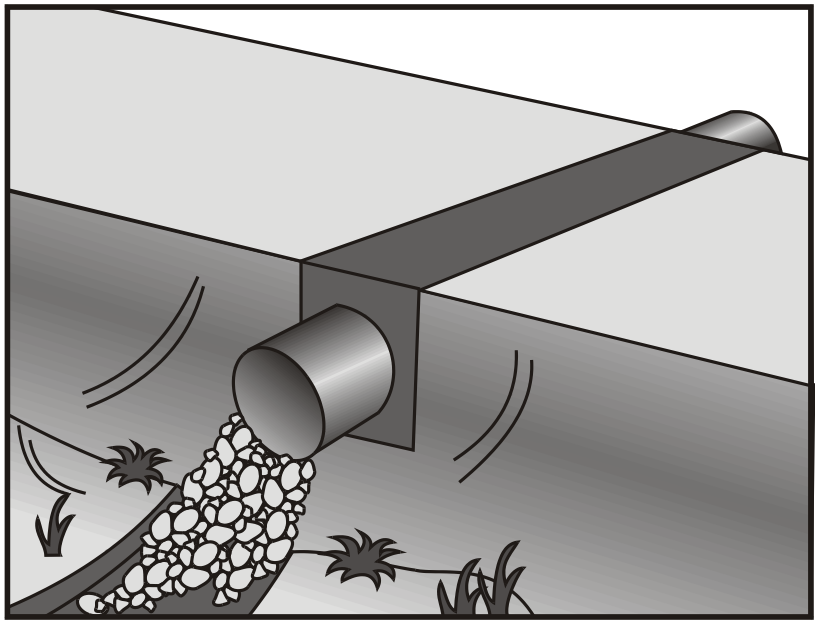
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Hot Mix Asphalt-Paving Handbook AC 150/5370-14, Appendix I, U.S. Army Corps of Engineers, July 1991.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Temporary Stream Crossing NS-4



Description and Purpose

A temporary stream crossing is a temporary culvert, ford or bridge placed across a waterway to provide access for construction purposes for a period of less than one year. Temporary access crossings are not intended to maintain traffic for the public. The temporary access will eliminate erosion and downstream sedimentation caused by vehicles.

Suitable Applications

Temporary stream crossings should be installed at all designated crossings of perennial and intermittent streams on the construction site, as well as for dry channels that may be significantly eroded by construction traffic.

Temporary streams crossings are installed at sites:

- Where appropriate permits have been secured (404 Permits, and 401 Certifications)
- Where construction equipment or vehicles need to frequently cross a waterway
- When alternate access routes impose significant constraints
- When crossing perennial streams or waterways causes significant erosion
- Where construction activities will not last longer than one year

Categories

EC	Erosion Control	☒
SE	Sediment Control	☒
TC	Tracking Control	☒
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Where appropriate permits have been obtained for the stream crossing

Limitations

The following limitations may apply:

- Installation and removal will usually disturb the waterway.
- Installation may require Regional Water Quality Control Board (RWQCB) 401 Certification, U.S. Army Corps of Engineers 404 permit and approval by California Department of Fish and Game. If numerical-based water quality standards are mentioned in any of these and other related permits, testing and sampling may be required.
- Installation may require dewatering or temporary diversion of the stream. See NS-2, Dewatering Operations and NS-5, Clear Water Diversion.
- Installation may cause a constriction in the waterway, which can obstruct flood flow and cause flow backups or washouts. If improperly designed, flow backups can increase the pollutant load through washouts and scouring.
- Use of natural or other gravel in the stream for construction of Cellular Confinement System (CCS) ford crossing will be contingent upon approval by fisheries agencies.
- Ford crossings may degrade water quality due to contact with vehicles and equipment.
- May be expensive for a temporary improvement.
- Requires other BMPs to minimize soil disturbance during installation and removal.
- Fords should only be used in dry weather.

Implementation

General

The purpose of this BMP is to provide a safe, erosion-free access across a stream for construction equipment. Minimum standards and specifications for the design, construction, maintenance, and removal of the structure should be established by an engineer registered in California. Temporary stream crossings may be necessary to prevent construction equipment from causing erosion of the stream and tracking sediment and other pollutants into the stream.

Temporary stream crossings are used as access points to construction sites when other detour routes may be too long or burdensome for the construction equipment. Often heavy construction equipment must cross streams or creeks, and detour routes may impose too many constraints such as being too narrow or poor soil strength for the equipment loadings. Additionally, the contractor may find a temporary stream crossing more economical for light–duty vehicles to use for frequent crossings, and may have less environmental impact than construction of a temporary access road.

Location of the temporary stream crossing should address:

- Site selection where erosion potential is low.

- Areas where the side slopes from site runoff will not spill into the side slopes of the crossing.

The following types of temporary stream crossings should be considered:

- **Culverts** – A temporary culvert is effective in controlling erosion but will cause erosion during installation and removal. A temporary culvert can be easily constructed and allows for heavy equipment loads.

- **Fords** - Appropriate during the dry season in arid areas. Used on dry washes and ephemeral streams, and low-flow perennial streams. CCS, a type of ford crossing, is also appropriate for use in streams that would benefit from an influx of gravels. A temporary ford provides little sediment and erosion control and is ineffective in controlling erosion in the stream channel. A temporary ford is the least expensive stream crossing and allows for maximum load limits. It also offers very low maintenance. Fords are more appropriate during the dry ice season and in arid areas of California.

- **Bridges** - Appropriate for streams with high flow velocities, steep gradients and where temporary restrictions in the channel are not allowed.

Design

During the long summer construction season in much of California, rainfall is infrequent and many streams are dry. Under these conditions, a temporary ford may be sufficient. A ford is not appropriate if construction will continue through the winter rainy season, if summer thunderstorms are likely, or if the stream flows during most of the year. Temporary culverts and bridges should then be considered and, if used, should be sized to pass a significant design storm (i.e., at least a 10-year storm). The temporary stream crossing should be protected against erosion, both to prevent excessive sedimentation in the stream and to prevent washout of the crossing.

Design and installation requires knowledge of stream flows and soil strength. Designs should be prepared under direction of, and approved by, a registered civil engineer and for bridges, a registered structural engineer. Both hydraulic and construction loading requirements should be considered with the following:

- Comply with any special requirements for culvert and bridge crossings, particularly if the temporary stream crossing will remain through the rainy season.

- Provide stability in the crossing and adjacent areas to withstand the design flow. The design flow and safety factor should be selected based on careful evaluation of the risks due to over topping, flow backups, or washout.

- Install sediment traps immediately downstream of crossings to capture sediments. See SE-3, Sediment Trap.

- Avoid oil or other potentially hazardous materials for surface treatment.

- Culverts are relatively easy to construct and able to support heavy equipment loads.

- Fords are the least expensive of the crossings, with maximum load limits.

- CCS crossing structures consist of clean, washed gravel and cellular confinement system blocks. CCS are appropriate for streams that would benefit from an influx of gravel; for example, salmonid streams, streams or rivers below reservoirs, and urban, channelized streams. Many urban stream systems are gravel-deprived due to human influences, such as dams, gravel mines, and concrete channels.
- CCS allow designers to use either angular or naturally occurring rounded gravel, because the cells provide the necessary structure and stability. In fact, natural gravel is optimal for this technique, because of the habitat improvement it will provide after removal of the CCS.
- A gravel depth of 6 to 12 in. for a CCS structure is sufficient to support most construction equipment.
- An advantage of a CCS crossing structure is that relatively little rock or gravel is needed, because the CCS provides the stability.
- Bridges are generally more expensive to design and construct, but provide the least disturbance of the streambed and constriction of the waterway flows.

Construction and Use

- Stabilize construction roadways, adjacent work area, and stream bottom against erosion.
- Construct during dry periods to minimize stream disturbance and reduce costs.
- Construct at or near the natural elevation of the streambed to prevent potential flooding upstream of the crossing.
- Install temporary erosion control BMPs in accordance with erosion control BMP fact sheets to minimize erosion of embankment into flow lines.
- Any temporary artificial obstruction placed within flowing water should only be built from material, such as clean gravel or sandbags, that will not introduce sediment or silt into the watercourse.
- Temporary water body crossings and encroachments should be constructed to minimize scour. Cobbles used for temporary water body crossings or encroachments should be clean, rounded river cobble.
- Vehicles and equipment should not be driven, operated, fueled, cleaned, maintained, or stored in the wet or dry portions of a water body where wetland vegetation, riparian vegetation, or aquatic organisms may be destroyed.
- The exterior of vehicles and equipment that will encroach on the water body within the project should be maintained free of grease, oil, fuel, and residues.
- Drip pans should be placed under all vehicles and equipment placed on docks, barges, or other structures over water bodies when the vehicle or equipment is planned to be idle for more than one hour.

- Disturbance or removal of vegetation should not exceed the minimum necessary to complete operations. Precautions should be taken to avoid damage to vegetation by people or equipment. Disturbed vegetation should be replaced with the appropriate soil stabilization measures.

- Riparian vegetation, when removed pursuant to the provisions of the work, should be cut off no lower than ground level to promote rapid re-growth. Access roads and work areas built over riparian vegetation should be covered by a sufficient layer of clean river run cobble to prevent damage to the underlying soil and root structure. The cobble must be removed upon completion of project activities.

- Conceptual temporary stream crossings are shown in the attached figures.

Costs

Caltrans Construction Cost index for temporary bridge crossings is $45-$95/ft^2.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Check for blockage in the channel, sediment buildup or trapped debris in culverts, blockage behind fords or under bridges.

- Check for erosion of abutments, channel scour, riprap displacement, or piping in the soil.

- Check for structural weakening of the temporary crossings, such as cracks, and undermining of foundations and abutments.

- Remove sediment that collects behind fords, in culverts, and under bridges periodically.

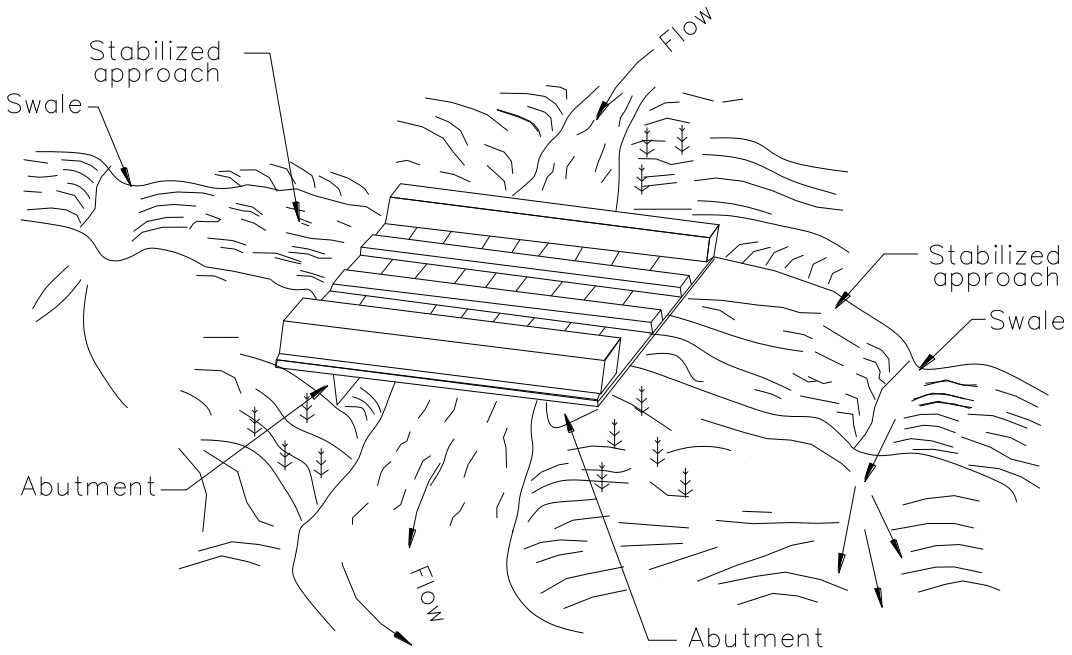
- Replace lost or displaced aggregate from inlets and outlets of culverts and cellular confinement systems.

- Remove temporary crossing promptly when it is no longer needed.

References

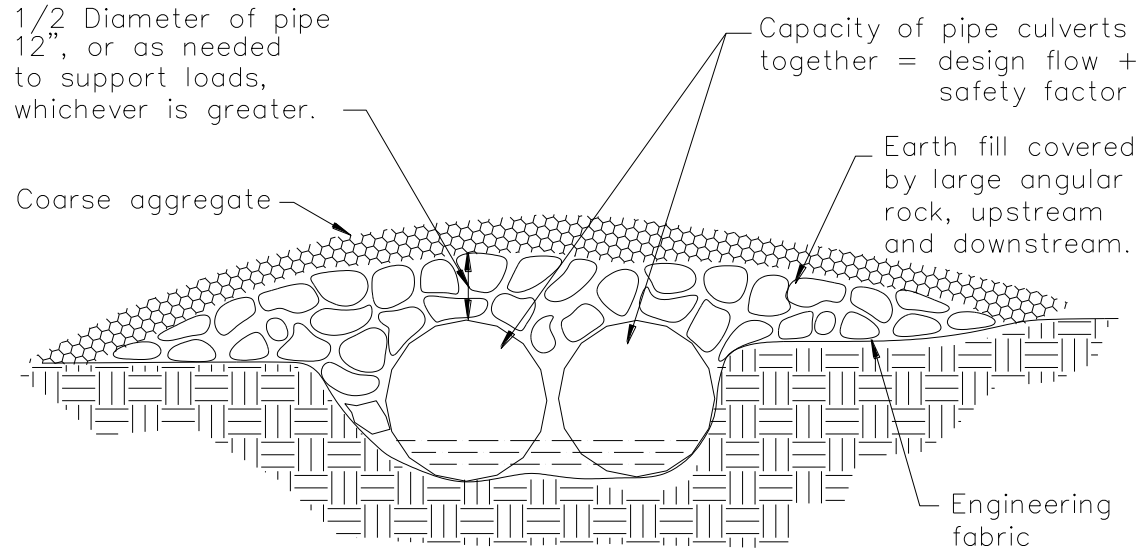
California Bank and Shore Rock Slope Protection Design – Practitioners Guide and Field Evaluations of Riprap Methods, Caltrans Study No. F90TL03, October 2000.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

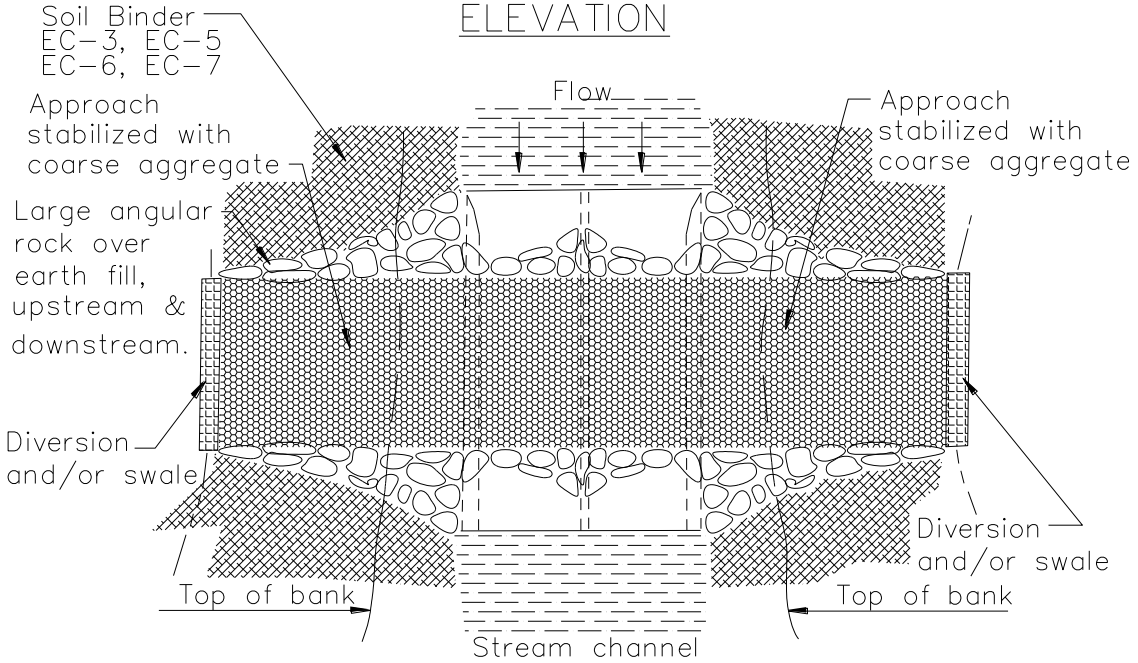


NOTE:
Surface flow of road diverted by swale and/or dike.

TYPICAL BRIDGE CROSSING
NOT TO SCALE

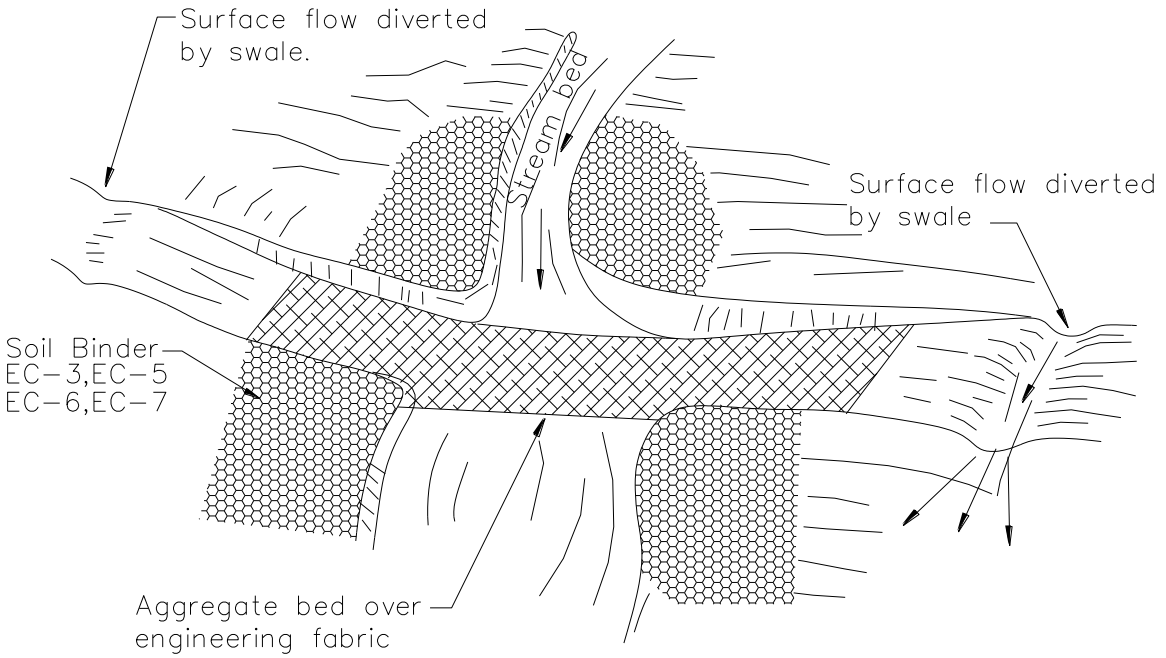


ELEVATION

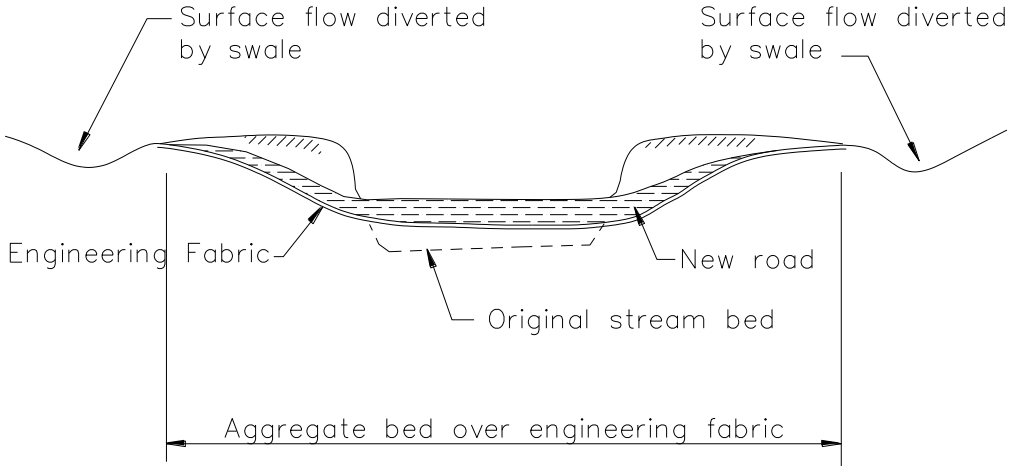


PLAN VIEW

TYPICAL CULVERT CROSSING
NOT TO SCALE

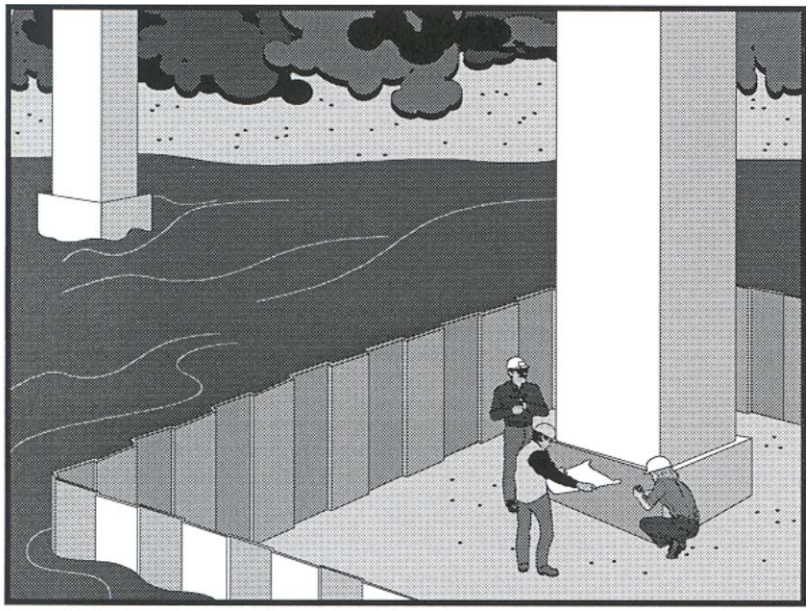


Aggregate approch
1:5 (V:H) Maximum slope on road



TYPICAL FORD CROSSING
NOT TO SCALE

Clear Water Diversion NS-5



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Objective**
☒ **Secondary Objective**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Clear water diversion consists of a system of structures and measures that intercept clear surface water runoff upstream of a project, transport it around the work area, and discharge it downstream with minimal water quality degradation from either the project construction operations or the construction of the diversion. Clear water diversions are used in a waterway to enclose a construction area and reduce sediment pollution from construction work occurring in or adjacent to water. Structures commonly used as part of this system include diversion ditches, berms, dikes, slope drains, rock, gravel bags, wood, aqua barriers, cofferdams, filter fabric or turbidity curtains, drainage and interceptor swales, pipes, or flumes.

Suitable Applications

A clear water diversion is typically implemented where appropriate permits (1601 Agreement) have been secured and work must be performed in a flowing stream or water body.

- Clear water diversions are appropriate for isolating construction activities occurring within or near a water body such as streambank stabilization, or culvert, bridge, pier or abutment installation. They may also be used in combination with other methods, such as clear water bypasses and/or pumps.
- Pumped diversions are suitable for intermittent and low flow streams.
- Excavation of a temporary bypass channel, or passing the flow through a heavy pipe (called a “flume”) with a trench

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

excavated under it, is appropriate for the diversion of streams less than 20 ft wide, with flow rates less than 100 cfs.

- Clear water diversions incorporating clean washed gravel may be appropriate for use in salmonid spawning streams.

Limitations

- Diversion and encroachment activities will usually disturb the waterway during installation and removal of diversion structures.
- Installation may require Regional Water Quality Control Board (RWQCB) 401 Certification, U.S. Army Corps of Engineers 404 permit and approval by California Department of Fish and Game. If numerical-based water quality standards are mentioned in any of these and other related permits, testing and sampling may be required.
- Diversion and encroachment activities may constrict the waterway, which can obstruct flood flows and cause flooding or washouts. Diversion structures should not be installed without identifying potential impacts to the stream channel.
- Diversion or isolation activities are not appropriate in channels where there is insufficient stream flow to support aquatic species in the area dewatered as a result of the diversion.
- Diversion or isolation activities are inappropriate in deep water unless designed or reviewed by an engineer registered in California.
- Diversion or isolation activities should not completely dam stream flow.
- Dewatering and removal may require additional sediment control or water treatment. See NS-2, Dewatering Operations.
- Not appropriate if installation, maintenance, and removal of the structures will disturb sensitive aquatic species of concern.

Implementation

General

- Implement guidelines presented in EC-12, Streambank Stabilization to minimize impacts to streambanks.
- Where working areas encroach on flowing streams, barriers adequate to prevent the flow of muddy water into streams should be constructed and maintained between working areas and streams. During construction of the barriers, muddying of streams should be held to a minimum.
- Diversion structures must be adequately designed to accommodate fluctuations in water depth or flow volume due to tides, storms, flash floods, etc.
- Heavy equipment driven in wet portions of a water body to accomplish work should be completely clean of petroleum residue, and water levels should be below the fuel tanks, gearboxes, and axles of the equipment unless lubricants and fuels are sealed such that inundation by water will not result in discharges of fuels, oils, greases, or hydraulic fluids.

- Excavation equipment buckets may reach out into the water for the purpose of removing or placing fill materials. Only the bucket of the crane/ excavator/backhoe may operate in a water body. The main body of the crane/excavator/backhoe should not enter the water body except as necessary to cross the stream to access the work site.
- Stationary equipment such as motors and pumps located within or adjacent to a water body, should be positioned over drip pans.
- When any artificial obstruction is being constructed, maintained, or placed in operation, sufficient water should, at all times, be allowed to pass downstream to maintain aquatic life.
- Equipment should not be parked below the high water mark unless allowed by a permit.
- Disturbance or removal of vegetation should not exceed the minimum necessary to complete operations. Precautions should be taken to avoid damage to vegetation by people or equipment. Disturbed vegetation should be replaced with the appropriate erosion control measures.
- Riparian vegetation approved for trimming as part of the project should be cut off no lower than ground level to promote rapid re-growth. Access roads and work areas built over riparian vegetation should be covered by a sufficient layer of clean river run cobble to prevent damage to the underlying soil and root structure. The cobble should be removed upon completion of project activities.
- Drip pans should be placed under all vehicles and equipment placed on docks, barges, or other structures over water bodies when the vehicle or equipment is planned to be idle for more than 1 hour.
- Where possible, avoid or minimize diversion and encroachment impacts by scheduling construction during periods of low flow or when the stream is dry. Scheduling should also consider seasonal releases of water from dams, fish migration and spawning seasons, and water demands due to crop irrigation.
- Construct diversion structures with materials free of potential pollutants such as soil, silt, sand, clay, grease, or oil.

Temporary Diversions and Encroachments

- Construct diversion channels in accordance with EC-9, Earth Dikes and Drainage Swales.
- In high flow velocity areas, stabilize slopes of embankments and diversion ditches using an appropriate liner, in accordance with EC-7, Geotextiles and Mats, or use rock slope protection.
- Where appropriate, use natural streambed materials such as large cobbles and boulders for temporary embankment and slope protection, or other temporary soil stabilization methods.
- Provide for velocity dissipation at transitions in the diversion, such as the point where the stream is diverted to the channel and the point where the diverted stream is returned to its natural channel. See also EC-10, Velocity Dissipation Devices.

Temporary Dry Construction Areas

- When dewatering behind temporary structures to create a temporary dry construction area, such as cofferdams, pass pumped water through a sediment-settling device, such as a portable tank or settling basin, before returning water to the water body. See also NS-2, Dewatering Operations.

- Any substance used to assemble or maintain diversion structures, such as form oil, should be non-toxic and non-hazardous.

- Any material used to minimize seepage underneath diversion structures, such as grout, should be non-toxic, non-hazardous, and as close to a neutral pH as possible.

Comparison of Diversion and Isolation Techniques:

- Gravel bags are relatively inexpensive, but installation and removal can be labor intensive. It is also difficult to dewater the isolated area. Sandbags should not be used for this technique in rivers or streams, as sand should never be put into or adjacent to a stream, even if encapsulated in geotextile.

- Gravel Bag Berms (SE-6) used in conjunction with an impermeable membrane are cost effective, and can be dewatered relatively easily. If spawning gravel is used, the impermeable membrane can be removed from the stream, and the gravel can be spread out and left as salmonid spawning habitat if approved in the permit. Only clean, washed gravel should be used for both the gravel bag and gravel berm techniques.

- Cofferdams are relatively expensive, but frequently allow full dewatering. Also, many options now available are relatively easy to install.

- Sheet pile enclosures are a much more expensive solution, but do allow full dewatering. This technique is not well suited to small streams, but can be effective on large rivers or lakes, and where staging and heavy equipment access areas are available.

- K-rails are an isolation method that does not allow full dewatering, but can be used in small to large watercourses, and in fast-water situations.

- A relatively inexpensive isolation method is filter fabric isolation. This method involves placement of gravel bags or continuous berms to 'key-in' the fabric, and subsequently staking the fabric in place. This method should be used in relatively calm water, and can be used in smaller streams. Note that this is not a dewatering method, but rather a sediment isolation method.

- Turbidity curtains should be used where sediment discharge to a stream is unavoidable. They can also be used for in-stream construction, when dewatering an area is not required.

- When used in watercourses or streams, cofferdams must be used in accordance with permit requirements.

- Manufactured diversion structures should be installed following manufacturer's specifications.

- Filter fabric and turbidity curtain isolation installation methods can be found in the specific technique descriptions that follow.

Filter Fabric Isolation Technique

Definition and Purpose

A filter fabric isolation structure is a temporary structure built into a waterway to enclose a construction area and reduce sediment pollution from construction work in or adjacent to water. This structure is composed of filter fabric, gravel bags, and steel t-posts.

Appropriate Applications

- Filter fabric may be used for construction activities such as streambank stabilization, or culvert, bridge, pier or abutment installation. It may also be used in combination with other methods, such as clean water bypasses and/or pumps.
- Filter fabric isolation is relatively inexpensive. This method involves placement of gravel bags or continuous berms to 'key-in' the fabric, and subsequently staking the fabric in place.
- If spawning gravel is used, all other components of the isolation can be removed from the stream, and the gravel may be spread out and left as salmonid spawning habitat if approved in the permit. Whether spawning gravel or other types of gravel are used, only clean washed gravel should be used as infill for the gravel bags or continuous berm.
- This method should be used in relatively calm water, and can be used in smaller streams. This is not a dewatering method, but rather a sediment isolation method.
- Water levels inside and outside the fabric curtain must be about the same, as differential heads will cause the curtain to collapse.

Limitations

- Do not use if the installation, maintenance and removal of the structures will disturb sensitive aquatic species of concern.
- Filter fabrics are not appropriate for projects where dewatering is necessary.
- Filter fabrics are not appropriate to completely dam stream flow.

Design and Installation

- For the filter fabric isolation method, a non-woven or heavy-duty fabric is recommended over standard silt fence. Using rolled geotextiles allows non-standard widths to be used.
- Anchor filter fabric with gravel bags filled with clean, washed gravel. Do not use sand. If a bag should split open, the gravel can be left in the stream, where it can provide aquatic habitat benefits. If a sandbag splits open in a watercourse, the sand could cause a decrease in water quality, and could bury sensitive aquatic habitat.
- Another anchor alternative is a continuous berm, made with the Continuous Berm Machine. This is a gravel-filled bag that can be made in very long segments. The length of the berms is usually limited to 18 ft for ease of handling (otherwise, it gets too heavy to move).

- Place the fabric on the bottom of the stream, and place either a bag of clean, washed gravel or a continuous berm over the bottom of the silt fence fabric, such that a bag-width of fabric lies on the stream bottom. The bag should be placed on what will be the outside of the isolation area.
- Pull the fabric up, and place a metal t-post immediately behind the fabric, on the inside of the isolation area; attach the silt fence to the post with three diagonal nylon ties.
- Continue placing fabric as described above until the entire work area has been isolated, staking the fabric at least every 6 ft.

Inspection and Maintenance

- Immediately repair any gaps, holes or scour.
- Remove and properly dispose of sediment buildup.
- Remove BMP upon completion of construction activity. Recycle or reuse if applicable.
- Revegetate areas disturbed by BMP removal if needed.

Turbidity Curtain Isolation Technique

Definition and Purpose

A turbidity curtain is a fabric barrier used to isolate the near shore work area. The barriers are intended to confine the suspended sediment. The curtain is a floating barrier, and thus does not prevent water from entering the isolated area; rather, it prevents suspended sediment from getting out.

Appropriate Applications

Turbidity curtains should be used where sediment discharge to a stream is unavoidable. They are used when construction activities adjoin quiescent waters, such as lakes, ponds, and slow flowing rivers. The curtains are designed to deflect and contain sediment within a limited area and provide sufficient retention time so that the sediment particles will fall out of suspension.

Limitations

- Turbidity curtains should not be used in flowing water; they are best suited for use in ponds, lakes, and very slow-moving rivers.
- Turbidity curtains should not be placed across the width of a channel.
- Removing sediment that has been deflected and settled out by the curtain may create a discharge problem through the resuspension of particles and by accidental dumping by the removal equipment.

Design and Installation

- Turbidity curtains should be oriented parallel to the direction of flow.
- The curtain should extend the entire depth of the watercourse in calm-water situations.
- In wave conditions, the curtain should extend to within 1 ft of the bottom of the watercourse, such that the curtain does not stir up sediment by hitting the bottom repeatedly. If it is

desirable for the curtain to reach the bottom in an active-water situation, a pervious filter fabric may be used for the bottom 1 ft.

- The top of the curtain should consist of flexible flotation buoys, and the bottom should be held down by a load line incorporated into the curtain fabric. The fabric should be a brightly colored impervious mesh.
- The curtain should be held in place by anchors placed at least every 100 ft.
- First, place the anchors, then tow the fabric out in a furled condition, and connect to the anchors. The anchors should be connected to the flotation devices, and not to the bottom of the curtain. Once in place, cut the furling lines, and allow the bottom of the curtain to sink.
- Consideration must be given to the probable outcome of the removal procedure. It must be determined if it will create more of a sediment problem through re-suspension of the particles or by accidental dumping of material during removal. It is recommended that the soil particles trapped by the turbidity curtain only be removed if there has been a significant change in the original contours of the affected area in the watercourse.
- Particles should always be allowed to settle for a minimum of 6 to 12 hours prior to their removal or prior to removal of the turbidity curtain.

Maintenance and Inspection:

- The curtain should be inspected for holes or other problems, and any repairs needed should be made promptly.
- Allow sediment to settle for 6 to 12 hours prior to removal of sediment or curtain. This means that after removing sediment, wait an additional 6 to 12 hours before removing the curtain.
- To remove, install furling lines along the curtain, detach from anchors, and tow out of the water.

K-rail River Isolation

Definition and Purpose

This temporary sediment control or stream isolation method uses K-rails to form the sediment deposition area, or to isolate the in-stream or near-bank construction area.

Barriers are placed end-to-end in a pre-designed configuration and gravel-filled bags are used at the toe of the barrier and at their abutting ends to seal and prevent movement of sediment beneath or through the barrier walls.

Appropriate Applications

The K-rail isolation can be used in streams with higher water velocities than many other isolation techniques.

- This technique is also useful at the toe of embankments, and cut or fill slopes.

Limitations

- The K-rail method should not be used to dewater a project site, as the barrier is not watertight.

Design and Installation

- To create a floor for the K-rail, move large rocks and obstructions. Place washed gravel and gravel-filled bags to create a level surface for K-rails to sit. Washed gravel should always be used.
- Place the bottom two K-rails adjacent to each other, and parallel to the direction of flow; fill the center portion with gravel bags. Then place the third K-rail on top of the bottom two. There should be sufficient gravel bags between the bottom K-rails such that the top rail is supported by the gravel. Place plastic sheeting around the K-rails, and secure at the bottom with gravel bags.
- Further support can be added by pinning and cabling the K-rails together. Also, large riprap and boulders can be used to support either side of the K-rail, especially where there is strong current.

Inspection and Maintenance:

- The barrier should be inspected and any leaks, holes, or other problems should be addressed immediately.
- Sediment should be allowed to settle for at least 6 to 12 hours prior to removal of sediment, and for 6 to 12 hours prior to removal of the barrier.

Stream Diversions

The selection of which stream diversion technique to use will depend upon the type of work involved, physical characteristics of the site, and the volume of water flowing through the project.

Advantages of a Pumped Diversion

- Downstream sediment transport can be nearly eliminated.
- Dewatering of the work area is possible.
- Pipes can be moved around to allow construction operations.
- The dams can serve as temporary access to the site.
- Increased flows can be managed by adding more pumping capacity.

Disadvantages of a Pumped Diversion

- Flow volume is limited by pump capacity.
- A pumped diversion requires 24 hour monitoring of pumps.
- Sudden rain could overtop dams.
- Erosion at the outlet.

- Minor in-stream disturbance is required to install and remove dams.

Advantages of Excavated Channels and Flumes

- Excavated channels isolate work from water flow and allow dewatering.
- Excavated channels can handle larger flows than pumps.

Disadvantages of Excavated Channels and Flumes

- Bypass channel or flume must be sized to handle flows, including possible floods.
- Channels must be protected from erosion.
- Flow diversion and re-direction with small dams involves in-stream disturbance and mobilization of sediment.

Design and Installation

- Installation guidelines will vary based on existing site conditions and type of diversion used.
- Pump capacity must be sufficient for design flow.
- A standby pump is required in case a primary pump fails.
- Dam materials used to create dams upstream and downstream of diversion should be erosion resistant; materials such as steel plate, sheet pile, sandbags, continuous berms, inflatable water bladders, etc., would be acceptable.

When constructing a diversion channel, begin excavation of the channel at the proposed downstream end, and work upstream. Once the watercourse to be diverted is reached and the excavated channel is stable, breach the upstream end and allow water to flow down the new channel. Once flow has been established in the diversion channel, install the diversion weir in the main channel; this will force all water to be diverted from the main channel.

Inspection and Maintenance

- Pumped diversions require 24 hour monitoring of pumps.
- Inspect embankments and diversion channels for damage to the linings, accumulating debris, sediment buildup, and adequacy of the slope protection. Remove debris and repair linings and slope protection as required. Remove holes, gaps, or scour.
- Upon completion of work, the diversion or isolation structure should be removed and flow should be redirected through the new culvert or back into the original stream channel. Recycle or reuse if applicable.
- Revegetate areas disturbed by BMP removal if needed.

Costs

Costs of clear water diversion vary considerably and can be very high.

Inspection and Maintenance

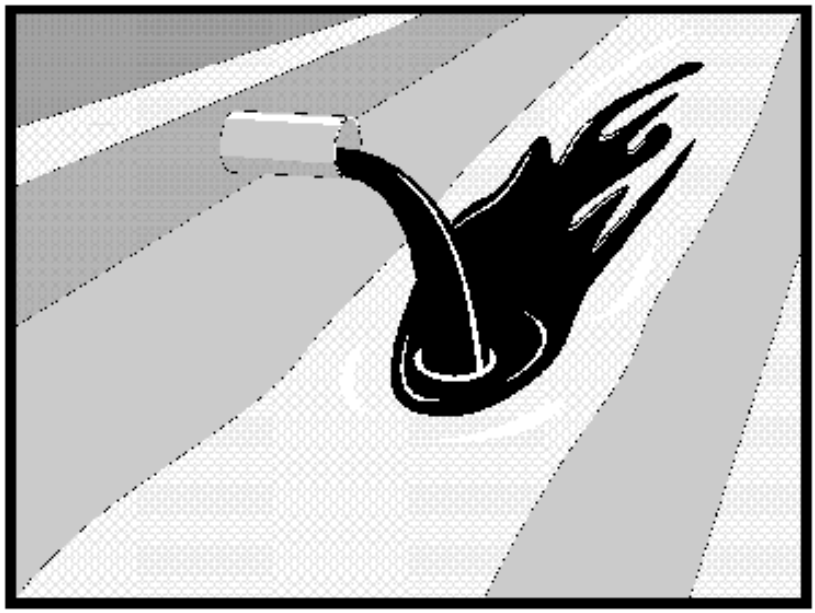
- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Refer to BMP-specific inspection and maintenance requirements.

References

California Bank and Shore Rock Slope Protection Design – Practitioners Guide and Field Evaluations of Riprap Methods, Caltrans Study No. F90TL03, October, 2000.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Illicit Connection / Discharge NS-6



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Procedures and practices designed for construction contractors to recognize illicit connections or illegally dumped or discharged materials on a construction site and report incidents.

Suitable Applications

This best management practice (BMP) applies to all construction projects. Illicit connection/discharge and reporting is applicable anytime an illicit connection or discharge is discovered or illegally dumped material is found on the construction site.

Limitations

Illicit connections and illegal discharges or dumping, for the purposes of this BMP, refer to discharges and dumping caused by parties other than the contractor. If pre-existing hazardous materials or wastes are known to exist onsite, they should be identified in the SWPPP and handled as set forth in the SWPPP.

Implementation

Planning

- Review the SWPPP. Pre-existing areas of contamination should be identified and documented in the SWPPP.
- Inspect site before beginning the job for evidence of illicit connections, illegal dumping or discharges. Document any pre-existing conditions and notify the owner.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Inspect site regularly during project execution for evidence of illicit connections, illegal dumping or discharges.
- Observe site perimeter for evidence for potential of illicitly discharged or illegally dumped material, which may enter the job site.

Identification of Illicit Connections and Illegal Dumping or Discharges

- **General –** unlabeled and unidentifiable material should be treated as hazardous.
- **Solids** - Look for debris, or rubbish piles. Solid waste dumping often occurs on roadways with light traffic loads or in areas not easily visible from the traveled way.
- **Liquids** - signs of illegal liquid dumping or discharge can include:
  - Visible signs of staining or unusual colors to the pavement or surrounding adjacent soils
  - Pungent odors coming from the drainage systems
  - Discoloration or oily substances in the water or stains and residues detained within ditches, channels or drain boxes
  - Abnormal water flow during the dry weather season
- **Urban Areas** - Evidence of illicit connections or illegal discharges is typically detected at storm drain outfall locations or at manholes. Signs of an illicit connection or illegal discharge can include:
  - Abnormal water flow during the dry weather season
  - Unusual flows in sub drain systems used for dewatering
  - Pungent odors coming from the drainage systems
  - Discoloration or oily substances in the water or stains and residues detained within ditches, channels or drain boxes
  - Excessive sediment deposits, particularly adjacent to or near active offsite construction projects
- **Rural Areas** - Illicit connections or illegal discharges involving irrigation drainage ditches are detected by visual inspections. Signs of an illicit discharge can include:
  - Abnormal water flow during the non-irrigation season
  - Non-standard junction structures
  - Broken concrete or other disturbances at or near junction structures

Reporting

Notify the owner of any illicit connections and illegal dumping or discharge incidents at the time of discovery. For illicit connections or discharges to the storm drain system, notify the local stormwater management agency. For illegal dumping, notify the local law enforcement agency.

Cleanup and Removal

The responsibility for cleanup and removal of illicit or illegal dumping or discharges will vary by location. Contact the local stormwater management agency for further information.

Costs

Costs to look for and report illicit connections and illegal discharges and dumping are low. The best way to avoid costs associated with illicit connections and illegal discharges and dumping is to keep the project perimeters secure to prevent access to the site, to observe the site for vehicles that should not be there, and to document any waste or hazardous materials that exist onsite before taking possession of the site.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect the site regularly to check for any illegal dumping or discharge.
- Prohibit employees and subcontractors from disposing of non-job related debris or materials at the construction site.
- Notify the owner of any illicit connections and illegal dumping or discharge incidents at the time of discovery.

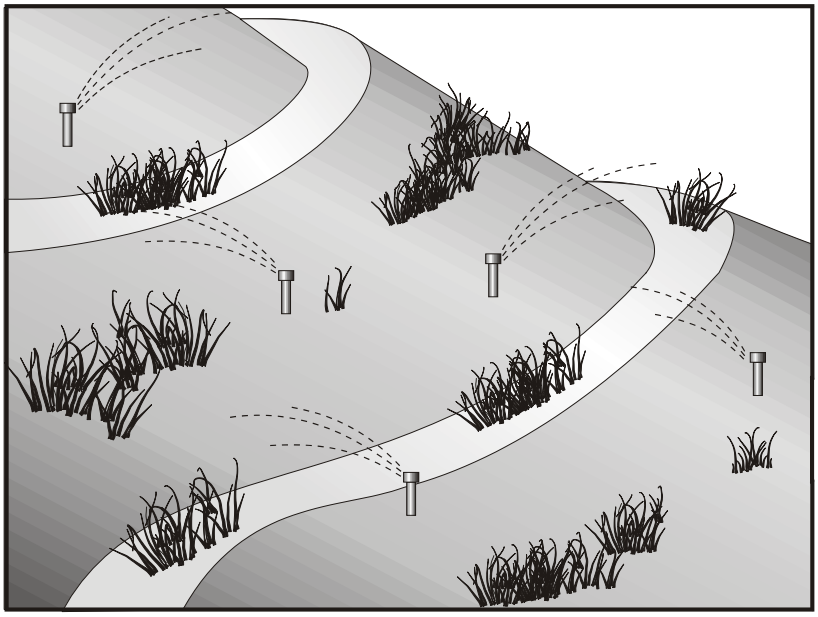
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Potable Water / Irrigation NS-7



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	
Metals	☑
Bacteria	
Oil and Grease	
Organics	☑

Potential Alternatives

None

Description and Purpose

Potable Water/Irrigation consists of practices and procedures to manage the discharge of potential pollutants generated during discharges from irrigation water lines, landscape irrigation, lawn or garden watering, planned and unplanned discharges from potable water sources, water line flushing, and hydrant flushing.

Suitable Applications

Implement this BMP whenever potable water or irrigation water discharges occur at or enter a construction site.

Limitations

None identified.

Implementation

- Direct water from offsite sources around or through a construction site, where feasible, in a way that minimizes contact with the construction site.
- Discharges from water line flushing should be reused for landscaping purposes where feasible.
- Shut off the water source to broken lines, sprinklers, or valves as soon as possible to prevent excess water flow.
- Protect downstream stormwater drainage systems and watercourses from water pumped or bailed from trenches excavated to repair water lines.

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Inspect irrigated areas within the construction limits for excess watering. Adjust watering times and schedules to ensure that the appropriate amount of water is being used and to minimize runoff. Consider factors such as soil structure, grade, time of year, and type of plant material in determining the proper amounts of water for a specific area.

Costs

Cost to manage potable water and irrigation are low and generally considered to be a normal part of related activities.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events..
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Repair broken water lines as soon as possible.
- Inspect irrigated areas regularly for signs of erosion and/or discharge.

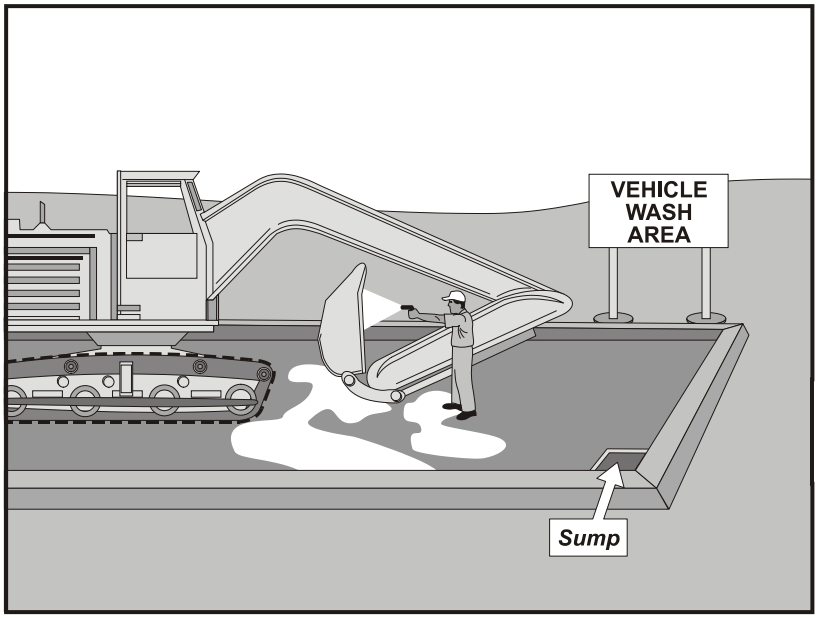
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Vehicle and Equipment Cleaning NS-8



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	
Metals	
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Vehicle and equipment cleaning procedures and practices eliminate or reduce the discharge of pollutants to stormwater from vehicle and equipment cleaning operations. Procedures and practices include but are not limited to: using offsite facilities; washing in designated, contained areas only; eliminating discharges to the storm drain by infiltrating the wash water; and training employees and subcontractors in proper cleaning procedures.

Suitable Applications

These procedures are suitable on all construction sites where vehicle and equipment cleaning is performed.

Limitations

Even phosphate-free, biodegradable soaps have been shown to be toxic to fish before the soap degrades. Sending vehicles/equipment offsite should be done in conjunction with TC-1, Stabilized Construction Entrance/Exit.

Implementation

Other options to washing equipment onsite include contracting with either an offsite or mobile commercial washing business. These businesses may be better equipped to handle and dispose of the wash waters properly. Performing this work offsite can also be economical by eliminating the need for a separate washing operation onsite.

If washing operations are to take place onsite, then:

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Use phosphate-free, biodegradable soaps.
- Educate employees and subcontractors on pollution prevention measures.
- Do not permit steam cleaning onsite. Steam cleaning can generate significant pollutant concentrates.
- Cleaning of vehicles and equipment with soap, solvents or steam should not occur on the project site unless resulting wastes are fully contained and disposed of. Resulting wastes should not be discharged or buried, and must be captured and recycled or disposed according to the requirements of WM-10, Liquid Waste Management or WM-6, Hazardous Waste Management, depending on the waste characteristics. Minimize use of solvents. Use of diesel for vehicle and equipment cleaning is prohibited.
- All vehicles and equipment that regularly enter and leave the construction site must be cleaned offsite.
- When vehicle and equipment washing and cleaning must occur onsite, and the operation cannot be located within a structure or building equipped with appropriate disposal facilities, the outside cleaning area should have the following characteristics:
  - Located away from storm drain inlets, drainage facilities, or watercourses
  - Paved with concrete or asphalt and bermed to contain wash waters and to prevent runon and runoff
  - Configured with a sump to allow collection and disposal of wash water
  - No discharge of wash waters to storm drains or watercourses
  - Used only when necessary
- When cleaning vehicles and equipment with water:
  - Use as little water as possible. High-pressure sprayers may use less water than a hose and should be considered
  - Use positive shutoff valve to minimize water usage
  - Facility wash racks should discharge to a sanitary sewer, recycle system or other approved discharge system and must not discharge to the storm drainage system, watercourses, or to groundwater

Costs

Cleaning vehicles and equipment at an offsite facility may reduce overall costs for vehicle and equipment cleaning by eliminating the need to provide similar services onsite. When onsite cleaning is needed, the cost to establish appropriate facilities is relatively low on larger, long-duration projects, and moderate to high on small, short-duration projects.

Inspection and Maintenance

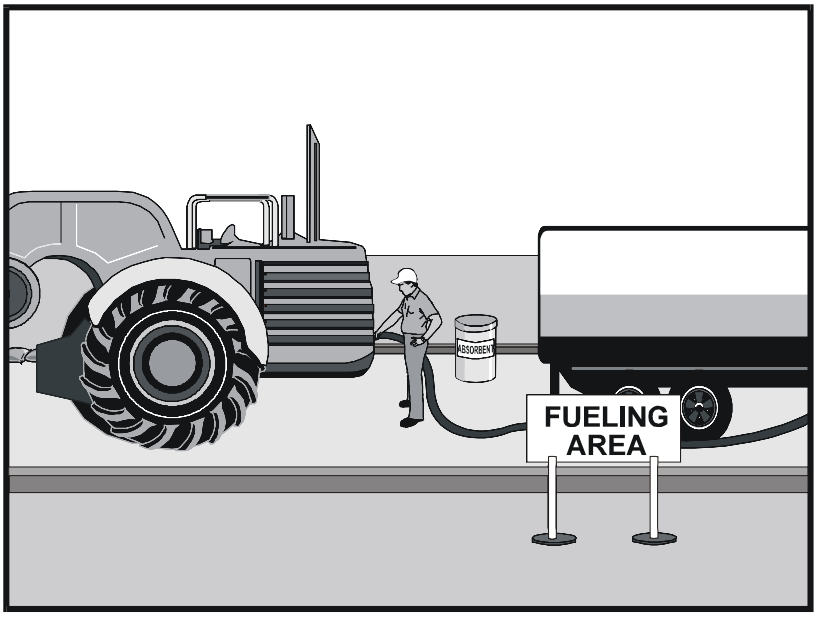
- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspection and maintenance is minimal, although some berm repair may be necessary.
- Monitor employees and subcontractors throughout the duration of the construction project to ensure appropriate practices are being implemented.
- Inspect sump regularly and remove liquids and sediment as needed.
- Prohibit employees and subcontractors from washing personal vehicles and equipment on the construction site.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Swisher, R.D. Surfactant Biodegradation, Marcel Decker Corporation, 1987.

Vehicle and Equipment Fueling NS-9



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Vehicle equipment fueling procedures and practices are designed to prevent fuel spills and leaks, and reduce or eliminate contamination of stormwater. This can be accomplished by using offsite facilities, fueling in designated areas only, enclosing or covering stored fuel, implementing spill controls, and training employees and subcontractors in proper fueling procedures.

Suitable Applications

These procedures are suitable on all construction sites where vehicle and equipment fueling takes place.

Limitations

Onsite vehicle and equipment fueling should only be used where it is impractical to send vehicles and equipment offsite for fueling. Sending vehicles and equipment offsite should be done in conjunction with TC-1, Stabilized Construction Entrance/ Exit.

Implementation

- Use offsite fueling stations as much as possible. These businesses are better equipped to handle fuel and spills properly. Performing this work offsite can also be economical by eliminating the need for a separate fueling area at a site.
- Discourage "topping-off" of fuel tanks.

- Absorbent spill cleanup materials and spill kits should be available in fueling areas and on fueling trucks, and should be disposed of properly after use.
- Drip pans or absorbent pads should be used during vehicle and equipment fueling, unless the fueling is performed over an impermeable surface in a dedicated fueling area.
- Use absorbent materials on small spills. Do not hose down or bury the spill. Remove the adsorbent materials promptly and dispose of properly.
- Avoid mobile fueling of mobile construction equipment around the site; rather, transport the equipment to designated fueling areas. With the exception of tracked equipment such as bulldozers and large excavators, most vehicles should be able to travel to a designated area with little lost time.
- Train employees and subcontractors in proper fueling and cleanup procedures.
- When fueling must take place onsite, designate an area away from drainage courses to be used. Fueling areas should be identified in the SWPPP.
- Dedicated fueling areas should be protected from stormwater runon and runoff, and should be located at least 50 ft away from downstream drainage facilities and watercourses. Fueling must be performed on level-grade areas.
- Protect fueling areas with berms and dikes to prevent runon, runoff, and to contain spills.
- Nozzles used in vehicle and equipment fueling should be equipped with an automatic shutoff to control drips. Fueling operations should not be left unattended.
- Use vapor recovery nozzles to help control drips as well as air pollution where required by Air Quality Management Districts (AQMD).
- Federal, state, and local requirements should be observed for any stationary above ground storage tanks.

Costs

- All of the above measures are low cost except for the capital costs of above ground tanks that meet all local environmental, zoning, and fire codes.

Inspection and Maintenance

- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Vehicles and equipment should be inspected each day of use for leaks. Leaks should be repaired immediately or problem vehicles or equipment should be removed from the project site.
- Keep ample supplies of spill cleanup materials onsite.

- Immediately clean up spills and properly dispose of contaminated soil and cleanup materials.

References

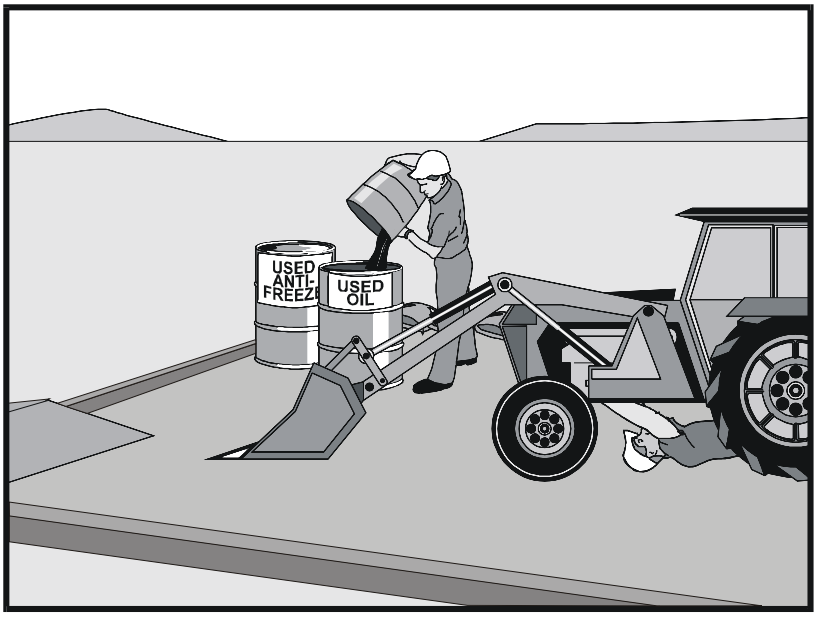
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Vehicle & Equipment Maintenance NS-10



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	
Nutrients	☑
Trash	☑
Metals	
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Prevent or reduce the contamination of stormwater resulting from vehicle and equipment maintenance by running a "dry and clean site". The best option would be to perform maintenance activities at an offsite facility. If this option is not available then work should be performed in designated areas only, while providing cover for materials stored outside, checking for leaks and spills, and containing and cleaning up spills immediately. Employees and subcontractors must be trained in proper procedures.

Suitable Applications

These procedures are suitable on all construction projects where an onsite yard area is necessary for storage and maintenance of heavy equipment and vehicles.

Limitations

Onsite vehicle and equipment maintenance should only be used where it is impractical to send vehicles and equipment offsite for maintenance and repair. Sending vehicles/equipment offsite should be done in conjunction with TC-1, Stabilized Construction Entrance/Exit.

Outdoor vehicle or equipment maintenance is a potentially significant source of stormwater pollution. Activities that can contaminate stormwater include engine repair and service, changing or replacement of fluids, and outdoor equipment storage and parking (engine fluid leaks). For further information on vehicle or equipment servicing, see NS-8,

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Vehicle and Equipment Cleaning, and NS-9, Vehicle and Equipment Fueling.

Implementation

- Use offsite repair shops as much as possible. These businesses are better equipped to handle vehicle fluids and spills properly. Performing this work offsite can also be economical by eliminating the need for a separate maintenance area.
- If maintenance must occur onsite, use designated areas, located away from drainage courses. Dedicated maintenance areas should be protected from stormwater runon and runoff, and should be located at least 50 ft from downstream drainage facilities and watercourses.
- Drip pans or absorbent pads should be used during vehicle and equipment maintenance work that involves fluids, unless the maintenance work is performed over an impermeable surface in a dedicated maintenance area.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- All fueling trucks and fueling areas are required to have spill kits and/or use other spill protection devices.
- Use adsorbent materials on small spills. Remove the absorbent materials promptly and dispose of properly.
- Inspect onsite vehicles and equipment daily at startup for leaks, and repair immediately.
- Keep vehicles and equipment clean; do not allow excessive build-up of oil and grease.
- Segregate and recycle wastes, such as greases, used oil or oil filters, antifreeze, cleaning solutions, automotive batteries, hydraulic and transmission fluids. Provide secondary containment and covers for these materials if stored onsite.
- Train employees and subcontractors in proper maintenance and spill cleanup procedures.
- Drip pans or plastic sheeting should be placed under all vehicles and equipment placed on docks, barges, or other structures over water bodies when the vehicle or equipment is planned to be idle for more than 1 hour.
- For long-term projects, consider using portable tents or covers over maintenance areas if maintenance cannot be performed offsite.
- Consider use of new, alternative greases and lubricants, such as adhesive greases, for chassis lubrication and fifth-wheel lubrication.
- Properly dispose of used oils, fluids, lubricants, and spill cleanup materials.
- Do not place used oil in a dumpster or pour into a storm drain or watercourse.
- Properly dispose of or recycle used batteries.
- Do not bury used tires.

- Repair leaks of fluids and oil immediately.

Listed below is further information if you must perform vehicle or equipment maintenance onsite.

Safer Alternative Products

- Consider products that are less toxic or hazardous than regular products. These products are often sold under an "environmentally friendly" label.
- Consider use of grease substitutes for lubrication of truck fifth-wheels. Follow manufacturers label for details on specific uses.
- Consider use of plastic friction plates on truck fifth-wheels in lieu of grease. Follow manufacturers label for details on specific uses.

Waste Reduction

Parts are often cleaned using solvents such as trichloroethylene, trichloroethane, or methylene chloride. Many of these cleaners are listed in California Toxic Rule as priority pollutants. These materials are harmful and must not contaminate stormwater. They must be disposed of as a hazardous waste. Reducing the number of solvents makes recycling easier and reduces hazardous waste management costs. Often, one solvent can perform a job as well as two different solvents. Also, if possible, eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous materials. For example, replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check the list of active ingredients to see whether it contains chlorinated solvents. The "chlor" term indicates that the solvent is chlorinated. Also, try substituting a wire brush for solvents to clean parts.

Recycling and Disposal

Separating wastes allows for easier recycling and may reduce disposal costs. Keep hazardous wastes separate, do not mix used oil solvents, and keep chlorinated solvents (like,-trichloroethane) separate from non-chlorinated solvents (like kerosene and mineral spirits). Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around. Provide cover and secondary containment until these materials can be removed from the site.

Oil filters can be recycled. Ask your oil supplier or recycler about recycling oil filters.

Do not dispose of extra paints and coatings by dumping liquid onto the ground or throwing it into dumpsters. Allow coatings to dry or harden before disposal into covered dumpsters.

Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Costs

All of the above are low cost measures. Higher costs are incurred to setup and maintain onsite maintenance areas.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Keep ample supplies of spill cleanup materials onsite.
- Maintain waste fluid containers in leak proof condition.
- Vehicles and equipment should be inspected on each day of use. Leaks should be repaired immediately or the problem vehicle(s) or equipment should be removed from the project site.
- Inspect equipment for damaged hoses and leaky gaskets routinely. Repair or replace as needed.

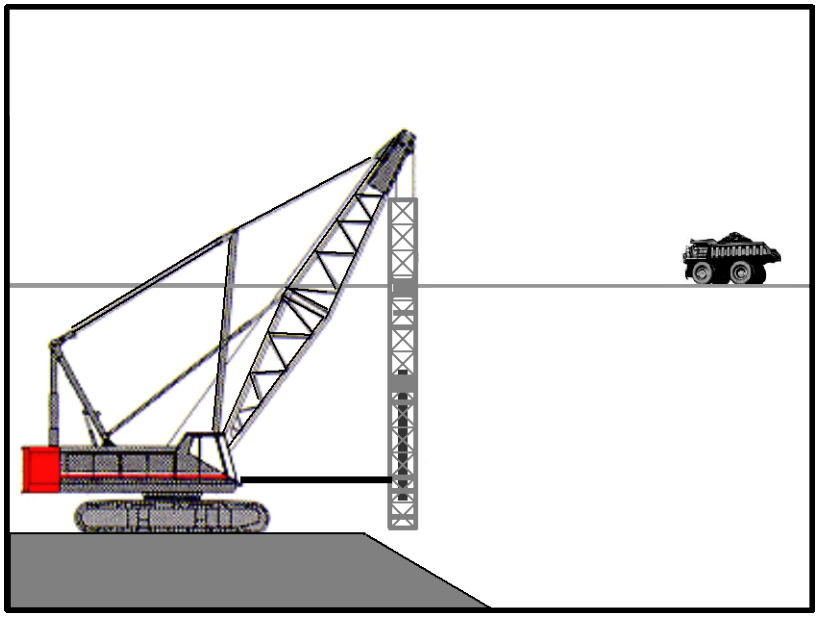
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Pile Driving Operations NS-11



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Objective**
☒ **Secondary Objective**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

The construction and retrofit of bridges and retaining walls often include driving piles for foundation support and shoring operations. Driven piles are typically constructed of precast concrete, steel, or timber. Driven sheet piles are also used for shoring and cofferdam construction. Proper control and use of equipment, materials, and waste products from pile driving operations will reduce or eliminate the discharge of potential pollutants to the storm drain system, watercourses, and waters of the United States.

Suitable Applications

These procedures apply to all construction sites near or adjacent to a watercourse or groundwater where permanent and temporary pile driving (impact and vibratory) takes place, including operations using pile shells as well as construction of cast-in-steel-shell and cast-in-drilled-hole piles.

Limitations

None identified.

Implementation

- Use drip pans or absorbent pads during vehicle and equipment operation, maintenance, cleaning, fueling, and storage. Refer to NS-8, Vehicle and Equipment Cleaning, NS-9, Vehicle and Equipment Fueling, and NS-10, Vehicle and Equipment Maintenance.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Have spill kits and cleanup materials available at all locations of pile driving. Refer to WM-4, Spill Prevention and Control.
- Equipment that is stored or in use in streambeds, or on docks, barges, or other structures over water bodies should be kept leak free.
- Park equipment over plastic sheeting or equivalent where possible. Plastic is not a substitute for drip pans or absorbent pads. The storage or use of equipment in streambeds or other bodies of water must comply with all applicable permits.
- Implement other BMPs as applicable, such as NS-2, Dewatering Operations, WM-5, Solid Waste Management, WM-6, Hazardous Waste Management, and WM-10, Liquid Waste Management.
- When not in use, store pile-driving equipment away from concentrated flows of stormwater, drainage courses, and inlets. Protect hammers and other hydraulic attachments from runon and runoff by placing them on plywood and covering them with plastic or a comparable material prior to the onset of rain.
- Use less hazardous products, e.g., vegetable oil, when practicable.

Costs

All of the above measures can be low cost.

Inspection and Maintenance

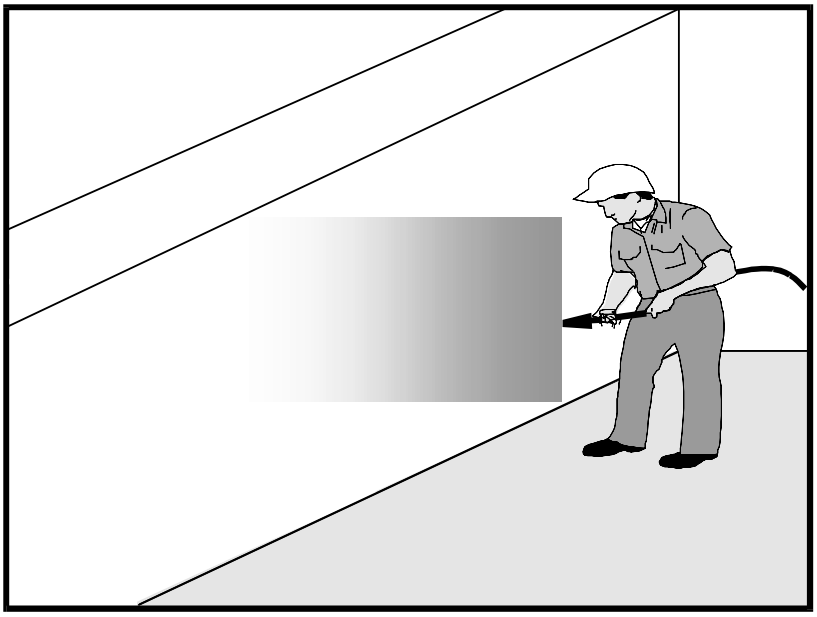
- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspect equipment every day at startup and repair equipment as needed (i.e., worn or damaged hoses, fittings, and gaskets). Recheck equipment at shift changes or at the end of the day and scheduled repairs as needed.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Concrete Curing NS-12



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	☑

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Concrete curing is used in the construction of structures such as bridges, retaining walls, pump houses, large slabs, and structured foundations. Concrete curing includes the use of both chemical and water methods.

Concrete and its associated curing materials have basic chemical properties that can raise the pH of water to levels outside of the permitted range. Discharges of stormwater and non-stormwater exposed to concrete during curing may have a high pH and may contain chemicals, metals, and fines. The General Permit incorporates Numeric Action Levels (NAL) for pH (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements).

Proper procedures and care should be taken when managing concrete curing materials to prevent them from coming into contact with stormwater flows, which could result in a high pH discharge.

Suitable Applications

Suitable applications include all projects where Portland Cement Concrete (PCC) and concrete curing chemicals are placed where they can be exposed to rainfall, runoff from other areas, or where runoff from the PCC will leave the site.

Limitations

- Runoff contact with concrete waste can raise pH levels in the water to environmentally harmful levels and trigger permit violations.

Implementation

Chemical Curing

- Avoid over spray of curing compounds.
- Minimize the drift by applying the curing compound close to the concrete surface. Apply an amount of compound that covers the surface, but does not allow any runoff of the compound.
- Use proper storage and handling techniques for concrete curing compounds. Refer to WM-1, Material Delivery and Storage.
- Protect drain inlets prior to the application of curing compounds.
- Refer to WM-4, Spill Prevention and Control.

Water Curing for Bridge Decks, Retaining Walls, and other Structures

- Direct cure water away from inlets and watercourses to collection areas for evaporation or other means of removal in accordance with all applicable permits. See WM-8 Concrete Waste Management.
- Collect cure water at the top of slopes and transport to a concrete waste management area in a non-erosive manner. See EC-9 Earth Dikes and Drainage Swales, EC-10, Velocity Dissipation Devices, and EC-11, Slope Drains.
- Utilize wet blankets or a similar method that maintains moisture while minimizing the use and possible discharge of water.

Education

- Educate employees, subcontractors, and suppliers on proper concrete curing techniques to prevent contact with discharge as described herein.
- Arrange for the QSP or the appropriately trained contractor's superintendent or representative to oversee and enforce concrete curing procedures.

Costs

All of the above measures are generally low cost.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.

- Sample non-stormwater discharges and stormwater runoff that contacts uncured and partially cured concrete as required by the General Permit.
- Ensure that employees and subcontractors implement appropriate measures for storage, handling, and use of curing compounds.
- Inspect cure containers and spraying equipment for leaks.

References

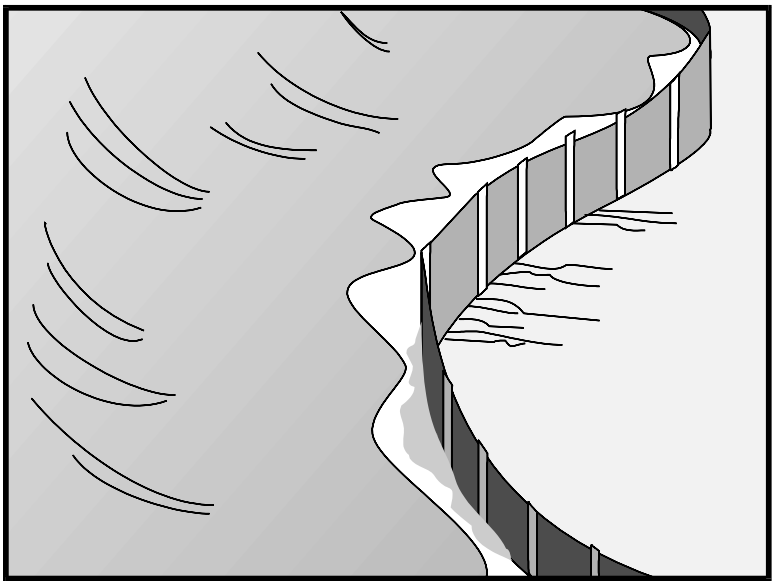
Blue Print for a Clean Bay-Construction-Related Industries: Best Management Practices for Stormwater Pollution Prevention; Santa Clara Valley Non Point Source Pollution Control Program, 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Silt Fence SE-1



Categories

EC	Erosion Control	
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Description and Purpose

A silt fence is made of a woven geotextile that has been entrenched, attached to supporting poles, and sometimes backed by a plastic or wire mesh for support. The silt fence detains water, promoting sedimentation of coarse sediment behind the fence. Silt fence does not retain soil fine particles like clays or silts.

Suitable Applications

Silt fences are suitable for perimeter control, placed below areas where sheet flows discharge from the site. They could also be used as interior controls below disturbed areas where runoff may occur in the form of sheet and rill erosion and around inlets within disturbed areas (SE-10). Silt fences should not be used in locations where the flow is concentrated. Silt fences should always be used in combination with erosion controls. Suitable applications include:

- At perimeter of a project.
- Below the toe or down slope of exposed and erodible slopes.
- Along streams and channels.
- Around temporary spoil areas and stockpiles.
- Around inlets.
- Below other small cleared areas.

Targeted Constituents

Sediment (coarse sediment)	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm SE-12 Manufactured Linear Sediment Controls

SE-13 Compost Socks and Berms

SE-14 Biofilter Bags

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Limitations

- Do not use in streams, channels, drain inlets, or anywhere flow is concentrated.
- Do not use in locations where ponded water may cause a flooding hazard.
- Do not use silt fence to divert water flows or place across any contour line.
- Improperly installed fences are subject to failure from undercutting, overtopping, or collapsing.
- Must be trenched and keyed in.
- Not intended for use as a substitute for Fiber Rolls (SE-5), when fiber rolls are being used as a slope interruption device.
- Do not use on slopes subject to creeping, slumping, or landslides.

Implementation

General

A silt fence is a temporary sediment barrier consisting of woven geotextile stretched across and attached to supporting posts, trenched-in, and, depending upon the strength of fabric used, supported with plastic or wire mesh fence. Silt fences trap coarse sediment by intercepting and detaining sediment-laden runoff from disturbed areas in order to promote sedimentation behind the fence.

The following layout and installation guidance can improve performance and should be followed:

- Silt fence should be used in combination with erosion controls up-slope in order to provide the most effective sediment control.
- Silt fence alone is not effective at reducing turbidity. (Barrett and Malina, 2004)
- Designers should consider diverting sediment laden water to a temporary sediment basin or trap. (EPA, 2012)
- Use principally in areas where sheet flow occurs.
- Install along a level contour, so water does not pond more than 1.5 ft at any point along the silt fence.
- Provide sufficient room for runoff to pond behind the fence and to allow sediment removal equipment to pass between the silt fence and toes of slopes or other obstructions. About 1200 ft^2 of ponding area should be provided for every acre draining to the fence.
- Efficiency of silt fences is primarily dependent on the detention time of the runoff behind the control. (Barrett and Malina, 2004)
- The drainage area above any fence should not exceed a quarter of an acre. (Rule of Thumb-100-feet of silt fence per 10,000 square feet of disturbed area.) (EPA 2012)

- The maximum length of slope draining to any point along the silt fence should be 100 ft per foot of silt fence.
- Turn the ends of the filter fence uphill to prevent stormwater from flowing around the fence.
- Leave an undisturbed or stabilized area immediately down slope from the fence where feasible.
- Silt fences should remain in place until the disturbed area draining to the silt fence is permanently stabilized, after which, the silt fence fabric and posts should be removed and properly disposed.
- J-Hooks, which have ends turning up the slope to break up long runs of fence and provide multiple storage areas that work like mini-retention areas, may be used to increase the effectiveness of silt fence.
- Be aware of local regulations regarding the type and installation requirements of silt fence, which may differ from those presented in this fact sheet.

Design and Layout

In areas where high winds are anticipated the fence should be supported by a plastic or wire mesh. The geotextile fabric of the silt fence should contain ultraviolet inhibitors and stabilizers to provide longevity equivalent to the project life or replacement schedule.

- Layout in accordance with the attached figures.
- For slopes that contain a high number of rocks or large dirt clods that tend to dislodge, it may be necessary to protect silt fence from rocks (e.g., rockfall netting) ensure the integrity of the silt fence installation.

Standard vs. Heavy Duty Silt Fence

Standard Silt Fence

- Generally applicable in cases where the area draining to fence produces moderate sediment loads.

Heavy Duty Silt Fence

- Heavy duty silt fence usually has 1 or more of the following characteristics, not possessed by standard silt fence.
  - Fabric is reinforced with wire backing or additional support.
  - Posts are spaced closer than pre-manufactured, standard silt fence products.
- Use is generally limited to areas affected by high winds.
- Area draining to fence produces moderate sediment loads.

Materials

Standard Silt Fence

- Silt fence material should be woven geotextile with a minimum width of 36 in. The fabric should conform to the requirements in ASTM designation D6461.
- Wooden stakes should be commercial quality lumber of the size and shape shown on the plans. Each stake should be free from decay, splits or cracks longer than the

thickness of the stake or other defects that would weaken the stakes and cause the stakes to be structurally unsuitable.

- Staples used to fasten the fence fabric to the stakes should be not less than 1.75 in. long and should be fabricated from 15 gauge or heavier wire. The wire used to fasten the tops of the stakes together when joining two sections of fence should be 9 gauge or heavier wire. Galvanizing of the fastening wire will not be required.

Heavy-Duty Silt Fence

- Some silt fence has a wire backing to provide additional support, and there are products that may use prefabricated plastic holders for the silt fence and use metal posts instead of wood stakes.

Installation Guidelines – Traditional Method

Silt fences are to be constructed on a level contour. Sufficient area should exist behind the fence for ponding to occur without flooding or overtopping the fence.

- A trench should be excavated approximately 6 in. wide and 6 in. deep along the line of the proposed silt fence (trenches should not be excavated wider or deeper than necessary for proper silt fence installation).
- Bottom of the silt fence should be keyed-in a minimum of 12 in.
- Posts should be spaced a maximum of 6 ft apart and driven securely into the ground a minimum of 18 in. or 12 in. below the bottom of the trench.
- When standard strength geotextile is used, a plastic or wire mesh support fence should be fastened securely to the upslope side of posts using heavy–duty wire staples at least 1 in. long. The mesh should extend into the trench.
- When extra-strength geotextile and closer post spacing are used, the mesh support fence may be eliminated.
- Woven geotextile should be purchased in a long roll, then cut to the length of the barrier. When joints are necessary, geotextile should be spliced together only at a support post, with a minimum 6 in. overlap and both ends securely fastened to the post.
- The trench should be backfilled with native material and compacted.
- Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/3 the height of the barrier; in no case should the reach exceed 500 ft.
- Cross barriers should be a minimum of 1/3 and a maximum of ½ the height of the linear barrier.
- See typical installation details at the end of this fact sheet.

Installation Guidelines - Static Slicing Method

- Static Slicing is defined as insertion of a narrow blade pulled behind a tractor, similar to a plow blade, at least 10 inches into the soil while at the same time pulling silt geotextile fabric into the ground through the opening created by the blade to the depth of the blade. Once the geotextile is installed, the soil is compacted using tractor tires.
- This method will not work with pre-fabricated, wire backed silt fence.
- Benefits:
    - Ease of installation (most often done with a 2 person crew).
    - Minimal soil disturbance.
    - Better level of compaction along fence, less susceptible to undercutting
    - Uniform installation.
- Limitations:
    - Does not work in shallow or rocky soils.
    - Complete removal of geotextile material after use is difficult.
    - Be cautious when digging near potential underground utilities.

Costs

- It should be noted that costs vary greatly across regions due to available supplies and labor costs.
- Average annual cost for installation using the traditional silt fence installation method (assumes 6 month useful life) is $7 per linear foot based on vendor research. Range of cost is $3.50 - $9.10 per linear foot.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Repair undercut silt fences.
- Repair or replace split, torn, slumping, or weathered fabric. The lifespan of silt fence fabric is generally 5 to 8 months.
- Silt fences that are damaged and become unsuitable for the intended purpose should be removed from the site of work, disposed, and replaced with new silt fence barriers.
- Sediment that accumulates in the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches 1/3 of the barrier height.
- Silt fences should be left in place until the upgradient area is permanently stabilized. Until then, the silt fence should be inspected and maintained regularly.

- Remove silt fence when upgradient areas are stabilized. Fill and compact post holes and anchor trench, remove sediment accumulation, grade fence alignment to blend with adjacent ground, and stabilize disturbed area.

References

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Monitoring Data on Effectiveness of Sediment Control Techniques, Proceedings of World Water and Environmental Resources Congress, Barrett M. and Malina J. 2004.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group-Working Paper, USEPA, April 1992.

Sedimentation and Erosion Control Practices, and Inventory of Current Practices (Draft), USEPA, 1990.

Southeastern Wisconsin Regional Planning Commission (SWRPC). Costs of Urban Nonpoint Source Water Pollution Control Measures. Technical Report No. 31. Southeastern Wisconsin Regional Planning Commission, Waukesha, WI. 1991.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management Manual for The Puget Sound Basin, Washington State Department of Ecology, Public Review Draft, 1991.

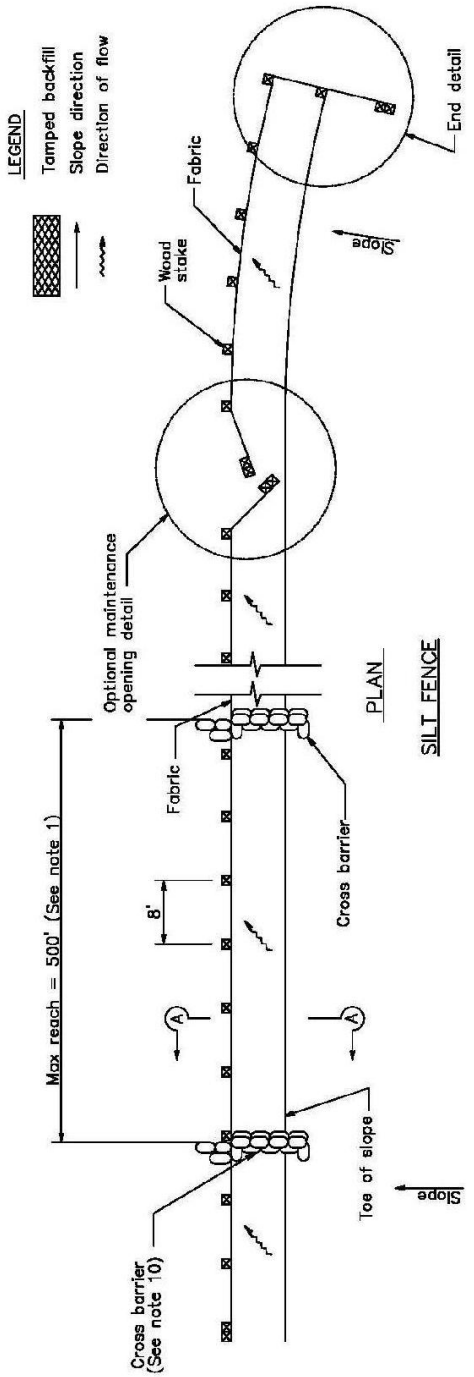
U.S. Environmental Protection Agency (USEPA). Stormwater Best Management Practices: Silt Fences. U.S. Environmental Protection Agency, Office of Water, Washington, DC, 2012.

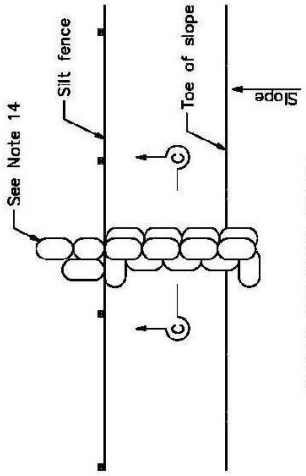
U.S. Environmental Protection Agency (USEPA). Stormwater Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices. U.S. Environmental Protection Agency, Office of Water, Washington, DC, 1992.

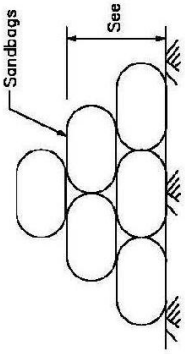
Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Soil Stabilization BMP Research for Erosion and Sediment Controls: Cost Survey Technical Memorandum, State of California Department of Transportation (Caltrans), July 2007.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

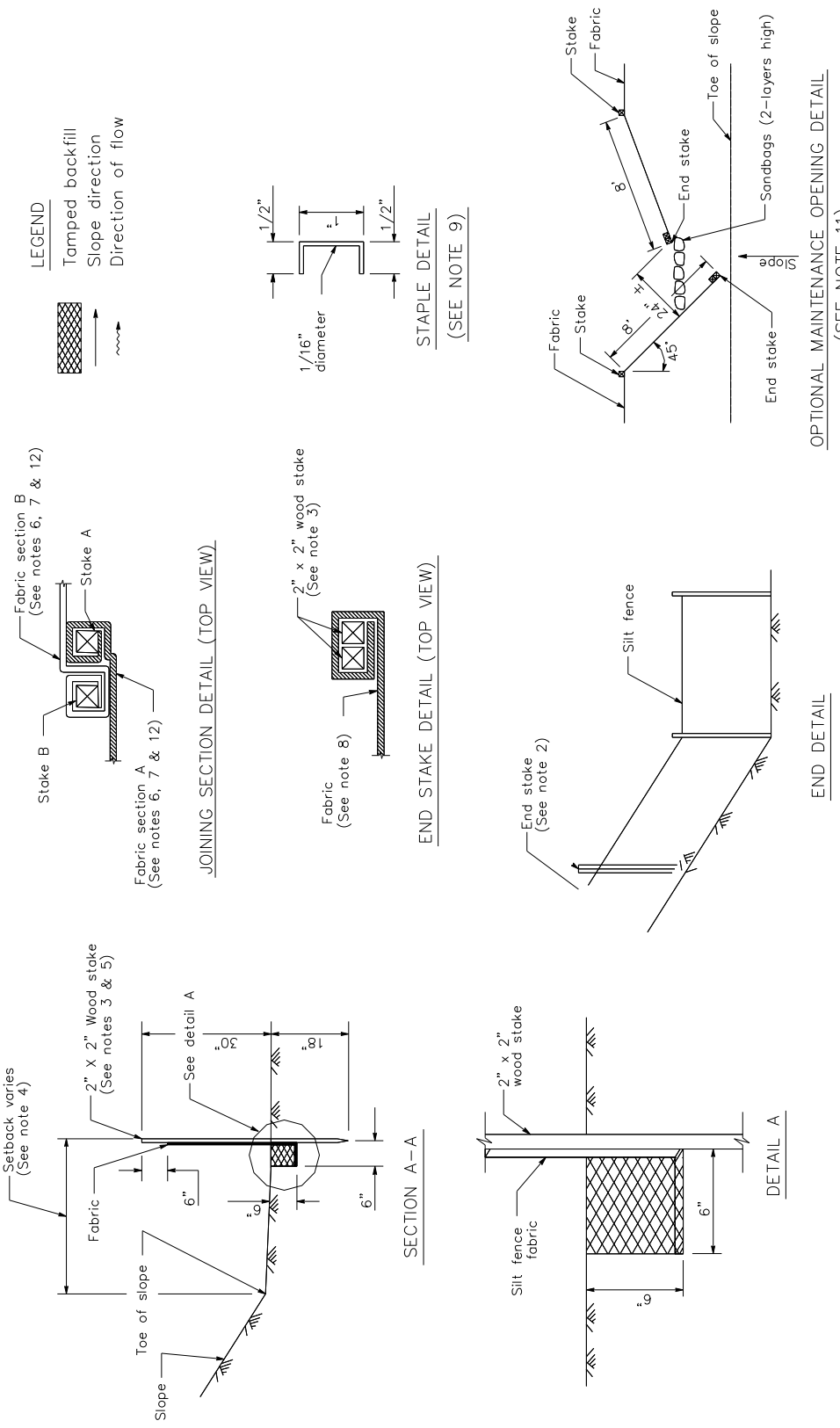


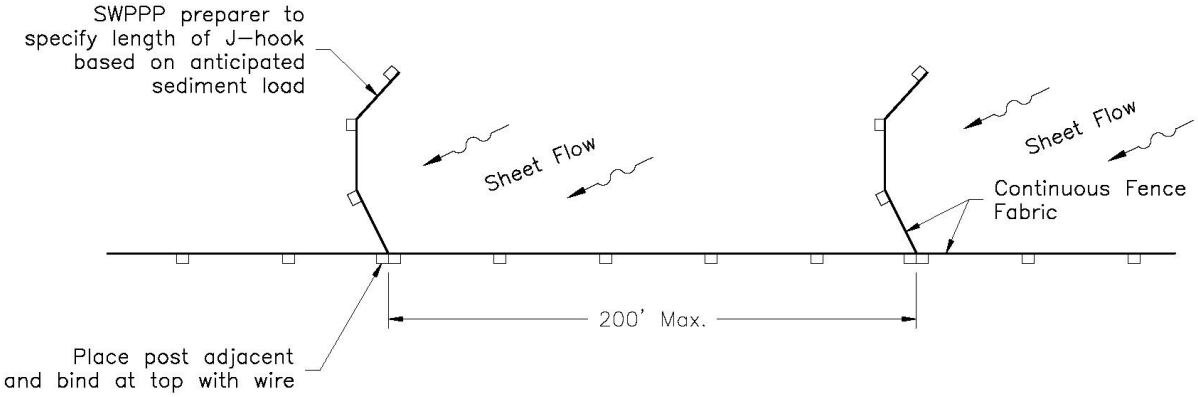




NOTES

1. Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/3 the height of the linear barrier, in no case shall the reach length exceed 500'.
2. The last 8'–0" of fence shall be turned up slope.
3. Stake dimensions are nominal.
4. Dimension may vary to fit field condition.
5. Stakes shall be spaced at 8'–0" maximum and shall be positioned on downstream side of fence.
6. Stakes to overlap and fence fabric to fold around each stake one full turn. Secure fabric to stake with 4 staples.
7. Stakes shall be driven tightly together to prevent potential flow–through of sediment at joint. The tops of the stakes shall be secured with wire.
8. For end stake, fence fabric shall be folded around two stakes one full turn and secured with 4 staples.
9. Minimum 4 staples per stake. Dimensions shown are typical.
10. Cross barriers shall be a minimum of 1/3 and a maximum of 1/2 the height of the linear barrier.
11. Maintenance openings shall be constructed in a manner to ensure sediment remains behind silt fence.
12. Joining sections shall not be placed at sump locations.
13. Sandbag rows and layers shall be offset to eliminate gaps.
14. Add 3–4 bags to cross barrier on downgradient side of silt fence as needed to prevent bypass or undermining and as allowable based on site limits of disturbance.

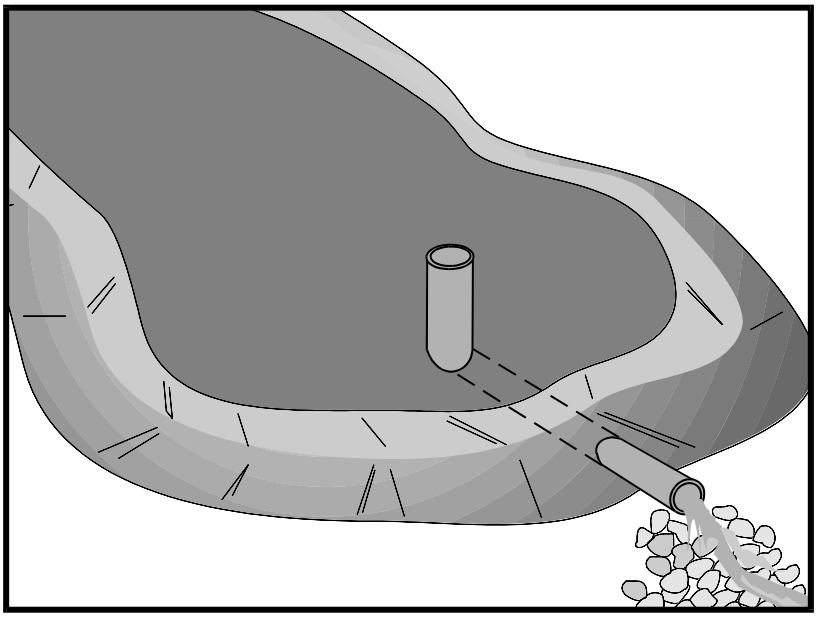

LEGEND
Tamped backfill
Slope direction
Direction of flow
1/2"
1"
1/2"
1/16" diameter
STAPLE DETAIL
(SEE NOTE 9)
Stake
Fabric
Toe of slope
8'
End stake
Sandbags (2-layers high)
Slope
4'
2'
8'
45°
Fabric
Stake
End stake
OPTIONAL MAINTENANCE OPENING DETAIL
(SEE NOTE 11)
Fabric section B
(See notes 6, 7 & 12)
Stake A
Stake B
Fabric section A
(See notes 6, 7 & 12)
JOINING SECTION DETAIL (TOP VIEW)
2" x 2" wood stake
(See note 3)
Fabric
(See note 8)
END STAKE DETAIL (TOP VIEW)
Silt fence
End stake
(See note 2)
END DETAIL
Setback varies
(See note 4)
2" X 2" Wood stake
(See notes 3 & 5)
See detail A
30"
18"
Fabric
6"
6"
6"
Toe of slope
Slope
SECTION A-A
2" x 2"
wood stake
Silt fence
fabric
6"
6"
DETAIL A


SWPPP preparer to specify length of J–hook based on anticipated sediment load
Sheet Flow
Sheet Flow
Continuous Fence Fabric
200' Max.
Place post adjacent and bind at top with wire

Plan

J–HOOK

Sediment Basin SE-2



Categories

EC	Erosion Control	
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☑
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-3 Sediment Trap (for smaller areas)

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

A sediment basin is a temporary basin formed by excavation or by constructing an embankment so that sediment-laden runoff is temporarily detained under quiescent conditions, allowing sediment to settle out before the runoff is released.

Sediment basin design guidance presented in this fact sheet is intended to provide options, methods, and techniques to optimize temporary sediment basin performance and basin sediment removal. Basin design guidance provided in this fact sheet is not intended to guarantee basin effluent compliance with numeric discharge limits (numeric action levels or numeric effluent limits for turbidity). Compliance with discharge limits requires a thoughtful approach to comprehensive BMP planning, implementation, and maintenance. Therefore, optimally designed and maintained sediment basins should be used in conjunction with a comprehensive system of BMPs that includes:

- Diverting runoff from undisturbed areas away from the basin
- Erosion control practices to minimize disturbed areas on-site and to provide temporary stabilization and interim sediment controls (e.g., stockpile perimeter control, check dams, perimeter controls around individual lots) to reduce the basin's influent sediment concentration.

At some sites, sediment basin design enhancements may be required to adequately remove sediment. Traditional

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION®

(a.k.a. "physical") enhancements such as alternative outlet configurations or flow deflection baffles increase detention time and other techniques such as outlet skimmers preferentially drain flows with lower sediment concentrations. These "physical" enhancement techniques are described in this fact sheet. To further enhance sediment removal particularly at sites with fine soils or turbidity sensitive receiving waters, some projects may need to consider implementing Active Treatment Systems (ATS) whereby coagulants and flocculants are used to enhance settling and removal of suspended sediments. Guidance on implementing ATS is provided in SE-11.

Suitable Applications

Sediment basins may be suitable for use on larger projects with sufficient space for constructing the basin. Sediment basins should be considered for use:

- Where sediment-laden water may enter the drainage system or watercourses
- On construction projects with disturbed areas during the rainy season
- At the outlet of disturbed watersheds between 5 acres and 75 acres and evaluated on a site by site basis
- Where post construction detention basins are required
- In association with dikes, temporary channels, and pipes used to convey runoff from disturbed areas

Limitations

Sediment basins must be installed only within the property limits and where failure of the structure will not result in loss of life, damage to homes or buildings, or interruption of use or service of public roads or utilities. In addition, sediment basins are attractive to children and can be very dangerous. Local ordinances regarding health and safety must be adhered to. If fencing of the basin is required, the type of fence and its location should be shown in the SWPPP and in the construction specifications.

- As a general guideline, sediment basins are suitable for drainage areas of 5 acres or more, but not appropriate for drainage areas greater than 75 acres. However, the tributary area should be evaluated on a site by site basis.
- Sediment basins may become an "attractive nuisance" and care must be taken to adhere to all safety practices. If safety is a concern, basin may require protective fencing.
- Sediment basins designed according to this fact sheet are only effective in removing sediment down to about the silt size fraction. Sediment-laden runoff with smaller size fractions (fine silt and clay) may not be adequately treated unless chemical (or other appropriate method) treatment is used in addition to the sediment basin.
- Basins with a height of 25 ft or more or an impounding capacity of 50 ac-ft or more must obtain approval from California Department of Water Resources Division of Safety of Dams (http://www.water.ca.gov/damsafety/).

- Water that stands in sediment basins longer than 96 hours may become a source of mosquitoes (and midges), particularly along perimeter edges, in shallow zones, in scour or below-grade pools, around inlet pipes, along low-flow channels, and among protected habitats created by emergent or floating vegetation (e.g. cattails, water hyacinth), algal mats, riprap, etc.
- Basins require large surface areas to permit settling of sediment. Size may be limited by the available area.

Implementation

General

A sediment basin is a controlled stormwater release structure formed by excavation or by construction of an embankment of compacted soil across a drainage way, or other suitable location. It is intended to trap sediment before it leaves the construction site. The basin is a temporary measure expected to be used during active construction in most cases and is to be maintained until the site area is permanently protected against erosion or a permanent detention basin is constructed.

Sediment basins are suitable for nearly all types of construction projects. Whenever possible, construct the sediment basins before clearing and grading work begins. Basins should be located at the stormwater outlet from the site but not in any natural or undisturbed stream. A typical application would include temporary dikes, pipes, and/or channels to convey runoff to the basin inlet.

Many development projects in California are required by local ordinances to provide a stormwater detention basin for post-construction flood control, desilting, or stormwater pollution control. A temporary sediment basin may be constructed by rough grading the post-construction control basins early in the project.

Sediment basins if properly designed and maintained can trap a significant amount of the sediment that flows into them. However, traditional basins do not remove all inflowing sediment. Therefore, they should be used in conjunction with erosion control practices such as temporary seeding, mulching, diversion dikes, etc., to reduce the amount of sediment flowing into the basin.

Planning

To improve the effectiveness of the basin, it should be located to intercept runoff from the largest possible amount of disturbed area. Locations best suited for a sediment basin are generally in lower elevation areas of the site (or basin tributary area) where site drainage would not require significant diversion or other means to direct water to the basin but outside jurisdictional waterways. However, as necessary, drainage into the basin can be improved by the use of earth dikes and drainage swales (see BMP EC-9). . The basin should not be located where its failure would result in the loss of life or interruption of the use or service of public utilities or roads.

Construct before clearing and grading work begins when feasible.

- Do not locate the basin in a jurisdictional stream.

- Basin sites should be located where failure of the structure will not cause loss of life, damage to homes or buildings, or interruption of use or service of public roads or utilities.
- Basins with a height of 25 ft or more or an impounding capacity of 50 ac-ft must obtain approval from the Division of Dam Safety. Local dam safety requirements may be more stringent.
- Limit the contributing area to the sediment basin to only the runoff from the disturbed soil areas. Use temporary concentrated flow conveyance controls to divert runoff from undisturbed areas away from the sediment basin.
- The basin should be located: (1) by excavating a suitable area or where a low embankment can be constructed across a swale, (2) where post-construction (permanent) detention basins will be constructed, and (3) where the basins can be maintained on a year-round basis to provide access for maintenance, including sediment removal and sediment stockpiling in a protected area, and to maintain the basin to provide the required capacity.

Design

When designing a sediment basin, designers should evaluate the site constraints that could affect the efficiency of the BMP. Some of these constraints include: the relationship between basin capacity, anticipated sediment load, and freeboard, available footprint for the basin, maintenance frequency and access, and hydraulic capacity and efficiency of the temporary outlet infrastructure. Sediment basins should be designed to maximize sediment removal and to consider sediment load retained by the basin as it affects basin performance.

Three Basin Design Options (Part A) are presented below along with a Typical Sediment/Detention Basin Design Methodology (Part B). Regardless of the design option that is selected, designers also need to evaluate the sediment basin capacity with respect to sediment accumulation (See "*Step 3. Evaluate the Capacity of the Sediment Basin"),* and should incorporate approaches identified in "*Step 4. Other Design Considerations*" to enhance basin performance.

A) Basin Design Options:

Option 1:

Design sediment basin(s) using the standard equation:

$$A_s = \frac{1.2Q}{V_s} \qquad \text{(Eq. 1)}$$

Where:

A_s = Minimum surface area for trapping soil particles of a certain size

V_s = Settling velocity of the design particle size chosen (V_s = 0.00028 ft/s for a design particle size of 0.01 mm at 68°F)

1.2 = Factor of safety recommended by USEPA to account for the reduction in basin efficiency caused due to turbulence and other non ideal conditions.

$Q = CIA$ (Eq.2)

Where

Q = Peak basin influent flow rate measured in cubic feet per second (ft^3/s)

C = Runoff coefficient (unitless)

I = Peak rainfall intensity for the 10-year, 6-hour rain event (in/hr)

A = Area draining into the sediment basin in acres

The design particle size should be the smallest soil grain size determined by wet sieve analysis, or the fine silt sized (0.01 mm [or 0.0004 in.]) particle, and the Vs used should be 100 percent of the calculated settling velocity.

This sizing basin method is dependent on the outlet structure design or the total basin length with an appropriate outlet. If the designer chooses to utilize the outlet structure to control the flow duration in the basin, the basin length (distance between the inlet and the outlet) should be a minimum of twice the basin width; the depth should not be less than 3 ft nor greater than 5 ft for safety reasons and for maximum efficiency (2 ft of sediment storage, 2 ft of capacity). If the designer chooses to utilize the basin length (with appropriate basin outlet) to control the flow duration in the basin, the basin length (distance between the inlet and the outlet) should be a specifically designed to capture 100% of the design particle size; the depth should not be less than 3 ft nor greater than 5 ft for safety reasons and for maximum efficiency (2 ft of sediment storage, 2 ft of capacity).

Basin design guidance provided herein assumes standard water properties (e.g., estimated average water temperature, kinematic viscosity, etc.) as a basis of the design. Designers can use an alternative design (Option 3) with site specific water properties as long as the design is as protective as Option 1.

The design guidance uses the peak influent flow rate to size sediment basins. Designers can use an alternative design (Option 3) with site specific average flow rates as long as the design is as protective as Option 1.

The basin should be located on the site where it can be maintained on a year-round basis and should be maintained on a schedule to retain the 2 ft of capacity.

Option 2:

Design pursuant to local ordinance for sediment basin design and maintenance, provided that the design efficiency is as protective or more protective of water quality than Option 1.

Option 3:

The use of an equivalent surface area design or equation provided that the design efficiency is as protective or more protective of water quality than Option 1.

B) Typical Sediment/Detention Basin Design Methodology:

Design of a sediment basin requires the designer to have an understanding of the site constraints, knowledge of the local soil (e.g., particle size distribution of potentially contributing soils), drainage area of the basin, and local hydrology. Designers should not assume that a sediment basin for location A is applicable to location B. Therefore, designers can use this factsheet as guidance but will need to apply professional judgment and knowledge of the site to design an effective and efficient sediment basin. The following provides a general overview of typical design methodologies:

Step 1. Hydrologic Design

- Evaluate the site constraints and assess the drainage area for the sediment basin. Designers should consider on- and off-site flows as well as changes in the drainage area associated with site construction/disturbance. To minimize additional construction during the course of the project, the designer should consider identifying the maximum drainage area when calculating the basin dimensions.

- If a local hydrology manual is not available it is recommended to follow standard rational method procedures to estimate the flow rate. The references section of this factsheet provides a reference to standard hydrology textbooks that can provide standard methodologies. If local rainfall depths are not available, values can be obtained from standard precipitation frequency maps from NOAA (downloaded from http://www.wrcc.dri.edu/pcpnfreq.html).

Step 2. Hydraulic Design

- Calculate the surface area required for the sediment basin using Equation 1. In which the flow rate is estimated for a 10-yr 6-hr event using rational method procedure listed in local hydrology manual and Vs is estimated using Stokes Law presented in Equation 3.

$$V_s = 2.81d^2 \qquad \text{(Eq.3)}$$

Where

V_s = Settling velocity in feet per second at 68˚F

d = diameter of sediment particle in millimeters (smallest soil grain size determined by wet sieve analysis or fine silt (0.01 mm [or 0.0004 in.])

- In general the basin outlet design requires an iterative trial and error approach that considered the maximum water surface elevation, the elevation versus volume (stage-storage) relationship, the elevation verses basin outflow (a.k.a.-discharge) relationship, and the estimated inflow hydrograph. To adequately design the basins to settle sediment, the outlet configuration and associated outflow rates can be estimated by numerous methodologies. The following provides some guidance for design the basin outlet:

  - An outlet should have more than one orifice.

  - An outlet design typically utilizes multiple horizontal rows of orifices (approximately 3 or more) with at least 2 orifices per row (see Figures 1 and 2 at the end of this fact sheet).

- Orifices can vary in shape.
- Select the appropriate orifice diameter and number of perforations per row with the objective of minimizing the number of rows while maximizing the detention time.
- The diameter of each orifice is typically a maximum of 3-4 inches and a minimum of 0.25-0.5 inches.
- If a rectangular orifice is used, it is recommended to have minimum height of 0.5 inches and a maximum height of 6 inches.
- Rows are typically spaced at three times the diameter center to center vertically with a minimum distance of approximately 4 inches on center and a maximum distance of 1 foot on center.
- To estimate the outflow rate, each row is calculated separately based on the flow through a single orifice then multiplied by the number of orifices in the row. This step is repeated for each of the rows. Once all of the orifices are estimated, the total outflow rate versus elevation (stage-discharge curve) is developed to evaluate the detention time within the basin.
- Flow through a single orifice can be estimated using an Equation 4:

$$Q = BC' A(2gH)^{0.5} \qquad \text{(Eq.4)}$$

Where
Q = Outflow rate in ft^3/s
C′ = Orifice coefficient (unitless)
A = Area of the orifice (ft^2)
g = acceleration due to gravity (ft^3/s)
H = Head above the orifice (ft)
B = Anticipated Blockage or clogging factor (unitless), It is dependent on anticipated sediment and debris load, trash rack configuration etc, so the value is dependent on design engineers professional judgment and/or local requirements (B is never greater than 1 and a value of 0.5 is generally used)

- Care must be taken in the selection of orifice coefficient ("C′"); 0.60 is most often recommended and used. However, based on actual tests, Young and Graziano (1989), "Outlet Hydraulics of Extended Detention Facilities for Northern Virginia Planning District Commission", recommends the following:
  - C′ = 0.66 for thin materials; where the thickness is equal to or less than the orifice diameter, or
  - C′ = 0.80 when the material is thicker than the orifice diameter
- If different sizes of orifices are used along the riser then they have to be sized such that not more than 50 percent of the design storm event drains in one-third of the drawdown time (to provide adequate settling time for events smaller than the design storm event)

and the entire volume drains within 96 hours or as regulated by the local vector control agency. If a basin fails to drain within 96 hours, the basin must be pumped dry.

- Because basins are not maintained for infiltration, water loss by infiltration should be disregarded when designing the hydraulic capacity of the outlet structure.

- Floating Outlet Skimmer: The floating skimmer (see Figure 3 at the end of this fact sheet is an alternative outlet configuration (patented) that drains water from upper portion of the water column. This configuration has been used for temporary and permanent basins and can improve basin performance by eliminating bottom orifices which have the potential of discharging solids. Some design considerations for this alternative outlet device includes the addition of a sand filter or perforated under drain at the low point in the basin and near the floating skimmer. These secondary drains allow the basin to fully drain. More detailed guidelines for sizing the skimmer can be downloaded from http://www.fairclothskimmer.com/.

- Hold and Release Valve: An ideal sediment/detention basin would hold all flows to the design storm level for sufficient time to settle solids, and then slowly release the storm water. Implementing a reliable valve system for releasing detention basins is critical to eliminate the potential for flooding in such a system. Some variations of hold and release valves include manual valves, bladder devices or electrically operated valves. When a precipitation event is forecast, the valve would be close for the duration of the storm and appropriate settling time. When the settling duration is met (approximately 24 or 48 hours), the valve would be opened and allow the stormwater to be released at a rate that does not resuspend settled solids and in a non-erosive manner. If this type of system is used the valve should be designed to empty the entire basin within 96 hours or as stipulated by local vector control regulations.

Step 3. Evaluate the Capacity of the Sediment Basin

- Typically, sediment basins do not perform as designed when they are not properly maintained or the sediment yield to the basin is larger than expected. As part of a good sediment basin design, designers should consider maintenance cycles, estimated soil loss and/or sediment yield, and basin sediment storage volume. The two equations below can be used to quantify the amount of soil entering the basin.

- The Revised Universal Soil Loss Equation (RUSLE, Eq.5) can be used to estimate annual soil loss and the Modified Universal Soil Equation (MUSLE, Eq.6) can be used to estimate sediment yield from a single storm event.

$$A = R \times K \times LS \times C \times P \qquad \text{(Eq.5)}$$

$$Y = 95 \times q_p^{0.56} \times K \times LS \times C \times P \qquad \text{(Eq.6)}$$

Where:

A = annual soil loss, tons/acre-year

R = rainfall erosion index, in 100 ft.tons/acre.in/hr

K = soil erodibility factor, tons/acre per unit of R

LS = slope length and steepness factor (unitless)

C = vegetative cover factor (unitless)

P = erosion control practice factor (unitless)

Y = single storm sediment yield in tons

Q = runoff volume in acre-feet

q_p = peak flow in cfs

- Detailed descriptions and methodologies for estimating the soil loss can be obtained from standard hydrology text books (See References section).
- Determination of the appropriate equation should consider construction duration and local environmental factors (soils, hydrology, etc.). For example, if a basin is planned for a project duration of 1 year and the designer specifies one maintenance cycle, RUSLE could be used to estimate the soil loss and thereby the designer could indicate that the sediment storage volume would be half of the soil loss value estimated. As an example for use of MUSLE, a project may have a short construction duration thereby requiring fewer maintenance cycles and a reduced sediment storage volume. MUSLE would be used to estimate the anticipated soil loss based on a specific storm event to evaluate the sediment storage volume and appropriate maintenance frequency.
- The soil loss estimates are an essential step in the design and it is essential that the designer provide construction contractors with enough information to understand maintenance frequency and/or depths within the basin that would trigger maintenance. Providing maintenance methods, frequency and specification should be included in design bid documents such as the SWPPP Site Map.
- Once the designer has quantified the amount of soil entering the basin, the depth required for sediment storage can be determined by dividing the estimated sediment loss by the surface area of the basin.

Step 4. Other Design Considerations

- Consider designing the volume of the settling zone for the total storm volume associated with the 2-year event or other appropriate design storms specified by the local agency. This volume can be used as a guide for sizing the basin without iterative routing calculations. The depth of the settling zone can be estimated by dividing the estimated 2-yr storm volume by the surface area of the basin.
- The basin volume consists of two zones:
  - A sediment storage zone at least 1 ft deep.
  - A settling zone at least 2 ft deep.

- The basin depth must be no less than 3 ft (not including freeboard).

- Proper hydraulic design of the outlet is critical to achieving the desired performance of the basin. The outlet should be designed to drain the basin within 24 to 96 hours (also referred to as "drawdown time"). The 24-hour limit is specified to provide adequate settling time; the 96-hour limit is specified to mitigate vector control concerns.

- Confirmation of the basin performance can be evaluated by routing the design storm (10-yr 6-hr, or as directed by local regulations) through the basin based on the basin volume (stage-storage curve) and the outlet design (stage-discharge curve based on the orifice configuration or equivalent outlet design).

- Sediment basins, regardless of size and storage volume, should include features to accommodate overflow or bypass flows that exceed the design storm event.

  - Include an emergency spillway to accommodate flows not carried by the principal spillway. The spillway should consist of an open channel (earthen or vegetated) over undisturbed material (not fill) or constructed of a non-erodible riprap (or equivalent protection) on fill slopes.

  - The spillway control section, which is a level portion of the spillway channel at the highest elevation in the channel, should be a minimum of 20 ft in length.

- Rock, vegetation or appropriate erosion control should be used to protect the basin inlet, outlet, and slopes against erosion.

- The total depth of the sediment basin should include the depth required for sediment storage, depth required for settling zone and freeboard of at least 1 foot or as regulated by local flood control agency for a flood event specified by the local agency.

- The basin alignment should be designed such that the length of the basin is more than twice the width of the basin; the length should be determined by measuring the distance between the inlet and the outlet. If the site topography does not allow for this configuration baffles should be installed so that the ratio is satisfied. If a basin has more than one inflow point, any inflow point that conveys more than 30 percent of the total peak inflow rate has to meet the required length to width ratio.

- An alternative basin sizing method proposed by Fifield (2004) can be consulted to estimate an alternative length to width ratio and basin configuration. These methods can be considered as part of Option 3 which allows for alternative designs that are protective or more protective of water quality.

- Baffles (see Figure 4 at the end of this fact sheet) can be considered at project sites where the existing topography or site constraints limit the length to width ratio. Baffles should be constructed of earthen berms or other structural material within the basin to divert flow in the basin, thus increasing the effective flow length from the basin inlet to the outlet riser. Baffles also reduce the change of short circuiting and allows for settling throughout the basin.

- Baffles are typically constructed from the invert of the basin to the crest of the emergency spillway (i.e., design event flows are meant to flow around the baffles and flows greater than the design event would flow over the baffles to the emergency spillway).
- Use of other materials for construction of basin baffles (such as silt fence) may not be appropriate based on the material specifications and will require frequent maintenance (maintain after every storm event). Maintenance may not be feasible when required due to flooded conditions resulting from frequent (i.e., back to back) storm events. Use of alternative baffle materials should not deviate from the intended purpose of the material, as described by the manufacturer.
- Sediment basins are best used in conjunction with erosion controls.
- Basins with an impounding levee greater than 4.5 ft tall, measured from the lowest point to the impounding area to the highest point of the levee, and basins capable of impounding more than 35,000 ft^3, should be designed by a Registered Civil Engineer. The design should include maintenance requirements, including sediment and vegetation removal, to ensure continuous function of the basin outlet and bypass structures.
- A forebay, constructed upstream of the basin, may be provided to remove debris and larger particles.
- The outflow from the sediment basin should be provided with velocity dissipation devices (see BMP EC-10) to prevent erosion and scouring of the embankment and channel.
- The principal outlet should consist of a corrugated metal, high density polyethylene (HDPE), or reinforced concrete riser pipe with dewatering holes and an anti-vortex device and trash rack attached to the top of the riser, to prevent floating debris from flowing out of the basin or obstructing the system. This principal structure should be designed to accommodate the inflow design storm.
- A rock pile or rock-filled gabions can serve as alternatives to the debris screen, although the designer should be aware of the potential for extra maintenance involved should the pore spaces in the rock pile clog.
- The outlet structure should be placed on a firm, smooth foundation with the base securely anchored with concrete or other means to prevent floatation.
- Attach riser pipe (watertight connection) to a horizontal pipe (barrel). Provide anti-seep collars on the barrel.
- Cleanout level should be clearly marked on the riser pipe.

Installation

- Securely anchor and install an anti-seep collar on the outlet pipe/riser and provide an emergency spillway for passing major floods (see local flood control agency).
- Areas under embankments must be cleared and stripped of vegetation.

- Chain link fencing should be provided around each sediment basin to prevent unauthorized entry to the basin or if safety is a concern.

Costs

The cost of a sediment basin is highly variable and is dependent of the site configuration. To decrease basin construction costs, designers should consider using existing site features such as berms or depressed area to site the sediment basin. Designers should also consider potential savings associated with designing the basin to minimize the number of maintenance cycles and siting the basin in a location where a permanent BMP (e.g., extended detention basin) is required for the project site.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level and as required by local requirements. It is recommended that at a minimum, basins be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Examine basin banks for seepage and structural soundness.
- Check inlet and outlet structures and spillway for any damage or obstructions. Repair damage and remove obstructions as needed.
- Check inlet and outlet area for erosion and stabilize if required.
- Check fencing for damage and repair as needed.
- Sediment that accumulates in the basin must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when sediment accumulation reaches one-half the designated sediment storage volume. Sediment removed during maintenance should be managed properly. The sediment should be appropriately evaluated and used or disposed of accordingly. Options include: incorporating sediment into earthwork on the site (only if there is no risk that sediment is contaminated); or off-site export/disposal at an appropriate location (e.g., sediment characterization and disposal to an appropriate landfill).
- Remove standing water from basin within 96 hours after accumulation.
- If the basin does not drain adequately (e.g., due to storms that are more frequent or larger than the design storm or other unforeseen site conditions), dewatering should be conducted in accordance with appropriate dewatering BMPs (see NS-2) and in accordance with local permits as applicable.
- To minimize vector production:
  - Remove accumulation of live and dead floating vegetation in basins during every inspection.
  - Remove excessive emergent and perimeter vegetation as needed or as advised by local or state vector control agencies.

References

A Current Assessment of Urban Best Management Practices: Techniques for Reducing Nonpoint Source Pollution in the Coastal Zones, Metropolitan Washington Council of Governments, March 1992.

Draft-Sedimentation and Erosion Control, an Inventory of Current Practices, USEPA. April 1990.

U.S. Environmental Protection Agency (USEPA). Erosion and Sediment Control, Surface Mining in the Eastern U.S., U.S. Environmental Protection Agency, Office of Water, Washington, DC,Washington, D.C., 1976.

Fifield, J.S. Designing for Effective Sediment and Erosion Control on Construction Sites. Forester Press, Santa Barbara, CA. 2004.

Goldman S.J., Jackson K. and Bursztynsky T.A. Erosion and Sediment Control Handbook. McGraw-Hill Book Company, 1986.

U.S. Environmental Protection Agency (USEPA). Guidance Specifying Management Measures for Nonpoint Pollution in Coastal Waters. EPA 840-B-9-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC, 1993.

Guidelines for the Design and Construction of Small Embankment Dams, Division of Safety of Dams, California Department of Water Resources, March 1986.

Haan C.T., Barfield B.J. and Hayes J.C. Design Hydrology and Sedimentology for Small Catchments. Academic Press. 1994.

Inlet/Outlet Alternatives for Extended Detention Basins. State of California Department of Transportation (Caltrans), 2001.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

McLean, J., 2000. Mosquitoes in Constructed Wetlands: A Management Bugaboo? In T.R. Schueler and H.K. Holland [eds.], The Practice of Watershed Protection. pp. 29-33. Center for Watershed Protection, Ellicott City, MD, 2000.

Metzger, M.E., D. F. Messer, C. L. Beitia, C. M. Myers, and V. L. Kramer. The Dark Side of Stormwater Runoff Management: Disease Vectors Associated with Structural BMPs, 2002.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Water, Work Group-Working Paper, USEPA, April 1992.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Water Quality Management Plan for the Lake Tahoe Region, Volume II Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Young, G.K. and Graziano, F., Outlet Hydraulics of Extended Detention Facilities for Northern Virginia Planning District Commission, 1989.

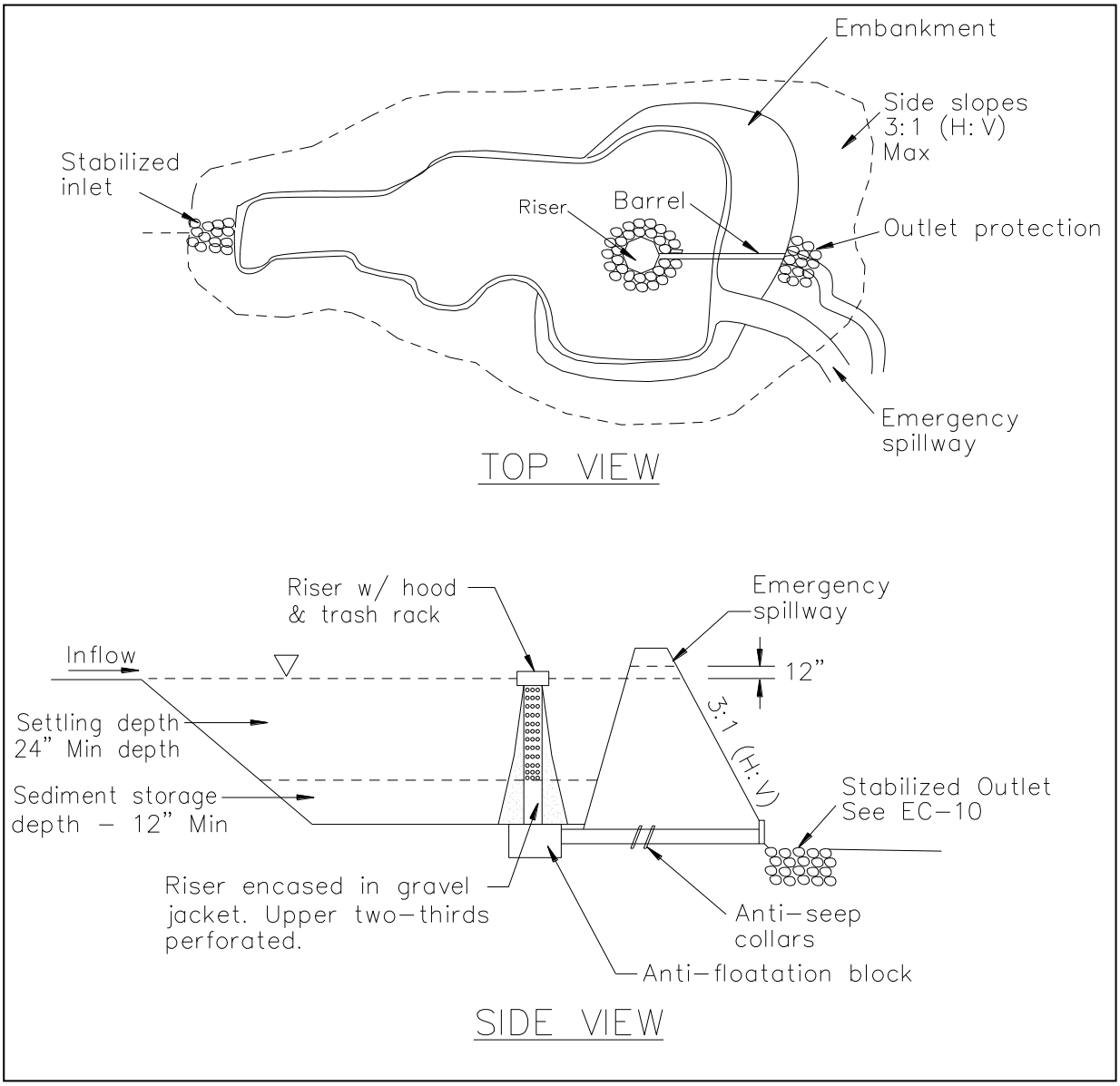


FIGURE 1: TYPICAL TEMPORARY SEDIMENT BASIN
MULTIPLE ORIFICE DESIGN
NOT TO SCALE

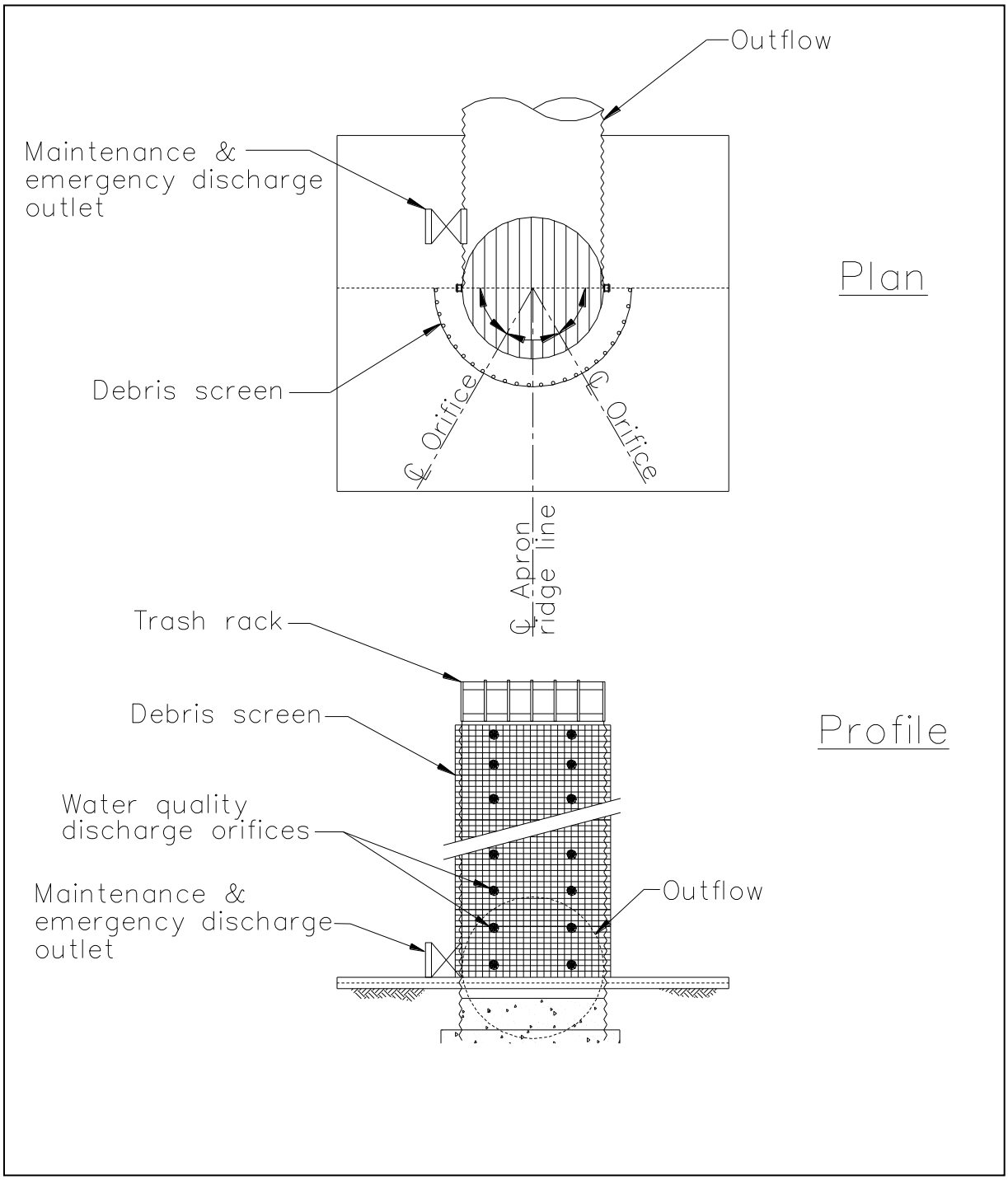


FIGURE 2: MULTIPLE ORIFICE OUTLET RISER
NOT TO SCALE

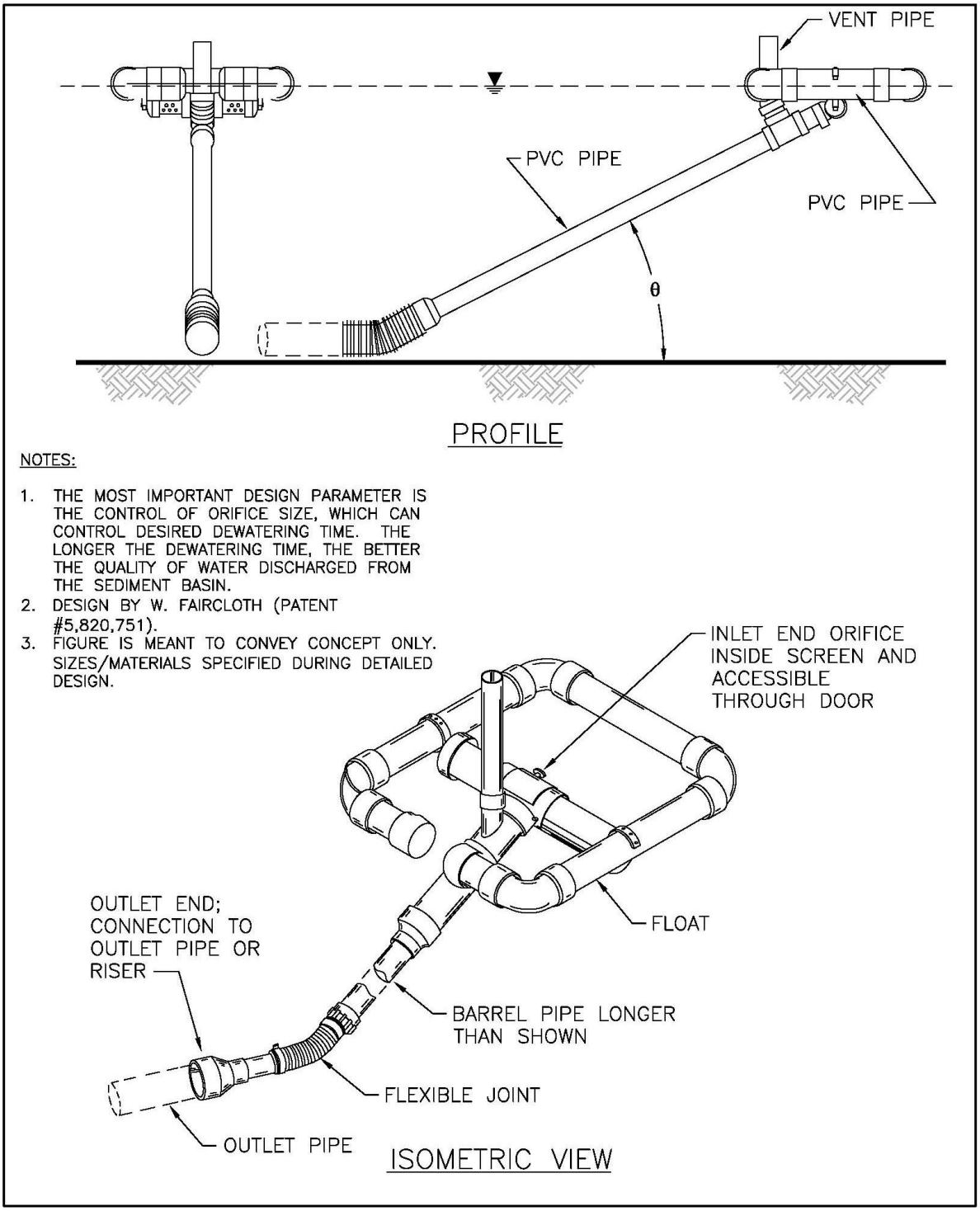


FIGURE 3: TYPICAL SKIMMER
NOT TO SCALE

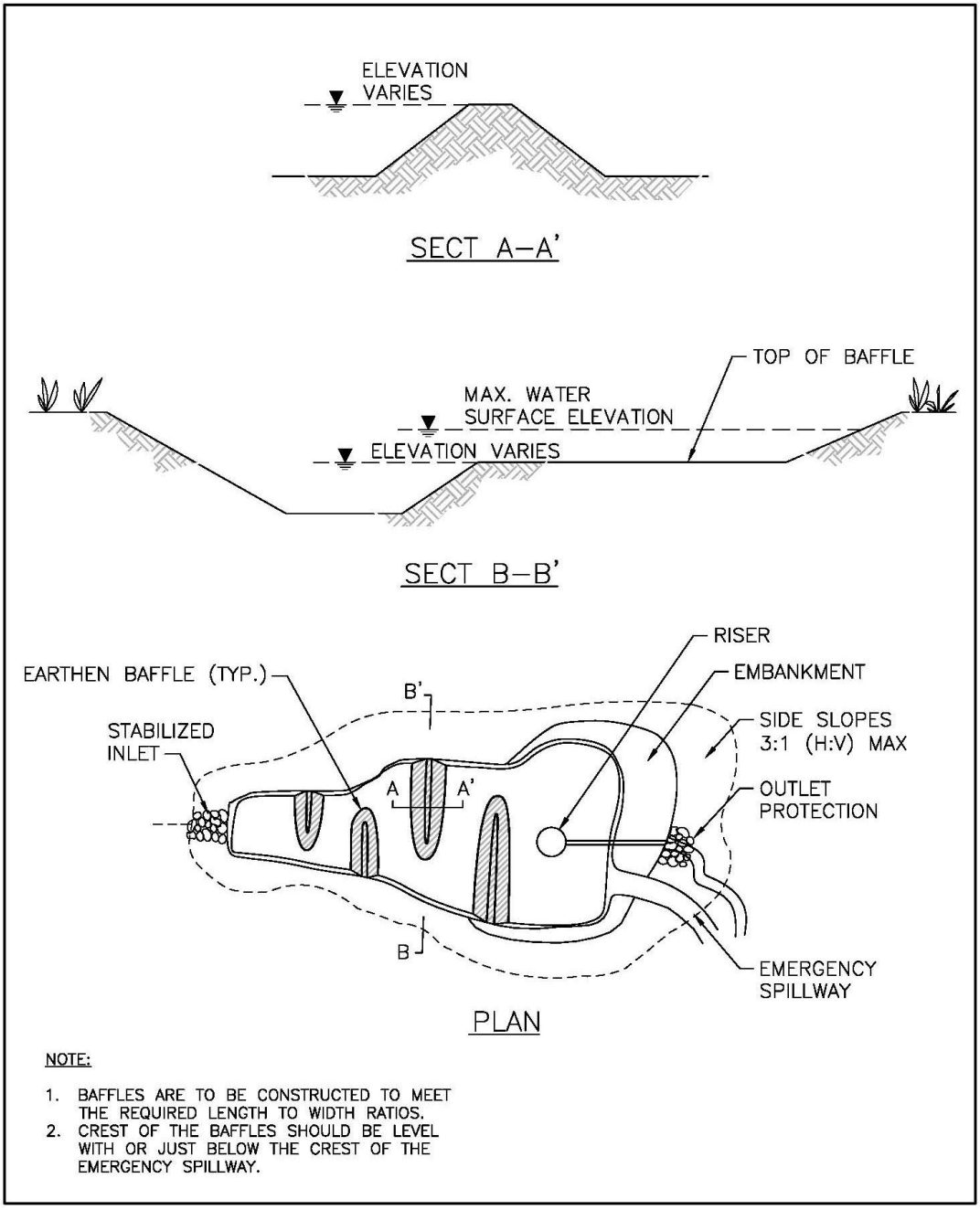
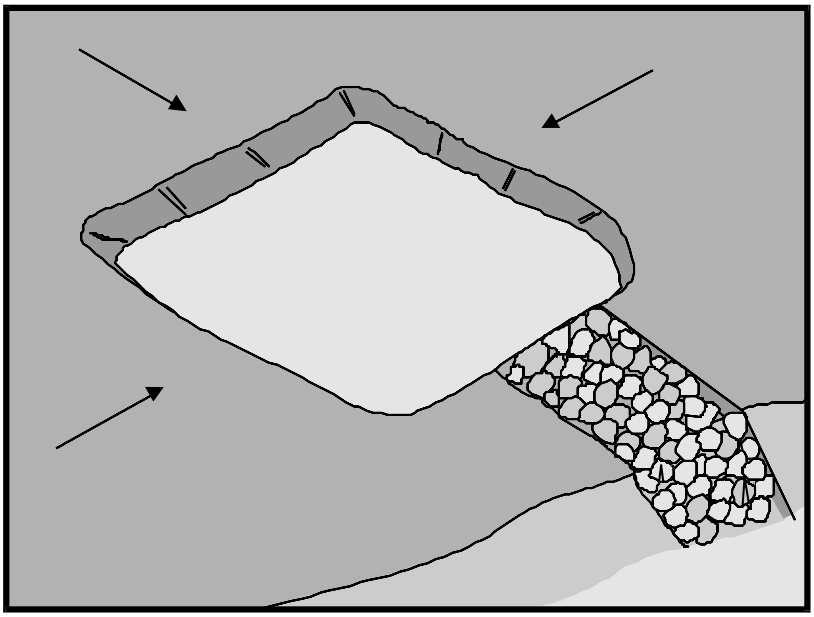


FIGURE 4: TYPICAL TEMPORARY SEDIMENT BASIN WITH BAFFLES
NOT TO SCALE

Sediment Trap SE-3



Description and Purpose

A sediment trap is a containment area where sediment-laden runoff is temporarily detained under quiescent conditions, allowing sediment to settle out or before the runoff is discharged by gravity flow. Sediment traps are formed by excavating or constructing an earthen embankment across a waterway or low drainage area.

Trap design guidance provided in this fact sheet is not intended to guarantee compliance with numeric discharge limits (numeric action levels or numeric effluent limits for turbidity). Compliance with discharge limits requires a thoughtful approach to comprehensive BMP planning, implementation, and maintenance. Therefore, optimally designed and maintained sediment traps should be used in conjunction with a comprehensive system of BMPs.

Suitable Applications

Sediment traps should be considered for use:

- At the perimeter of the site at locations where sediment-laden runoff is discharged offsite.
- At multiple locations within the project site where sediment control is needed.
- Around or upslope from storm drain inlet protection measures.
- Sediment traps may be used on construction projects where the drainage area is less than 5 acres. Traps would be

Categories

EC	Erosion Control	
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☑
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-2 Sediment Basin (for larger areas)

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

placed where sediment-laden stormwater may enter a storm drain or watercourse. SE-2, Sediment Basins, must be used for drainage areas greater than 5 acres.

- As a supplemental control, sediment traps provide additional protection for a water body or for reducing sediment before it enters a drainage system.

Limitations

- Requires large surface areas to permit infiltration and settling of sediment.
- Not appropriate for drainage areas greater than 5 acres.
- Only removes large and medium sized particles and requires upstream erosion control.
- Attractive and dangerous to children, requiring protective fencing.
- Conducive to vector production.
- Should not be located in live streams.

Implementation

Design

A sediment trap is a small temporary ponding area, usually with a gravel outlet, formed by excavation or by construction of an earthen embankment. Its purpose is to collect and store sediment from sites cleared or graded during construction. It is intended for use on small drainage areas with no unusual drainage features and projected for a quick build-out time. It should help in removing coarse sediment from runoff. The trap is a temporary measure with a design life of approximately six months to one year and is to be maintained until the site area is permanently protected against erosion by vegetation and/or structures.

Sediment traps should be used only for small drainage areas. If the contributing drainage area is greater than 5 acres, refer to SE-2, Sediment Basins, or subdivide the catchment area into smaller drainage basins.

Sediment usually must be removed from the trap after each rainfall event. The SWPPP should detail how this sediment is to be disposed, such as in fill areas onsite, or removal to an approved offsite dump. Sediment traps used as perimeter controls should be installed before any land disturbance takes place in the drainage area.

Sediment traps are usually small enough that a failure of the structure would not result in a loss of life, damage to home or buildings, or interruption in the use of public roads or utilities. However, sediment traps are attractive to children and can be dangerous. The following recommendations should be implemented to reduce risks:

- Install continuous fencing around the sediment trap or pond. Consult local ordinances regarding requirements for maintaining health and safety.
- Restrict basin side slopes to 3:1 or flatter.

Sediment trap size depends on the type of soil, size of the drainage area, and desired sediment removal efficiency (see SE-2, Sediment Basin). As a rule of thumb, the larger the basin volume

the greater the sediment removal efficiency. Sizing criteria are typically established under the local grading ordinance or equivalent. The runoff volume from a 2-year storm is a common design criteria for a sediment trap. The sizing criteria below assume that this runoff volume is 0.042 acre-ft/acre (0.5 in. of runoff). While the climatic, topographic, and soil type extremes make it difficult to establish a statewide standard, the following criteria should trap moderate to high amounts of sediment in most areas of California:

- Locate sediment traps as near as practical to areas producing the sediment.
- Trap should be situated according to the following criteria: (1) by excavating a suitable area or where a low embankment can be constructed across a swale, (2) where failure would not cause loss of life or property damage, and (3) to provide access for maintenance, including sediment removal and sediment stockpiling in a protected area.
- Trap should be sized to accommodate a settling zone and sediment storage zone with recommended minimum volumes of 67 yd^3/acre and 33 yd^3/acre of contributing drainage area, respectively, based on 0.5 in. of runoff volume over a 24-hour period. In many cases, the size of an individual trap is limited by available space. Multiple traps or additional volume may be required to accommodate specific rainfall, soil, and site conditions.
- Traps with an impounding levee greater than 4.5 ft tall, measured from the lowest point to the impounding area to the highest point of the levee, and traps capable of impounding more than 35,000 ft^3, should be designed by a Registered Civil Engineer. The design should include maintenance requirements, including sediment and vegetation removal, to ensure continuous function of the trap outlet and bypass structures.
- The outlet pipe or open spillway must be designed to convey anticipated peak flows.
- Use rock or vegetation to protect the trap outlets against erosion.
- Fencing should be provided to prevent unauthorized entry.

Installation

Sediment traps can be constructed by excavating a depression in the ground or creating an impoundment with a small embankment. Sediment traps should be installed outside the area being graded and should be built prior to the start of the grading activities or removal of vegetation. To minimize the area disturbed by them, sediment traps should be installed in natural depressions or in small swales or drainage ways. The following steps must be followed during installation:

- The area under the embankment must be cleared, grubbed, and stripped of any vegetation and root mat. The pool area should be cleared.
- The fill material for the embankment must be free of roots or other woody vegetation as well as oversized stones, rocks, organic material, or other objectionable material. The embankment may be compacted by traversing with equipment while it is being constructed.
- All cut-and-fill slopes should be 3:1 or flatter.
- When a riser is used, all pipe joints must be watertight.

- When a riser is used, at least the top two-thirds of the riser should be perforated with 0.5 in. diameter holes spaced 8 in. vertically and 10 to 12 in. horizontally. See SE-2, Sediment Basin.
- When an earth or stone outlet is used, the outlet crest elevation should be at least 1 ft below the top of the embankment.
- When crushed stone outlet is used, the crushed stone used in the outlet should meet AASHTO M43, size No. 2 or 24, or its equivalent such as MSHA No. 2. Gravel meeting the above gradation may be used if crushed stone is not available.

Costs

Average annual cost per installation and maintenance (18 month useful life) is $0.73 per ft^3 ($1,300 per drainage acre). Maintenance costs are approximately 20% of installation costs.

Inspection and Maintenance

- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect outlet area for erosion and stabilize if required.
- Inspect trap banks for seepage and structural soundness, repair as needed.
- Inspect outlet structure and spillway for any damage or obstructions. Repair damage and remove obstructions as needed.
- Inspect fencing for damage and repair as needed.
- Inspect the sediment trap for area of standing water during every visit. Corrective measures should be taken if the BMP does not dewater completely in 96 hours or less to prevent vector production.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the trap capacity. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed of at an appropriate location.
- Remove vegetation from the sediment trap when first detected to prevent pools of standing water and subsequent vector production.
- BMPs that require dewatering shall be continuously attended while dewatering takes place. Dewatering BMPs per NS-2 shall be implemented at all times during dewatering activities.

References

Brown, W., and T. Schueler. The Economics of Stormwater BMPs in the Mid-Atlantic Region. Prepared for Chesapeake Research Consortium, Edgewater, MD, by the Center for Watershed Protection, Ellicott City, MD, 1997.

Draft – Sedimentation and Erosion Control, an Inventory of Current Practices, USEPA, April 1990.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Metzger, M.E., D.F. Messer, C.L. Beitia, C.M. Myers, and V.L. Kramer, The Dark Side of Stormwater Runoff Management: Disease Vectors Associated with Structural BMPs, 2002.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

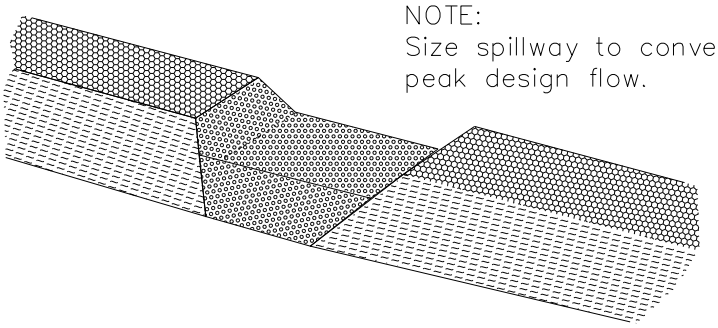
Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group-Working Paper, USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

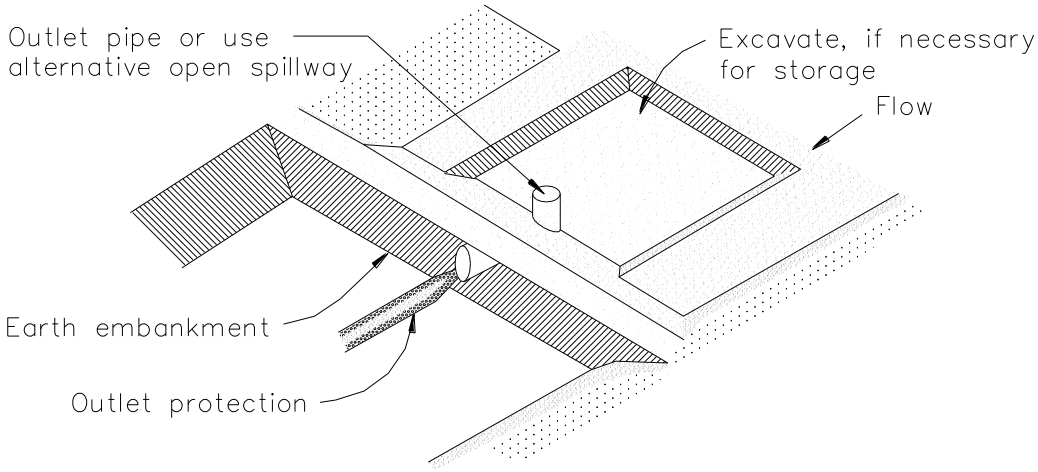
Stormwater Management Manual for The Puget Sound Basin, Washington State Department of Ecology, Public Review Draft, 1991.

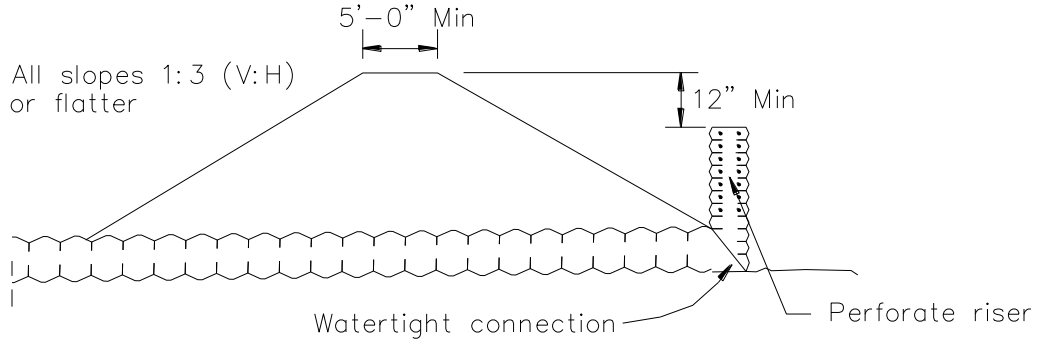
U.S. Environmental Protection Agency (USEPA). Guidance Specifying Management Measures for Nonpoint Pollution in Coastal Waters. EPA 840-B-9-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC, 1993.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



TYPICAL OPEN SPILLWAY

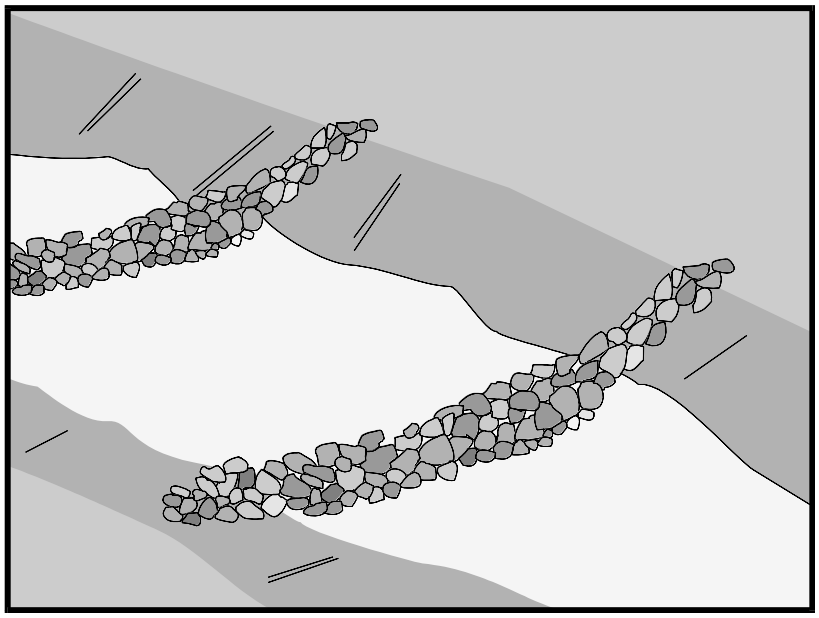




EMBANKMENT SECTION THRU RISER

TYPICAL SEDIMENT TRAP
NOT TO SCALE

Check Dams SE-4



Description and Purpose

A check dam is a small barrier constructed of rock, gravel bags, sandbags, fiber rolls, or other proprietary products, placed across a constructed swale or drainage ditch. Check dams reduce the effective slope of the channel, thereby reducing scour and channel erosion by reducing flow velocity and increasing residence time within the channel, allowing sediment to settle.

Suitable Applications

Check dams may be appropriate in the following situations:

- To promote sedimentation behind the dam.
- To prevent erosion by reducing the velocity of channel flow in small intermittent channels and temporary swales.
- In small open channels that drain 10 acres or less.
- In steep channels where stormwater runoff velocities exceed 5 ft/s.
- During the establishment of grass linings in drainage ditches or channels.
- In temporary ditches where the short length of service does not warrant establishment of erosion-resistant linings.
- To act as a grade control structure.

Categories

EC	Erosion Control	☒
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-12 Manufactured Linear Sediment Controls

SE-14 Biofilter Bags

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Limitations

- Not to be used in live streams or in channels with extended base flows.
- Not appropriate in channels that drain areas greater than 10 acres.
- Not appropriate in channels that are already grass-lined unless erosion potential or sediment-laden flow is expected, as installation may damage vegetation.
- Require extensive maintenance following high velocity flows.
- Promotes sediment trapping which can be re-suspended during subsequent storms or removal of the check dam.
- Do not construct check dams with straw bales or silt fence.
- Water suitable for mosquito production may stand behind check dams, particularly if subjected to daily non-stormwater discharges.

Implementation

General

Check dams reduce the effective slope and create small pools in swales and ditches that drain 10 acres or less. Using check dams to reduce channel slope reduces the velocity of stormwater flows, thus reducing erosion of the swale or ditch and promoting sedimentation. Thus, check dams are dual-purpose and serve an important role as erosion controls as well as as sediment controls. Note that use of 1-2 isolated check dams for sedimentation will likely result in little net removal of sediment because of the small detention time and probable scour during longer storms. Using a series of check dams will generally increase their effectiveness. A sediment trap (SE-3) may be placed immediately upstream of the check dam to increase sediment removal efficiency.

Design and Layout

Check dams work by decreasing the effective slope in ditches and swales. An important consequence of the reduced slope is a reduction in capacity of the ditch or swale. This reduction in capacity should be considered when using this BMP, as reduced capacity can result in overtopping of the ditch or swale and resultant consequences. In some cases, such as a "permanent" ditch or swale being constructed early and used as a "temporary" conveyance for construction flows, the ditch or swale may have sufficient capacity such that the temporary reduction in capacity due to check dams is acceptable. When check dams reduce capacities beyond acceptable limits, either:

- Don't use check dams. Consider alternative BMPs, or.
- Increase the size of the ditch or swale to restore capacity.

Maximum slope and velocity reduction is achieved when the toe of the upstream dam is at the same elevation as the top of the downstream dam (see "Spacing Between Check Dams" detail at the end of this fact sheet). The center section of the dam should be lower than the edge sections (at least 6 inches), acting as a spillway, so that the check dam will direct flows to the center of

the ditch or swale (see "Typical Rock Check Dam" detail at the end of this fact sheet). Bypass or side-cutting can occur if a sufficient spillway is not provided in the center of the dam.

Check dams are usually constructed of rock, gravel bags, sandbags, and fiber rolls. A number of products can also be used as check dams (e.g. HDPE check dams, temporary silt dikes (SE-12)), and some of these products can be removed and reused. Check dams can also be constructed of logs or lumber, and have the advantage of a longer lifespan when compared to gravel bags, sandbags, and fiber rolls. Check dams should not be constructed from straw bales or silt fences, since concentrated flows quickly wash out these materials.

Rock check dams are usually constructed of 8 to 12 in. rock. The rock is placed either by hand or mechanically, but never just dumped into the channel. The dam should completely span the ditch or swale to prevent washout. The rock used should be large enough to stay in place given the expected design flow through the channel. It is recommended that abutments be extended 18 in. into the channel bank. Rock can be graded such that smaller diameter rock (e.g. 2-4 in) is located on the upstream side of larger rock (holding the smaller rock in place); increasing residence time.

Log check dams are usually constructed of 4 to 6 in. diameter logs, installed vertically. The logs should be embedded into the soil at least 18 in. Logs can be bolted or wired to vertical support logs that have been driven or buried into the soil.

See fiber rolls, SE-5, for installation of fiber roll check dams.

Gravel bag and sand bag check dams are constructed by stacking bags across the ditch or swale, shaped as shown in the drawings at the end of this fact sheet (see "Gravel Bag Check Dam" detail at the end of this fact sheet).

Manufactured products, such as temporary silt dikes (SE-12), should be installed in accordance with the manufacturer's instructions. Installation typically requires anchoring or trenching of products, as well as regular maintenance to remove accumulated sediment and debris.

If grass is planted to stabilize the ditch or swale, the check dam should be removed when the grass has matured (unless the slope of the swales is greater than 4%).

The following guidance should be followed for the design and layout of check dams:

- Install the first check dam approximately 16 ft from the outfall device and at regular intervals based on slope gradient and soil type.
- Check dams should be placed at a distance and height to allow small pools to form between each check dam.
- For multiple check dam installation, backwater from a downstream check dam should reach the toes of the upstream check dam.
- A sediment trap provided immediately upstream of the check dam will help capture sediment. Due to the potential for this sediment to be resuspended in subsequent storms, the sediment trap should be cleaned following each storm event.

- High flows (typically a 2-year storm or larger) should safely flow over the check dam without an increase in upstream flooding or damage to the check dam.
- Where grass is used to line ditches, check dams should be removed when grass has matured sufficiently to protect the ditch or swale.

Materials

- Rock used for check dams should typically be 8-12 in rock and be sufficiently sized to stay in place given expected design flows in the channel. Smaller diameter rock (e.g. 2 to 4 in) can be placed on the upstream side of larger rock to increase residence time.
- Gravel bags used for check dams should conform to the requirements of SE-6, Gravel Bag Berms.
- Sandbags used for check dams should conform to SE-8, Sandbag Barrier.
- Fiber rolls used for check dams should conform to SE-5, Fiber Rolls.
- Temporary silt dikes used for check dams should conform to SE-12, Temporary Silt Dikes.

Installation

- Rock should be placed individually by hand or by mechanical methods (no dumping of rock) to achieve complete ditch or swale coverage.
- Tightly abut bags and stack according to detail shown in the figure at the end of this section (pyramid approach). Gravel bags and sandbags should not be stacked any higher than 3 ft.
- Upper rows or gravel and sand bags shall overlap joints in lower rows.
- Fiber rolls should be trenched in, backfilled, and firmly staked in place.
- Install along a level contour.
- HDPE check dams, temporary silt dikes, and other manufactured products should be used and installed per manufacturer specifications.

Costs

Cost consists of labor costs if materials are readily available (such as gravel on-site). If material must be imported, costs will increase. For other material and installation costs, see SE-5, SE-6, SE-8, SE-12, and SE-14.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Replace missing rock, bags, rolls, etc. Replace bags or rolls that have degraded or have become damaged.

- If the check dam is used as a sediment capture device, sediment that accumulates behind the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height.
- If the check dam is used as a grade control structure, sediment removal is not required as long as the system continues to control the grade.
- Inspect areas behind check dams for pools of standing water, especially if subjected to daily non-stormwater discharges.
- Remove accumulated sediment prior to permanent seeding or soil stabilization.
- Remove check dam and accumulated sediment when check dams are no longer needed.

References

Draft – Sedimentation and Erosion Control, and Inventory of Current Practices, USEPA, April 1990.

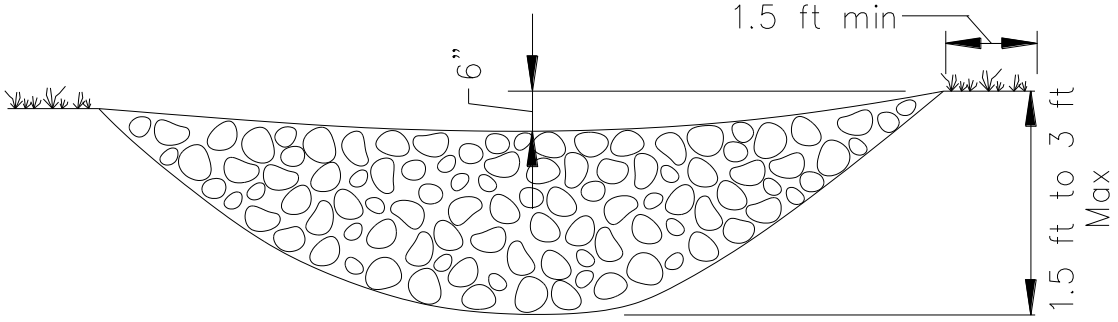
Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

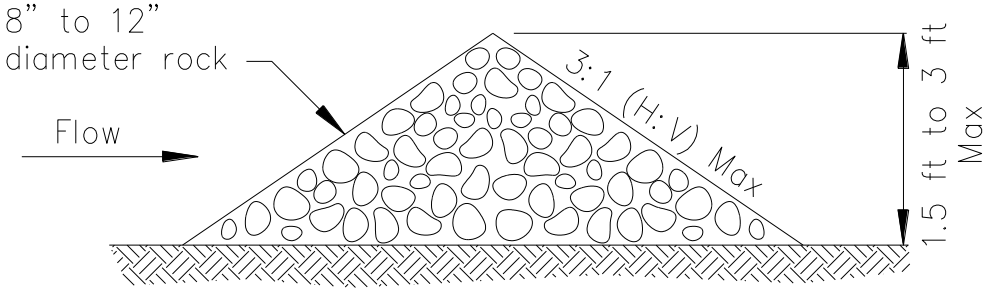
Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Metzger, M.E. 2004. Managing mosquitoes in stormwater treatment devices. University of California Division of Agriculture and Natural Resources, Publication 8125. On-line: http://anrcatalog.ucdavis.edu/pdf/8125.pdf

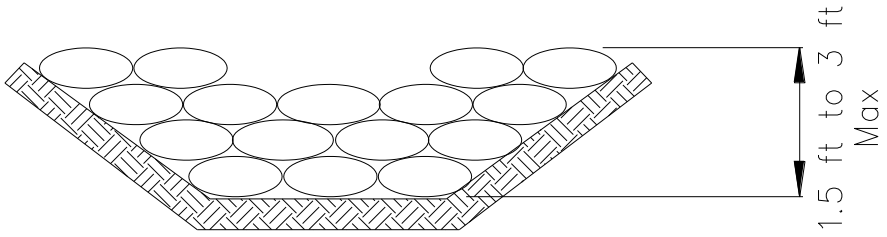


ELEVATION

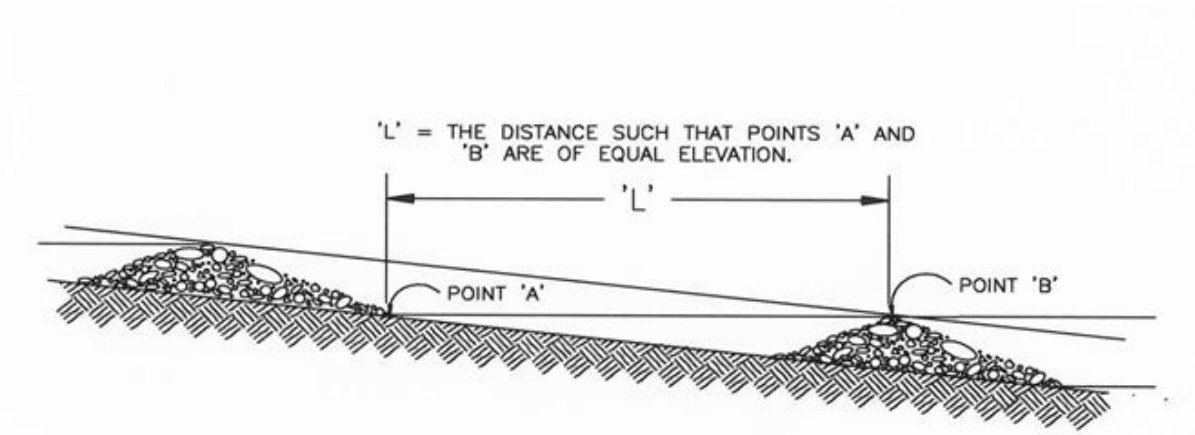


TYPICAL ROCK CHECK DAM SECTION

ROCK CHECK DAM
NOT TO SCALE

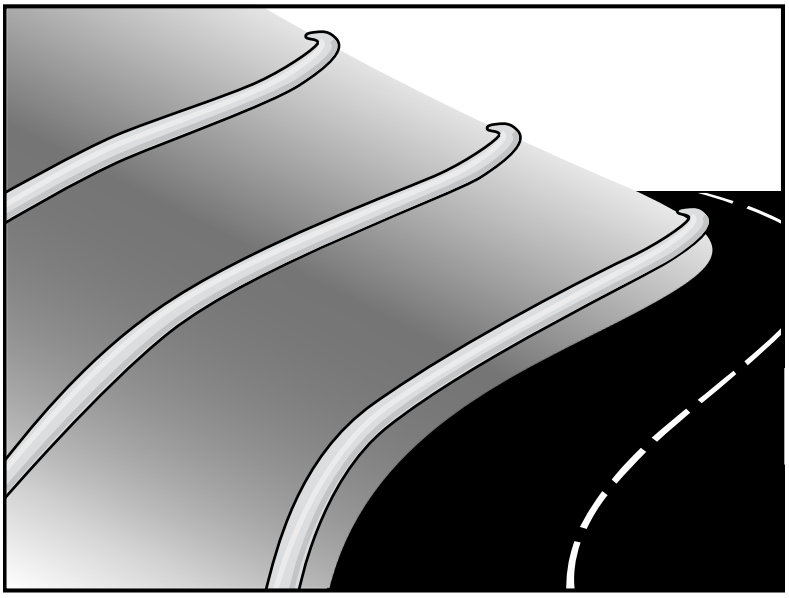


GRAVEL BAG CHECK DAM ELEVATION
NOT TO SCALE



SPACING BETWEEN CHECK DAMS

Fiber Rolls SE-5



Description and Purpose

A fiber roll consists of straw, coir, or other biodegradable materials bound into a tight tubular roll wrapped by netting, which can be photodegradable or natural. Additionally, gravel core fiber rolls are available, which contain an imbedded ballast material such as gravel or sand for additional weight when staking the rolls are not feasible (such as use as inlet protection). When fiber rolls are placed at the toe and on the face of slopes along the contours, they intercept runoff, reduce its flow velocity, release the runoff as sheet flow, and provide removal of sediment from the runoff (through sedimentation). By interrupting the length of a slope, fiber rolls can also reduce sheet and rill erosion until vegetation is established.

Suitable Applications

Fiber rolls may be suitable:

- Along the toe, top, face, and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow.
- At the end of a downward slope where it transitions to a steeper slope.
- Along the perimeter of a project.
- As check dams in unlined ditches with minimal grade.
- Down-slope of exposed soil areas.
- At operational storm drains as a form of inlet protection.

Categories

EC	Erosion Control	☒
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-12 Manufactured Linear Sediment Controls

SE-14 Biofilter Bags

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Around temporary stockpiles.

Limitations

- Fiber rolls are not effective unless trenched in and staked.
- Not intended for use in high flow situations.
- Difficult to move once saturated.
- If not properly staked and trenched in, fiber rolls could be transported by high flows.
- Fiber rolls have a very limited sediment capture zone.
- Fiber rolls should not be used on slopes subject to creep, slumping, or landslide.
- Rolls typically function for 12-24 months depending upon local conditions.

Implementation

Fiber Roll Materials

- Fiber rolls should be prefabricated.
- Fiber rolls may come manufactured containing polyacrylamide (PAM), a flocculating agent within the roll. Fiber rolls impregnated with PAM provide additional sediment removal capabilities and should be used in areas with fine, clayey or silty soils to provide additional sediment removal capabilities. Monitoring may be required for these installations.
- Fiber rolls are made from weed free rice straw, flax, or a similar agricultural material bound into a tight tubular roll by netting.
- Typical fiber rolls vary in diameter from 9 in. to 20 in. Larger diameter rolls are available as well.

Installation

- Locate fiber rolls on level contours spaced as follows:
  - Slope inclination of 4:1 (H:V) or flatter: Fiber rolls should be placed at a maximum interval of 20 ft.
  - Slope inclination between 4:1 and 2:1 (H:V): Fiber Rolls should be placed at a maximum interval of 15 ft. (a closer spacing is more effective).
  - Slope inclination 2:1 (H:V) or greater: Fiber Rolls should be placed at a maximum interval of 10 ft. (a closer spacing is more effective).
- Prepare the slope before beginning installation.
- Dig small trenches across the slope on the contour. The trench depth should be ¼ to 1/3 of the thickness of the roll, and the width should equal the roll diameter, in order to provide area to backfill the trench.

- It is critical that rolls are installed perpendicular to water movement, and parallel to the slope contour.
- Start building trenches and installing rolls from the bottom of the slope and work up.
- It is recommended that pilot holes be driven through the fiber roll. Use a straight bar to drive holes through the roll and into the soil for the wooden stakes.
- Turn the ends of the fiber roll up slope to prevent runoff from going around the roll.
- Stake fiber rolls into the trench.
  - Drive stakes at the end of each fiber roll and spaced 4 ft maximum on center.
  - Use wood stakes with a nominal classification of 0.75 by 0.75 in. and minimum length of 24 in.
- If more than one fiber roll is placed in a row, the rolls should be overlapped, not abutted.
- See typical fiber roll installation details at the end of this fact sheet.

Removal

- Fiber rolls can be left in place or removed depending on the type of fiber roll and application (temporary vs. permanent installation). Typically, fiber rolls encased with plastic netting are used for a temporary application because the netting does not biodegrade. Fiber rolls used in a permanent application are typically encased with a biodegradeable material and are left in place. Removal of a fiber roll used in a permanent application can result in greater disturbance.
- Temporary installations should only be removed when up gradient areas are stabilized per General Permit requirements, and/or pollutant sources no longer present a hazard. But, they should also be removed before vegetation becomes too mature so that the removal process does not disturb more soil and vegetation than is necessary.

Costs

Material costs for regular fiber rolls range from $20 - $30 per 25 ft roll.

Material costs for PAM impregnated fiber rolls range between 7.00-$9.00 per linear foot, based upon vendor research.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Repair or replace split, torn, unraveling, or slumping fiber rolls.
- If the fiber roll is used as a sediment capture device, or as an erosion control device to maintain sheet flows, sediment that accumulates in the BMP should be periodically removed

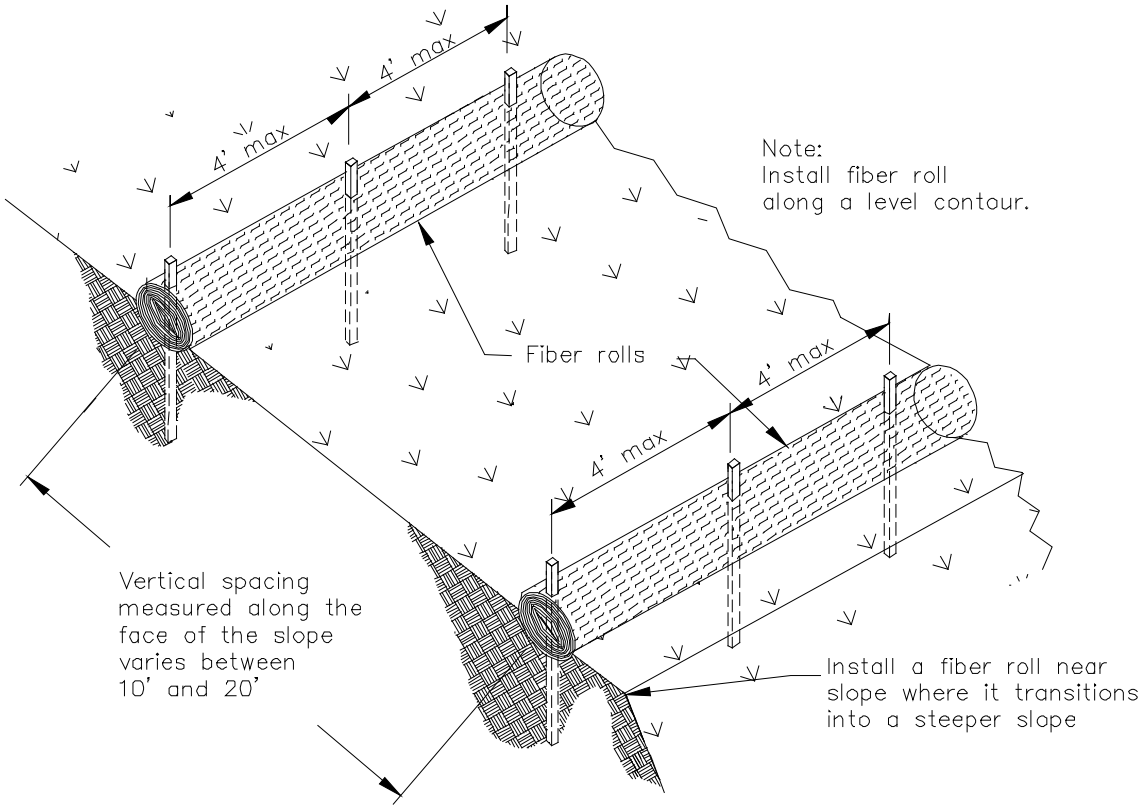
in order to maintain BMP effectiveness. Sediment should be removed when sediment accumulation reaches one-third the designated sediment storage depth.

- If fiber rolls are used for erosion control, such as in a check dam, sediment removal should not be required as long as the system continues to control the grade. Sediment control BMPs will likely be required in conjunction with this type of application.
- Repair any rills or gullies promptly.

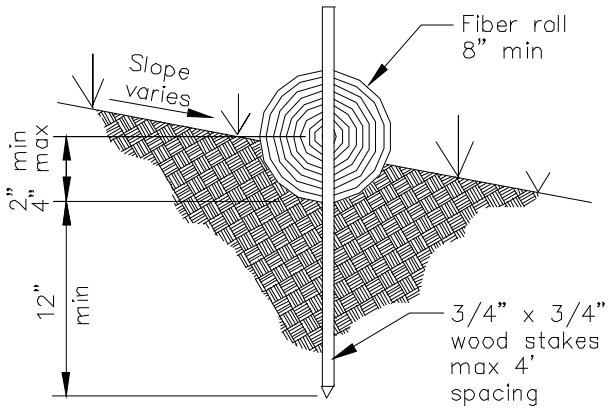
References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

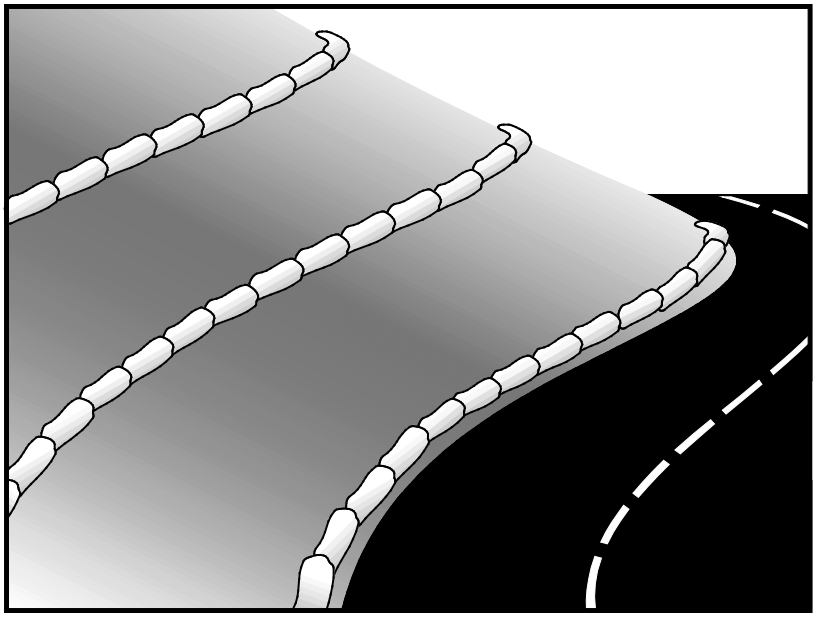


TYPICAL FIBER ROLL INSTALLATION
N.T.S.



ENTRENCHMENT DETAIL
N.T.S.

Gravel Bag Berm SE-6



Description and Purpose

A gravel bag berm is a series of gravel-filled bags placed on a level contour to intercept sheet flows. Gravel bags pond sheet flow runoff, allowing sediment to settle out, and release runoff slowly as sheet flow, preventing erosion.

Suitable Applications

Gravel bag berms may be suitable:

- As a linear sediment control measure:
  - Below the toe of slopes and erodible slopes
  - As sediment traps at culvert/pipe outlets
  - Below other small cleared areas
  - Along the perimeter of a site
  - Down slope of exposed soil areas
  - Around temporary stockpiles and spoil areas
  - Parallel to a roadway to keep sediment off paved areas
  - Along streams and channels
- As a linear erosion control measure:
  - Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow.

Categories

EC	Erosion Control	☒
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Roll

SE-8 Sandbag Barrier

SE-12 Temporary Silt Dike

SE-14 Biofilter Bags

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- At the top of slopes to divert runoff away from disturbed slopes.
- As chevrons (small check dams) across mildly sloped construction roads. For use check dam use in channels, see SE-4, Check Dams.

Limitations

- Gravel berms may be difficult to remove.
- Removal problems limit their usefulness in landscaped areas.
- Gravel bag berm may not be appropriate for drainage areas greater than 5 acres.
- Runoff will pond upstream of the berm, possibly causing flooding if sufficient space does not exist.
- Degraded gravel bags may rupture when removed, spilling contents.
- Installation can be labor intensive.
- Durability of gravel bags is somewhat limited and bags may need to be replaced when installation is required for longer than 6 months.
- Easily damaged by construction equipment.
- When used to detain concentrated flows, maintenance requirements increase.

Implementation

General

A gravel bag berm consists of a row of open graded gravel-filled bags placed on a level contour. When appropriately placed, a gravel bag berm intercepts and slows sheet flow runoff, causing temporary ponding. The temporary ponding allows sediment to settle. The open graded gravel in the bags is porous, which allows the ponded runoff to flow slowly through the bags, releasing the runoff as sheet flows. Gravel bag berms also interrupt the slope length and thereby reduce erosion by reducing the tendency of sheet flows to concentrate into rivulets, which erode rills, and ultimately gullies, into disturbed, sloped soils. Gravel bag berms are similar to sand bag barriers, but are more porous. Generally, gravel bag berms should be used in conjunction with temporary soil stabilization controls up slope to provide effective erosion and sediment control.

Design and Layout

- Locate gravel bag berms on level contours.
- When used for slope interruption, the following slope/sheet flow length combinations apply:
  - Slope inclination of 4:1 (H:V) or flatter: Gravel bags should be placed at a maximum interval of 20 ft, with the first row near the slope toe.
  - Slope inclination between 4:1 and 2:1 (H:V): Gravel bags should be placed at a maximum interval of 15 ft. (a closer spacing is more effective), with the first row near the slope toe.

Slope inclination 2:1 (H:V) or greater: Gravel bags should be placed at a maximum interval of 10 ft. (a closer spacing is more effective), with the first row near the slope toe.

- Turn the ends of the gravel bag barriers up slope to prevent runoff from going around the berm.
- Allow sufficient space up slope from the gravel bag berm to allow ponding, and to provide room for sediment storage.
- For installation near the toe of the slope, gravel bag barriers should be set back from the slope toe to facilitate cleaning. Where specific site conditions do not allow for a set-back, the gravel bag barrier may be constructed on the toe of the slope. To prevent flows behind the barrier, bags can be placed perpendicular to a berm to serve as cross barriers.
- Drainage area should not exceed 5 acres.
- In Non-Traffic Areas:
  - Height = 18 in. maximum
  - Top width = 24 in. minimum for three or more layer construction
  - Top width = 12 in. minimum for one or two layer construction
  - Side slopes = 2:1 (H:V) or flatter
- In Construction Traffic Areas:
  - Height = 12 in. maximum
  - Top width = 24 in. minimum for three or more layer construction.
  - Top width = 12 in. minimum for one or two layer construction.
  - Side slopes = 2:1 (H:V) or flatter.
- Butt ends of bags tightly.
- On multiple row, or multiple layer construction, overlap butt joints of adjacent row and row beneath.
- Use a pyramid approach when stacking bags.

Materials

- ***Bag Material:*** Bags should be woven polypropylene, polyethylene or polyamide fabric or burlap, minimum unit weight of 4 ounces/yd^2, Mullen burst strength exceeding 300 lb/in^2 in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70% in conformance with the requirements in ASTM designation D4355.

- ***Bag Size:*** Each gravel-filled bag should have a length of 18 in., width of 12 in., thickness of 3 in., and mass of approximately 33 lbs. Bag dimensions are nominal, and may vary based on locally available materials.

- ***Fill Material:*** Fill material should be 0.5 to 1 in. crushed rock, clean and free from clay, organic matter, and other deleterious material, or other suitable open graded, non-cohesive, porous gravel.

Costs

Material costs for gravel bags are average and are dependent upon material availability. $2.50-3.00 per filled gravel bag is standard based upon vendor research.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Gravel bags exposed to sunlight will need to be replaced every two to three months due to degrading of the bags.

- Reshape or replace gravel bags as needed.

- Repair washouts or other damage as needed.

- Sediment that accumulates in the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height.

- Remove gravel bag berms when no longer needed and recycle gravel fill whenever possible and properly dispose of bag material. Remove sediment accumulation and clean, re-grade, and stabilize the area.

References

Handbook of Steel Drainage and Highway Construction, American Iron and Steel Institute, 1983.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Pollution Plan Handbook, First Edition, State of California, Department of Transportation Division of New Technology, Materials and Research, October 1992.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Street Sweeping and Vacuuming SE-7



Description and Purpose

Street sweeping and vacuuming includes use of self-propelled and walk-behind equipment to remove sediment from streets and roadways, and to clean paved surfaces in preparation for final paving. Sweeping and vacuuming prevents sediment from the project site from entering storm drains or receiving waters.

Suitable Applications

Sweeping and vacuuming are suitable anywhere sediment is tracked from the project site onto public or private paved streets and roads, typically at points of egress. Sweeping and vacuuming are also applicable during preparation of paved surfaces for final paving.

Limitations

Sweeping and vacuuming may not be effective when sediment is wet or when tracked soil is caked (caked soil may need to be scraped loose).

Implementation

- Controlling the number of points where vehicles can leave the site will allow sweeping and vacuuming efforts to be focused, and perhaps save money.
- Inspect potential sediment tracking locations daily.
- Visible sediment tracking should be swept or vacuumed on a daily basis.

Categories

EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☑
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Do not use kick brooms or sweeper attachments. These tend to spread the dirt rather than remove it.
- If not mixed with debris or trash, consider incorporating the removed sediment back into the project

Costs

Rental rates for self-propelled sweepers vary depending on hopper size and duration of rental. Expect rental rates from $58/hour (3 yd^3 hopper) to $88/hour (9 yd^3 hopper), plus operator costs. Hourly production rates vary with the amount of area to be swept and amount of sediment. Match the hopper size to the area and expect sediment load to minimize time spent dumping.

Inspection and Maintenance

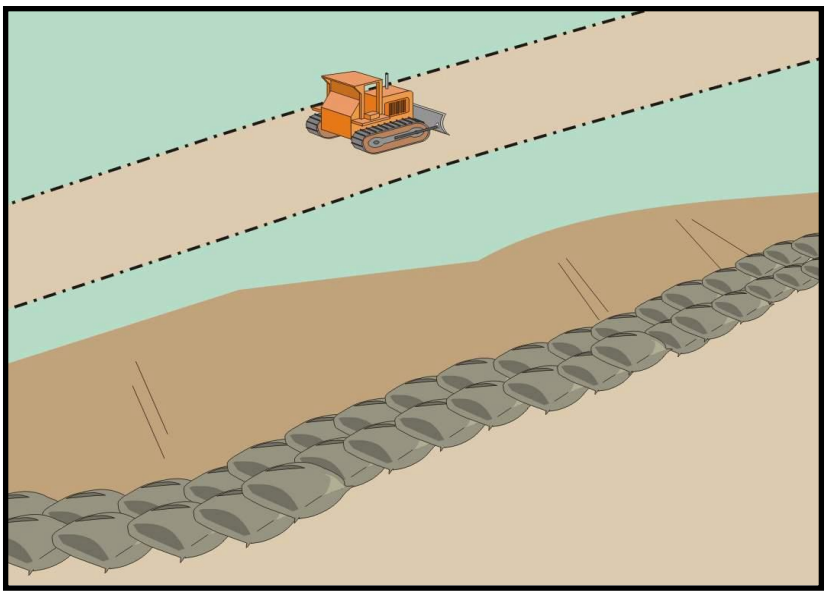
- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- When actively in use, points of ingress and egress must be inspected daily.
- When tracked or spilled sediment is observed outside the construction limits, it must be removed at least daily. More frequent removal, even continuous removal, may be required in some jurisdictions.
- Be careful not to sweep up any unknown substance or any object that may be potentially hazardous.
- Adjust brooms frequently; maximize efficiency of sweeping operations.
- After sweeping is finished, properly dispose of sweeper wastes at an approved dumpsite.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Labor Surcharge and Equipment Rental Rates, State of California Department of Transportation (Caltrans), April 1, 2002 – March 31, 2003.

Sandbag Barrier SE-8



Categories		
EC	Erosion Control	☒
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Description and Purpose

A sandbag barrier is a series of sand-filled bags placed on a level contour to intercept or to divert sheet flows. Sandbag barriers placed on a level contour pond sheet flow runoff, allowing sediment to settle out.

Suitable Applications

Sandbag barriers may be a suitable control measure for the applications described below. It is important to consider that sand bags are less porous than gravel bags and ponding or flooding can occur behind the barrier. Also, sand is easily transported by runoff if bags are damaged or ruptured. The SWPPP Preparer should select the location of a sandbag barrier with respect to the potential for flooding, damage, and the ability to maintain the BMP.

- As a linear sediment control measure:
  - Below the toe of slopes and erodible slopes.
  - As sediment traps at culvert/pipe outlets.
  - Below other small cleared areas.
  - Along the perimeter of a site.
  - Down slope of exposed soil areas.
  - Around temporary stockpiles and spoil areas.
  - Parallel to a roadway to keep sediment off paved areas.
  - Along streams and channels.

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-12 Manufactured Linear Sediment Controls

SE-14 Biofilter Bags

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- As linear erosion control measure:
  - Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow.
  - At the top of slopes to divert runoff away from disturbed slopes.
  - As check dams across mildly sloped construction roads.

Limitations

- It is necessary to limit the drainage area upstream of the barrier to 5 acres.
- Sandbags are not intended to be used as filtration devices.
- Easily damaged by construction equipment.
- Degraded sandbags may rupture when removed, spilling sand.
- Installation can be labor intensive.
- Durability of sandbags is somewhat limited and bags will need to be replaced when there are signs of damage or wear.
- Burlap should not be used for sandbags.

Implementation

General

A sandbag barrier consists of a row of sand-filled bags placed on a level contour. When appropriately placed, a sandbag barrier intercepts and slows sheet flow runoff, causing temporary ponding. The temporary ponding allows sediment to settle. Sand-filled bags have limited porosity, which is further limited as the fine sand tends to quickly plug with sediment, limiting or completely blocking the rate of flow through the barrier. If a porous barrier is desired, consider SE-1, Silt Fence, SE-5, Fiber Rolls, SE-6, Gravel Bag Berms or SE-14, Biofilter Bags. Sandbag barriers also interrupt the slope length and thereby reduce erosion by reducing the tendency of sheet flows to concentrate into rivulets which erode rills, and ultimately gullies, into disturbed, sloped soils. Sandbag barriers are similar to gravel bag berms, but less porous. Generally, sandbag barriers should be used in conjunction with temporary soil stabilization controls up slope to provide effective erosion and sediment control.

Design and Layout

- Locate sandbag barriers on a level contour.
- When used for slope interruption, the following slope/sheet flow length combinations apply:
  - Slope inclination of 4:1 (H:V) or flatter: Sandbags should be placed at a maximum interval of 20 ft, with the first row near the slope toe.
  - Slope inclination between 4:1 and 2:1 (H:V): Sandbags should be placed at a maximum interval of 15 ft. (a closer spacing is more effective), with the first row near the slope toe.

- Slope inclination 2:1 (H:V) or greater: Sandbags should be placed at a maximum interval of 10 ft. (a closer spacing is more effective), with the first row near the slope toe.

- Turn the ends of the sandbag barrier up slope to prevent runoff from going around the barrier.
- Allow sufficient space up slope from the barrier to allow ponding, and to provide room for sediment storage.
- For installation near the toe of the slope, sand bag barriers should be set back from the slope toe to facilitate cleaning. Where specific site conditions do not allow for a set-back, the sand bag barrier may be constructed on the toe of the slope. To prevent flows behind the barrier, bags can be placed perpendicular to a berm to serve as cross barriers.
- Drainage area should not exceed 5 acres.
- Butt ends of bags tightly.
- Overlap butt joints of row beneath with each successive row.
- Use a pyramid approach when stacking bags.
- In non-traffic areas
  - Height = 18 in. maximum
  - Top width = 24 in. minimum for three or more layer construction
  - Side slope = 2:1 (H:V) or flatter
- In construction traffic areas
  - Height = 12 in. maximum
  - Top width = 24 in. minimum for three or more layer construction.
  - Side slopes = 2:1 (H:V) or flatter.
- See typical sandbag barrier installation details at the end of this fact sheet.

Materials

- ***Sandbag Material:*** Sandbag should be woven polypropylene, polyethylene or polyamide fabric, minimum unit weight of 4 ounces/yd^2, Mullen burst strength exceeding 300 lb/in^2 in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70% in conformance with the requirements in ASTM designation D4355. Use of burlap is not an acceptable substitute, as sand can more easily mobilize out of burlap.
- ***Sandbag Size:*** Each sand-filled bag should have a length of 18 in., width of 12 in., thickness of 3 in., and mass of approximately 33 lbs. Bag dimensions are nominal, and may vary based on locally available materials.

- ***Fill Material:*** All sandbag fill material should be non-cohesive, Class 3 (Caltrans Standard Specification, Section 25) or similar permeable material free from clay and deleterious material, such as recycled concrete or asphalt.

Costs

Empty sandbags cost $0.25 - $0.75. Average cost of fill material is $8 per yd^3. Additional labor is required to fill the bags. Pre-filled sandbags are more expensive at $1.50 - $2.00 per bag. These costs are based upon vendor research.

Inspection and Maintenance

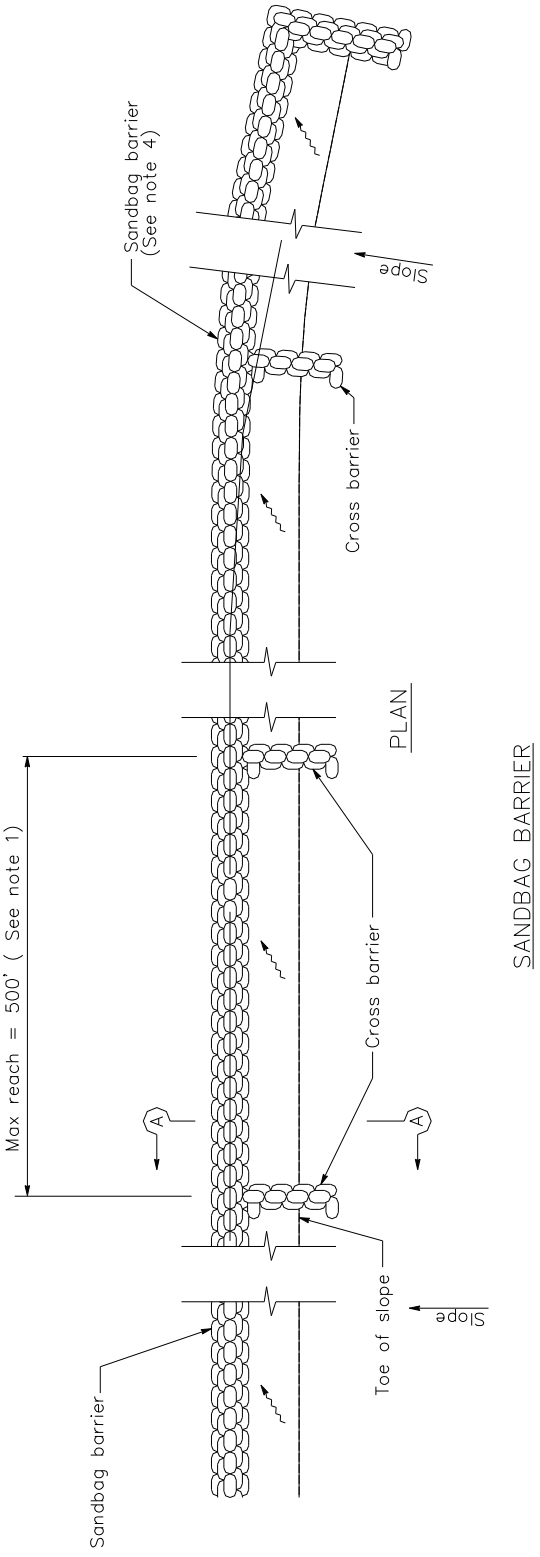
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Sandbags exposed to sunlight will need to be replaced every two to three months due to degradation of the bags.
- Reshape or replace sandbags as needed.
- Repair washouts or other damage as needed.
- Sediment that accumulates behind the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height.
- Remove sandbags when no longer needed and recycle sand fill whenever possible and properly dispose of bag material. Remove sediment accumulation, and clean, re-grade, and stabilize the area.

References

Standard Specifications for Construction of Local Streets and Roads, California Department of Transportation (Caltrans), July 2002.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

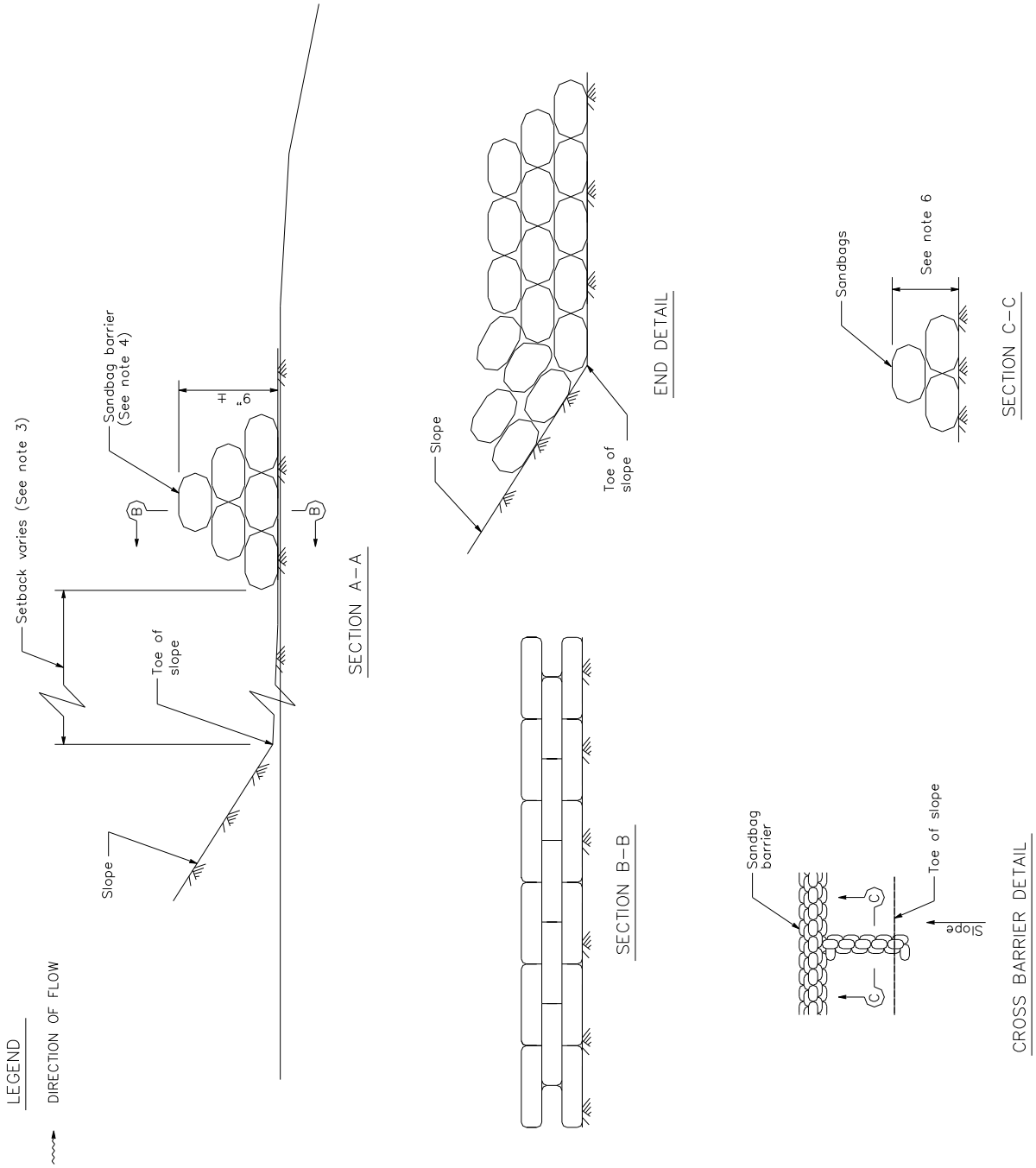
Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.



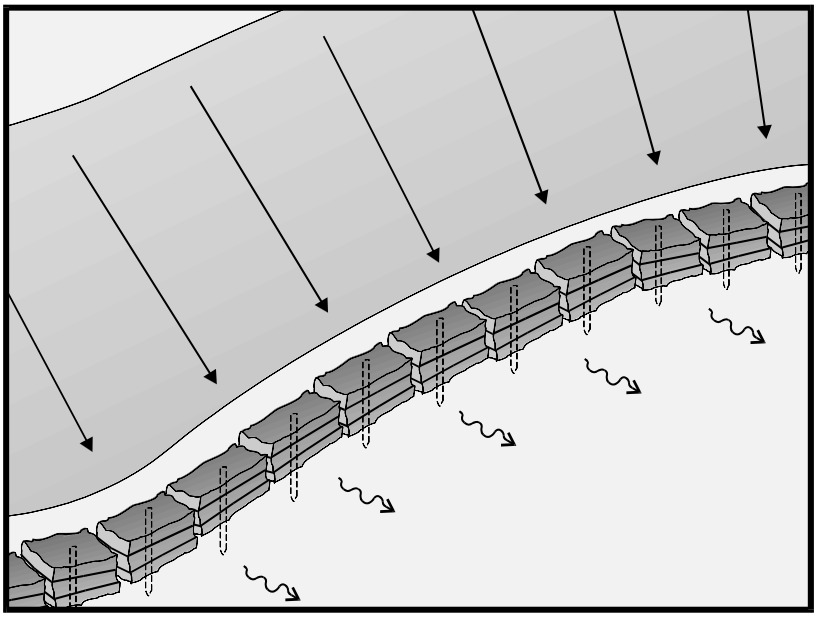
SANDBAG BARRIER

NOTES

1. Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/2 the height of the linear barrier. In no case shall the reach length exceed 500'.
2. Place sandbags tightly.
3. Dimension may vary to fit field condition.
4. Sandbag barrier shall be a minimum of 3 bags high.
5. The end of the barrier shall be turned up slope.
6. Cross barriers shall be a min of 1/2 and a max of 2/3 the height of the linear barrier.
7. Sandbag rows and layers shall be staggered to eliminate gaps.


LEGEND
DIRECTION OF FLOW
Setback varies (See note 3)
Sandbag barrier (See note 4)
H
B
B
Toe of slope
Slope
SECTION A-A
Slope
Toe of slope
END DETAIL
SECTION B-B
Sandbags
See note 6
SECTION C-C
Sandbag barrier
C
C
Toe of slope
Slope
CROSS BARRIER DETAIL

Straw Bale Barrier SE-9



Description and Purpose

A straw bale barrier is a series of straw bales placed on a level contour to intercept sheet flows. Straw bale barriers pond sheet-flow runoff, allowing sediment to settle out.

Suitable Applications

Straw bale barriers may be suitable:

- As a linear sediment control measure:
  - Below the toe of slopes and erodible slopes
  - As sediment traps at culvert/pipe outlets
  - Below other small cleared areas
  - Along the perimeter of a site
  - Down slope of exposed soil areas
  - Around temporary stockpiles and spoil areas
  - Parallel to a roadway to keep sediment off paved areas
  - Along streams and channels
- As linear erosion control measure:
  - Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow

Categories

EC	Erosion Control	☒
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-12 Temporary Silt Dike

SE-14 Biofilter Bags

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- At the top of slopes to divert runoff away from disturbed slopes
- As check dams across mildly sloped construction roads

Limitations

Straw bale barriers:

- Are not to be used for extended periods of time because they tend to rot and fall apart
- Are suitable only for sheet flow on slopes of 10 % or flatter
- Are not appropriate for large drainage areas, limit to one acre or less
- May require constant maintenance due to rotting
- Are not recommended for concentrated flow, inlet protection, channel flow, and live streams
- Cannot be made of bale bindings of jute or cotton
- Require labor-intensive installation and maintenance
- Cannot be used on paved surfaces
- Should not to be used for drain inlet protection
- Should not be used on lined ditches
- May introduce undesirable non-native plants to the area

Implementation

General

A straw bale barrier consists of a row of straw bales placed on a level contour. When appropriately placed, a straw bale barrier intercepts and slows sheet flow runoff, causing temporary ponding. The temporary ponding provides quiescent conditions allowing sediment to settle. Straw bale barriers also interrupt the slope length and thereby reduce erosion by reducing the tendency of sheet flows to concentrate into rivulets, which erode rills, and ultimately gullies, into disturbed, sloped soils.

Straw bale barriers have not been as effective as expected due to improper use. These barriers have been placed in streams and drainage ways where runoff volumes and velocities have caused the barriers to wash out. In addition, failure to stake and entrench the straw bale has allowed undercutting and end flow. Use of straw bale barriers in accordance with this BMP should produce acceptable results.

Design and Layout

- Locate straw bale barriers on a level contour.
  - Slopes up to 10:1 (H:V): Straw bales should be placed at a maximum interval of 50 ft (a closer spacing is more effective), with the first row near the toe of slope.
  - Slopes greater than 10:1 (H:V): Not recommended.

- Turn the ends of the straw bale barrier up slope to prevent runoff from going around the barrier.
- Allow sufficient space up slope from the barrier to allow ponding, and to provide room for sediment storage.
- For installation near the toe of the slope, consider moving the barrier away from the slope toe to facilitate cleaning. To prevent flow behind the barrier, sand bags can be placed perpendicular to the barrier to serve as cross barriers.
- Drainage area should not exceed 1 acre, or 0.25 acre per 100 ft of barrier.
- Maximum flow path to the barrier should be limited to 100 ft.
- Straw bale barriers should consist of two parallel rows.
  - Butt ends of bales tightly
  - Stagger butt joints between front and back row
  - Each row of bales must be trenched in and firmly staked
- Straw bale barriers are limited in height to one bale laid on its side.
- Anchor bales with either two wood stakes or four bars driven through the bale and into the soil. Drive the first stake towards the butt joint with the adjacent bale to force the bales together.
- See attached figure for installation details.

Materials

- ***Straw Bale Size:*** Each straw bale should be a minimum of 14 in. wide, 18 in. in height, 36 in. in length and should have a minimum mass of 50 lbs. The straw bale should be composed entirely of vegetative matter, except for the binding material.
- ***Bale Bindings:*** Bales should be bound by steel wire, nylon or polypropylene string placed horizontally. Jute and cotton binding should not be used. Baling wire should be a minimum diameter of 14 gauge. Nylon or polypropylene string should be approximately 12 gauge in diameter with a breaking strength of 80 lbs force.
- ***Stakes:*** Wood stakes should be commercial quality lumber of the size and shape shown on the plans. Each stake should be free from decay, splits or cracks longer than the thickness of the stake, or other defects that would weaken the stakes and cause the stakes to be structurally unsuitable. Steel bar reinforcement should be equal to a #4 designation or greater. End protection should be provided for any exposed bar reinforcement.

Costs

Straw bales cost $5 - $7 each. Adequate labor should be budgeted for installation and maintenance.

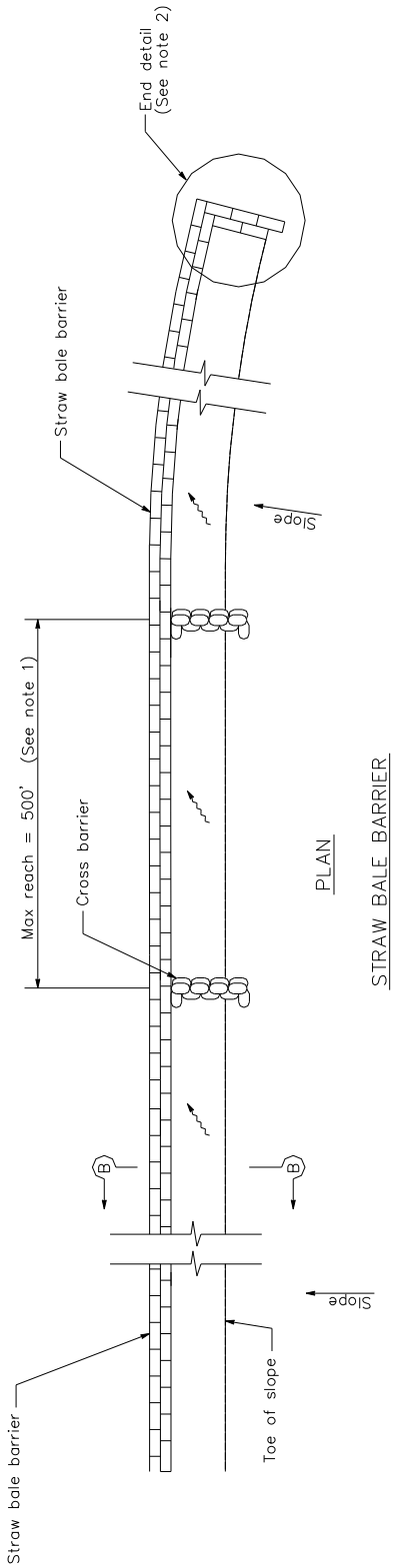
Inspection and Maintenance

Maintenance

- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Straw bales degrade, especially when exposed to moisture. Rotting bales will need to be replaced on a regular basis.
- Replace or repair damaged bales as needed.
- Repair washouts or other damages as needed.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.
- Remove straw bales when no longer needed. Remove sediment accumulation, and clean, re-grade, and stabilize the area. Removed sediment should be incorporated in the project or disposed of.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.



PLAN

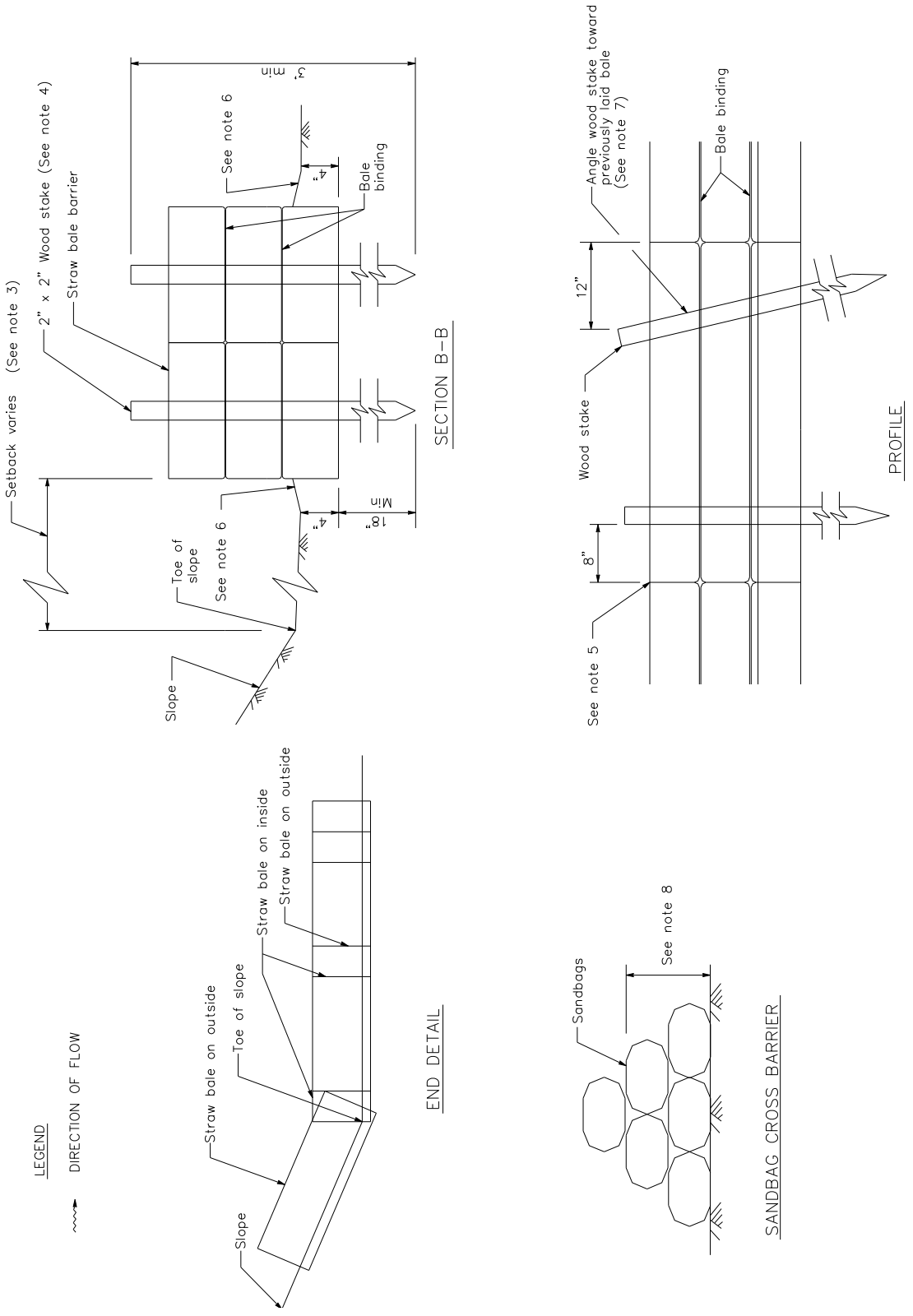
STRAW BALE BARRIER

LEGEND

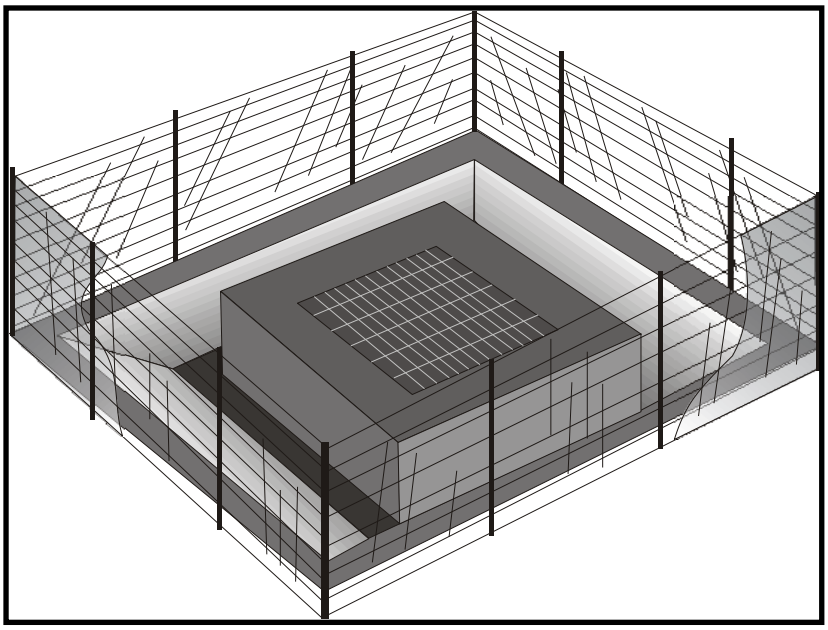
DIRECTION OF FLOW

NOTES

1. Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/2 the height of the linear barrier. In no case shall the reach length exceed 500'.
2. The end of barrier shall be turned up slope.
3. Dimension may vary to fit field condition.
4. Stake dimensions are nominal.
5. Place straw bales tightly together.
6. Tamp embedment spoils against sides of installed bales.
7. Drive angled wood stake before vertical stake to ensure tight abutment to adjacent bale.
8. Sandbag cross barriers should be a min of 1/2 and a max of 2/3 the height of the linear barrier.
9. Sandbag rows and layers should be offset to eliminate gaps.


Setback varies (See note 3)
2" x 2" Wood stake (See note 4)
Straw bale barrier
See note 6
Bale binding
Min 3"
4"
Min 18"
Toe of slope
See note 6
Slope
SECTION B-B
Angle wood stake toward previously laid bale (See note 7)
Bale binding
12"
Wood stake
8"
See note 5
PROFILE
LEGEND
DIRECTION OF FLOW
Straw bale on outside
Toe of slope
Straw bale on inside
Straw bale on outside
Slope
END DETAIL
Sandbags
See note 8
SANDBAG CROSS BARRIER

Storm Drain Inlet Protection SE-10



Description and Purpose

Storm drain inlet protection consists of a sediment filter or an impounding area in, around or upstream of a storm drain, drop inlet, or curb inlet. Storm drain inlet protection measures temporarily pond runoff before it enters the storm drain, allowing sediment to settle. Some filter configurations also remove sediment by filtering, but usually the ponding action results in the greatest sediment reduction. Temporary geotextile storm drain inserts attach underneath storm drain grates to capture and filter storm water.

Suitable Applications

- Every storm drain inlet receiving runoff from unstabilized or otherwise active work areas should be protected. Inlet protection should be used in conjunction with other erosion and sediment controls to prevent sediment-laden stormwater and non-stormwater discharges from entering the storm drain system.

Limitations

- Drainage area should not exceed 1 acre.
- In general straw bales should not be used as inlet protection.
- Requires an adequate area for water to pond without encroaching into portions of the roadway subject to traffic.
- Sediment removal may be inadequate to prevent sediment discharges in high flow conditions or if runoff is heavily sediment laden. If high flow conditions are expected, use

Categories

EC	Erosion Control	
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☒
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-14 Biofilter Bags

SE-13 Compost Socks and Berms

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

other onsite sediment trapping techniques in conjunction with inlet protection.

- Frequent maintenance is required.
- Limit drainage area to 1 acre maximum. For drainage areas larger than 1 acre, runoff should be routed to a sediment-trapping device designed for larger flows. See BMPs SE-2, Sediment Basin, and SE-3, Sediment Traps.
- Excavated drop inlet sediment traps are appropriate where relatively heavy flows are expected, and overflow capability is needed.

Implementation

General

Inlet control measures presented in this handbook should not be used for inlets draining more than one acre. Runoff from larger disturbed areas should be first routed through SE-2, Sediment Basin or SE-3, Sediment Trap and/or used in conjunction with other drainage control, erosion control, and sediment control BMPs to protect the site. Different types of inlet protection are appropriate for different applications depending on site conditions and the type of inlet. Alternative methods are available in addition to the methods described/shown herein such as prefabricated inlet insert devices, or gutter protection devices.

Design and Layout

Identify existing and planned storm drain inlets that have the potential to receive sediment-laden surface runoff. Determine if storm drain inlet protection is needed and which method to use.

- The key to successful and safe use of storm drain inlet protection devices is to know where runoff that is directed toward the inlet to be protected will pond or be diverted as a result of installing the protection device.
  - Determine the acceptable location and extent of ponding in the vicinity of the drain inlet. The acceptable location and extent of ponding will influence the type and design of the storm drain inlet protection device.
  - Determine the extent of potential runoff diversion caused by the storm drain inlet protection device. Runoff ponded by inlet protection devices may flow around the device and towards the next downstream inlet. In some cases, this is acceptable; in other cases, serious erosion or downstream property damage can be caused by these diversions. The possibility of runoff diversions will influence whether or not storm drain inlet protection is suitable; and, if suitable, the type and design of the device.
- The location and extent of ponding, and the extent of diversion, can usually be controlled through appropriate placement of the inlet protection device. In some cases, moving the inlet protection device a short distance upstream of the actual inlet can provide more efficient sediment control, limit ponding to desired areas, and prevent or control diversions.
- Seven types of inlet protection are presented below. However, it is recognized that other effective methods and proprietary devices exist and may be selected.

- Silt Fence: Appropriate for drainage basins with less than a 5% slope, sheet flows, and flows under 0.5 cfs.

- Excavated Drop Inlet Sediment Trap: An excavated area around the inlet to trap sediment (SE-3).

- Gravel bag barrier: Used to create a small sediment trap upstream of inlets on sloped, paved streets. Appropriate for sheet flow or when concentrated flow may exceed 0.5 cfs, and where overtopping is required to prevent flooding.

- Block and Gravel Filter: Appropriate for flows greater than 0.5 cfs.

- Temporary Geotextile Storm drain Inserts: Different products provide different features. Refer to manufacturer details for targeted pollutants and additional features.

- Biofilter Bag Barrier: Used to create a small retention area upstream of inlets and can be located on pavement or soil. Biofilter bags slowly filter runoff allowing sediment to settle out. Appropriate for flows under 0.5 cfs.

- Compost Socks: Allow filtered run-off to pass through the compost while retaining sediment and potentially other pollutants (SE-13). Appropriate for flows under 1.0 cfs.

- Select the appropriate type of inlet protection and design as referred to or as described in this fact sheet.

- Provide area around the inlet for water to pond without flooding structures and property.

- Grates and spaces around all inlets should be sealed to prevent seepage of sediment-laden water.

- Excavate sediment sumps (where needed) 1 to 2 ft with 2:1 side slopes around the inlet.

Installation

- ***DI Protection Type 1 - Silt Fence -*** Similar to constructing a silt fence; see BMP SE-1, Silt Fence. Do not place fabric underneath the inlet grate since the collected sediment may fall into the drain inlet when the fabric is removed or replaced and water flow through the grate will be blocked resulting in flooding. See typical Type 1 installation details at the end of this fact sheet.

  1. Excavate a trench approximately 6 in. wide and 6 in. deep along the line of the silt fence inlet protection device.

  2. Place 2 in. by 2 in. wooden stakes around the perimeter of the inlet a maximum of 3 ft apart and drive them at least 18 in. into the ground or 12 in. below the bottom of the trench. The stakes should be at least 48 in.

  3. Lay fabric along bottom of trench, up side of trench, and then up stakes. See SE-1, Silt Fence, for details. The maximum silt fence height around the inlet is 24 in.

  4. Staple the filter fabric (for materials and specifications, see SE-1, Silt Fence) to wooden stakes. Use heavy-duty wire staples at least 1 in. in length.

5. Backfill the trench with gravel or compacted earth all the way around.

- ***DI Protection Type 2 - Excavated Drop Inlet Sediment Trap -*** Install filter fabric fence in accordance with DI Protection Type 1. Size excavated trap to provide a minimum storage capacity calculated at the rate 67 yd^3/acre of drainage area. See typical Type 2 installation details at the end of this fact sheet.

- ***DI Protection Type 3 - Gravel bag -*** Flow from a severe storm should not overtop the curb. In areas of high clay and silts, use filter fabric and gravel as additional filter media. Construct gravel bags in accordance with SE-6, Gravel Bag Berm. Gravel bags should be used due to their high permeability. See typical Type 3 installation details at the end of this fact sheet.

  1. Construct on gently sloping street.

  2. Leave room upstream of barrier for water to pond and sediment to settle.

  3. Place several layers of gravel bags – overlapping the bags and packing them tightly together.

  4. Leave gap of one bag on the top row to serve as a spillway. Flow from a severe storm (e.g., 10 year storm) should not overtop the curb.

- ***DI Protection Type 4 – Block and Gravel Filter -*** Block and gravel filters are suitable for curb inlets commonly used in residential, commercial, and industrial construction. See typical Type 4 installation details at the end of this fact sheet.

  1. Place hardware cloth or comparable wire mesh with 0.5 in. openings over the drop inlet so that the wire extends a minimum of 1 ft beyond each side of the inlet structure. If more than one strip is necessary, overlap the strips. Place woven geotextile over the wire mesh.

  2. Place concrete blocks lengthwise on their sides in a single row around the perimeter of the inlet, so that the open ends face outward, not upward. The ends of adjacent blocks should abut. The height of the barrier can be varied, depending on design needs, by stacking combinations of blocks that are 4 in., 8 in., and 12 in. wide. The row of blocks should be at least 12 in. but no greater than 24 in. high.

  3. Place wire mesh over the outside vertical face (open end) of the concrete blocks to prevent stone from being washed through the blocks. Use hardware cloth or comparable wire mesh with 0.5 in. opening.

  4. Pile washed stone against the wire mesh to the top of the blocks. Use 0.75 to 3 in.

- ***DI Protection Type 5 – Temporary Geotextile Insert (proprietary) –*** Many types of temporary inserts are available. Most inserts fit underneath the grate of a drop inlet or inside of a curb inlet and are fastened to the outside of the grate or curb. These inserts are removable and many can be cleaned and reused. Installation of these inserts differs between manufacturers. Please refer to manufacturer instruction for installation of proprietary devices.

- ***DI Protection Type 6 - Biofilter bags*** – Biofilter bags may be used as a substitute for gravel bags in low-flow situations. Biofilter bags should conform to specifications detailed in SE-14, Biofilter bags.

    1. Construct in a gently sloping area.
    2. Biofilter bags should be placed around inlets to intercept runoff flows.
    3. All bag joints should overlap by 6 in.
    4. Leave room upstream for water to pond and for sediment to settle out.
    5. Stake bags to the ground as described in the following detail. Stakes may be omitted if bags are placed on a paved surface.

- ***DI Protection Type 7 – Compost Socks*** – A compost sock can be assembled on site by filling a mesh sock (e.g., with a pneumatic blower). Compost socks do not require special trenching compared to other sediment control methods (e.g., silt fence). Compost socks should conform to specification detailed in SE-13, Compost Socks and Berms.

Costs

- Average annual cost for installation and maintenance of DI Type 1-4 and 6 (one year useful life) is $200 per inlet.
- Temporary geotextile inserts are proprietary and cost varies by region. These inserts can often be reused and may have greater than 1 year of use if maintained and kept undamaged. Average cost per insert ranges from $50-75 plus installation, but costs can exceed $100. This cost does not include maintenance.
- See SE-13 for Compost Sock cost information.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Silt Fences. If the fabric becomes clogged, torn, or degrades, it should be replaced. Make sure the stakes are securely driven in the ground and are in good shape (i.e., not bent, cracked, or splintered, and are reasonably perpendicular to the ground). Replace damaged stakes. At a minimum, remove the sediment behind the fabric fence when accumulation reaches one-third the height of the fence or barrier height.
- Gravel Filters. If the gravel becomes clogged with sediment, it should be carefully removed from the inlet and either cleaned or replaced. Since cleaning gravel at a construction site may be difficult, consider using the sediment-laden stone as fill material and put fresh stone around the inlet. Inspect bags for holes, gashes, and snags, and replace bags as needed. Check gravel bags for proper arrangement and displacement.

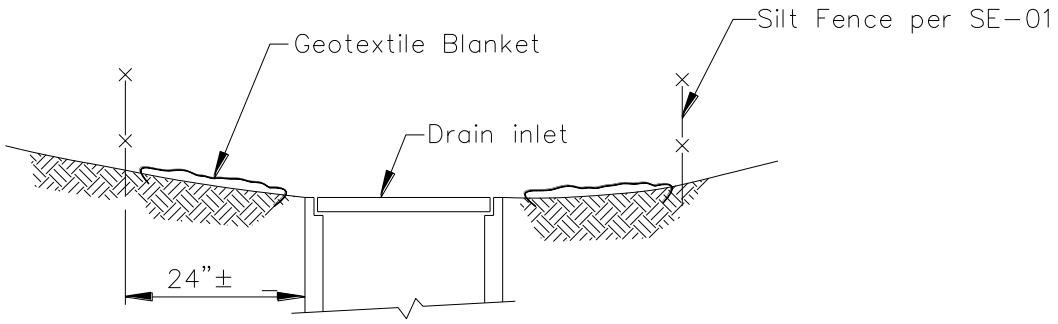
- Sediment that accumulates in the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height.
- Inspect and maintain temporary geotextile insert devices according to manufacturer's specifications.
- Remove storm drain inlet protection once the drainage area is stabilized.
    - Clean and regrade area around the inlet and clean the inside of the storm drain inlet, as it should be free of sediment and debris at the time of final inspection.

References

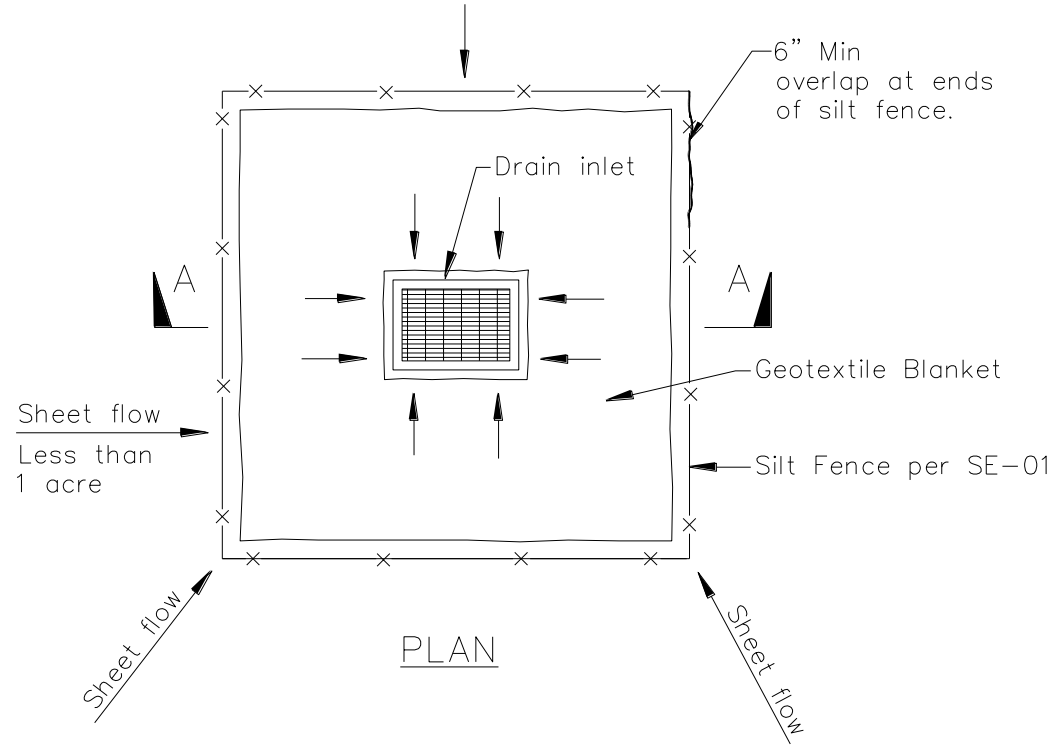
Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management Manual for The Puget Sound Basin, Washington State Department of Ecology, Public Review Draft, 1991.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.



SECTION A–A

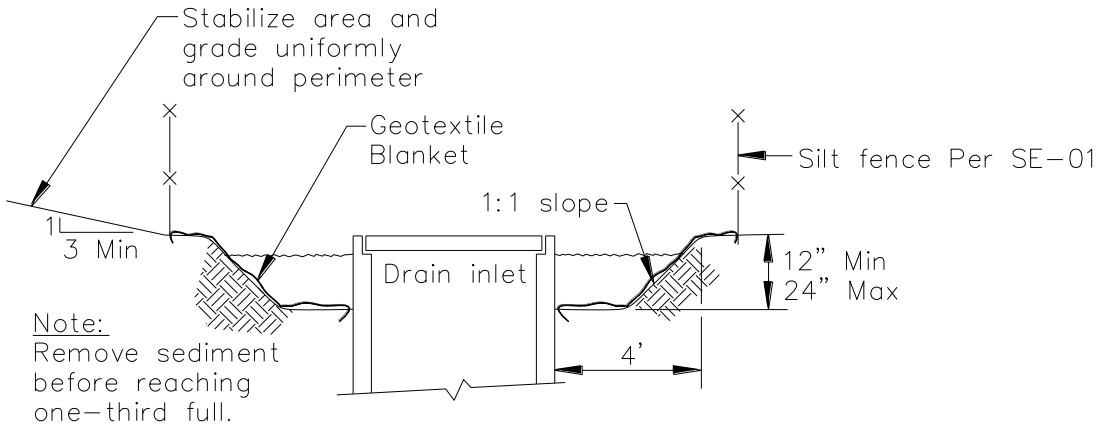


PLAN

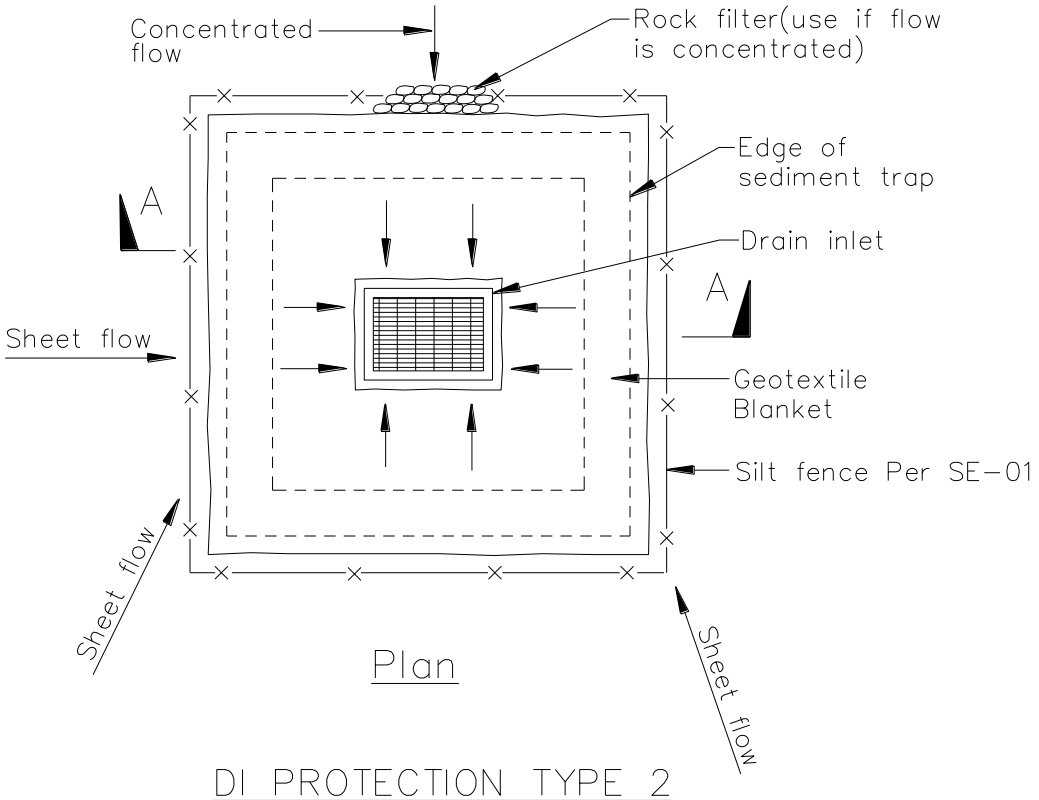
DI PROTECTION TYPE 1
NOT TO SCALE

NOTES:

1. For use in areas where grading has been completed and final soil stabilization and seeding are pending.
2. Not applicable in paved areas.
3. Not applicable with concentrated flows.



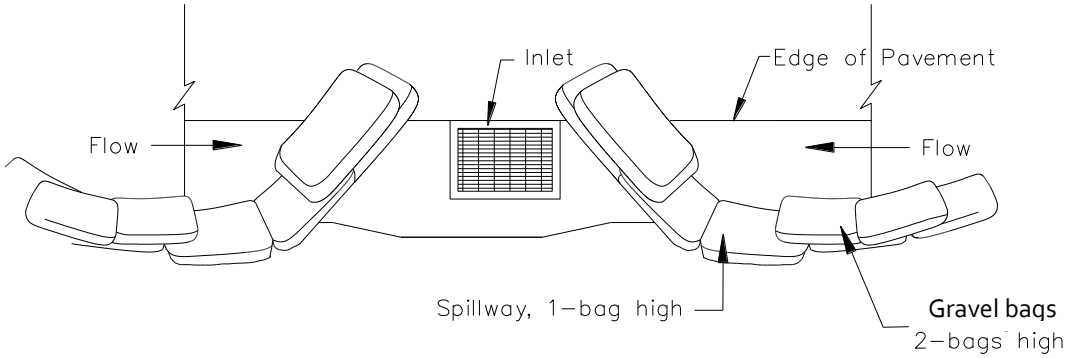
Section A–A



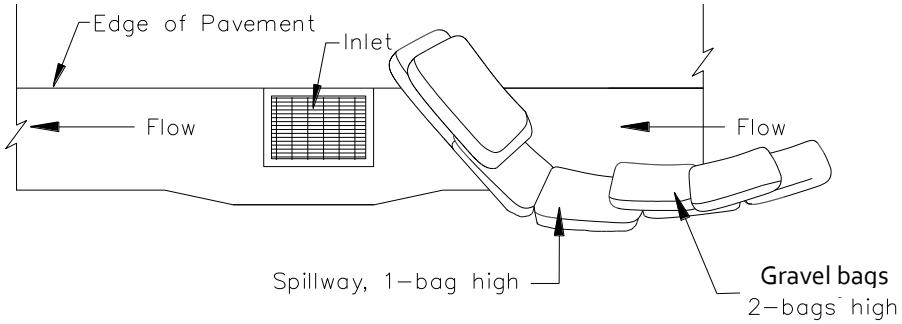
Plan

DI PROTECTION TYPE 2
NOT TO SCALE

Notes
1. For use in cleared and grubbed and in graded areas.
2. Shape basin so that longest inflow area faces longest length of trap.
3. For concentrated flows, shape basin in 2:1 ratio with length oriented towards direction of flow.



TYPICAL PROTECTION FOR INLET ON SUMP

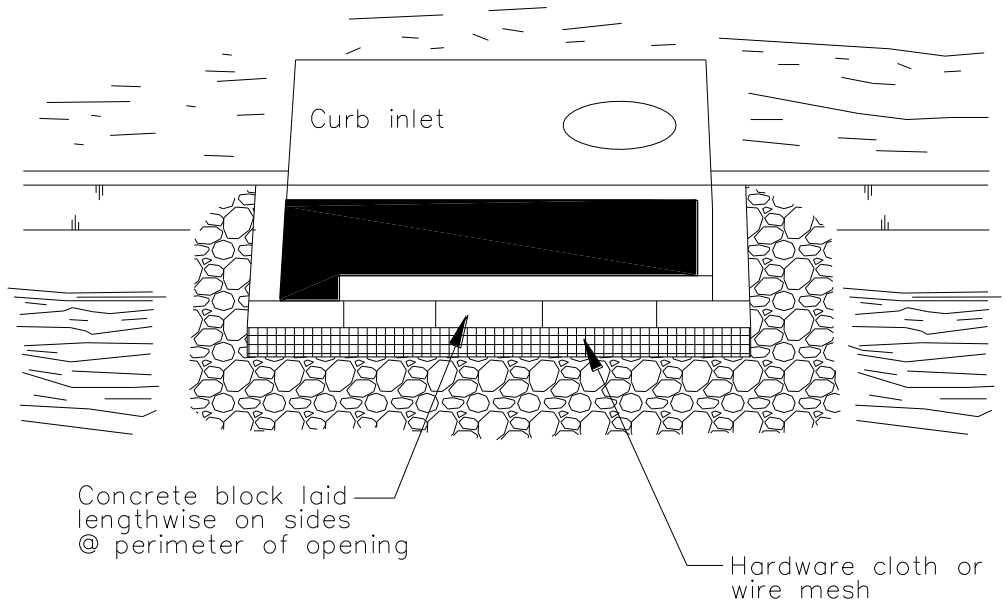


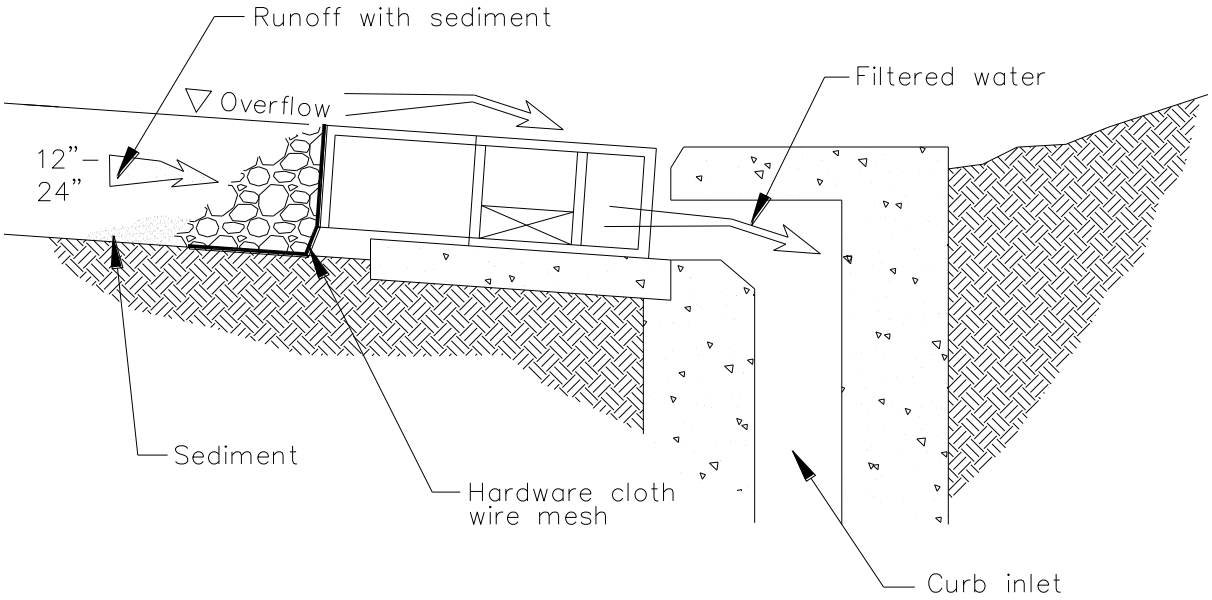
TYPICAL PROTECTION FOR INLET ON GRADE

NOTES:

1. Intended for short-term use.
2. Use to inhibit non-storm water flow.
3. Allow for proper maintenance and cleanup.
4. Bags must be removed after adjacent operation is completed
5. Not applicable in areas with high silts and clays without filter fabric.
6. Protection can be effective even if it is not immediately adjacent to the inlet provided that the inlet is protected from potential sources of pollution.

DI PROTECTION TYPE 3
NOT TO SCALE

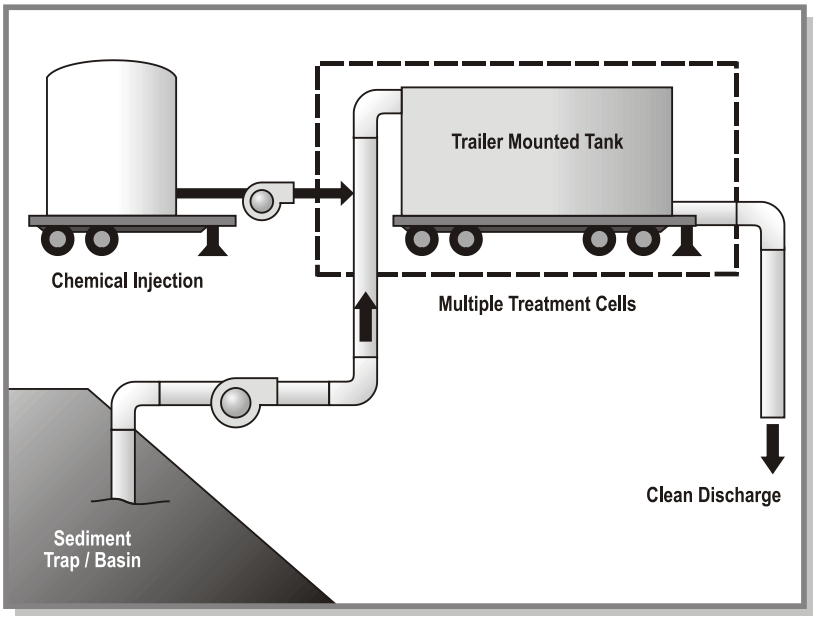




DI PROTECTION – TYPE 4

NOT TO SCALE

Active Treatment Systems SE-11



Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Active Treatment Systems (ATS) reduce turbidity of construction site runoff by introducing chemicals to stormwater through direct dosing or an electrical current to enhance flocculation, coagulation, and settling of the suspended sediment. Coagulants and flocculants are used to enhance settling and removal of suspended sediments and generally include inorganic salts and polymers (USACE, 2001). The increased flocculation aids in sedimentation and ability to remove fine suspended sediments, thus reducing stormwater runoff turbidity and improving water quality.

Suitable Applications

ATS can reliably provide exceptional reductions of turbidity and associated pollutants and should be considered where turbid discharges to sediment and turbidity sensitive waters cannot be avoided using traditional BMPs. Additionally, it may be appropriate to use an ATS when site constraints inhibit the ability to construct a correctly sized sediment basin, when clay and/or highly erosive soils are present, or when the site has very steep or long slope lengths.

Limitations

Dischargers choosing to utilize chemical treatment in an ATS must follow all guidelines of the Construction General Permit Attachment F – Active Treatment System Requirements. General limitations are as follows:

- Numeric Effluent Limit (NEL) for all discharges (10 NTU daily flow-weighted average)
- Limited availability of chemical residual testing procedures that meet permit requirements for flow-through treatment
- Specific field and classroom ATS training required to operate equipment
- Batch treatment requires extensive toxicity testing of effluent
- Batch treatment requires large footprint to accommodate treatment cells
- Requires additional filtration to remove residual floc and treatment chemicals prior to discharge
- Petroleum based polymers should not be used
- Requires site-specific design and equipment
- Limited discharge rates depending on receiving water body
- Labor intensive operation and maintenance
- ATS costs are higher on a unit basis for smaller sites that would be expected to have a lower volume of treated runoff
- ATS costs are seasonably variable due to increases or decreases in rainfall volumes

Implementation

Turbidity is difficult to control once fine particles are suspended in stormwater runoff from a construction site. Sedimentation ponds are effective at removing larger particulate matter by gravity settling, but are ineffective at removing smaller particulates such as clay and fine silt. Sediment ponds are typically designed to remove sediment no smaller than medium silt (0.02 mm). ATS may be used to reduce the turbidity of stormwater runoff. With an ATS, very high turbidities can be reduced to levels comparable to what is found in streams during dry weather.

Criteria for ATS Product Use

Chemically treated stormwater discharged from construction sites must be non-toxic to aquatic organisms. The following protocol should be used to evaluate chemicals proposed for stormwater treatment at construction sites. Authorization to use a chemical in the field based on this protocol does not relieve the applicant from responsibility for meeting all discharge and receiving water criteria applicable to a site.

- An ATS Plan, which includes an Operation and Maintenance component, a Monitoring, Sampling and Reporting component, a Health and Safety component, and a Spill Prevention component must be prepared and submitted to the Regional Water Quality Control Board (RWQCB).

- Treatment chemicals should be approved by EPA for potable water use or otherwise be demonstrated to be protective of human health and the environment. Chemical residual or whole effluent toxicity testing is required.

- Prior to field use of chemical treatment, jar tests are to be conducted to demonstrate that turbidity reduction necessary to meet the NELs and receiving water criteria can be achieved. Test conditions, including but not limited to raw water quality and jar test procedures, should be indicative of field conditions. Although these small-scale tests cannot be expected to reproduce performance under field conditions, they are indicative of treatment capability. A minimum of six site-specific jar tests must be conducted per chemical.

- The proposed maximum dosage should be at least a factor of five lower than the no observed effects concentration (NOEC).

- Effluent discharge from an ATS to a receiving water is conditional upon the favorable results of full-scale whole effluent bioassay/toxicity testing for batch treatment systems and upon chemical residuals testing for flow-through systems.

- Contact the RWQCB for a list of treatment chemicals that may be pre-approved for use.

Active Treatment System Design Considerations

The design and operation of an ATS should take into consideration the factors that determine optimum, cost-effective performance. While site characteristics will influence system design, it is important to recognize the following overriding considerations:

- The right chemical must be used at the right dosage. A dosage that is either too low or too high will not produce the lowest turbidity. There is an optimum dosage rate. This is a situation where the adage "adding more is always better" is not the case.

- The coagulant must be mixed rapidly into the water to insure proper dispersion.

- The mixing system for batch treatment must be sized to provide adequate mixing for the design storage volume. Lack of adequate mixing during the flocculation phase results in flocs that are too small and/or insufficiently dense. Too much mixing can rapidly destroy floc as it is formed.

- Care must be taken in the design of the withdrawal system to minimize outflow velocities and to prevent floc discharge. The discharge should be directed through a filtration system such as sand, bag, or cartridge filter that would catch any unintended floc discharge.

- ATS is also regulated for pH of the discharge. A pH-adjusting chemical should be added into the treated water to control pH if the selected coagulant requires alteration of the pH of the discharge outside of the acceptable range.

Active Treatment System Design

ATS can be designed as batch treatment systems using either ponds or portable trailer-mounted tanks, or as flow-through systems using any number of proprietary designed systems.

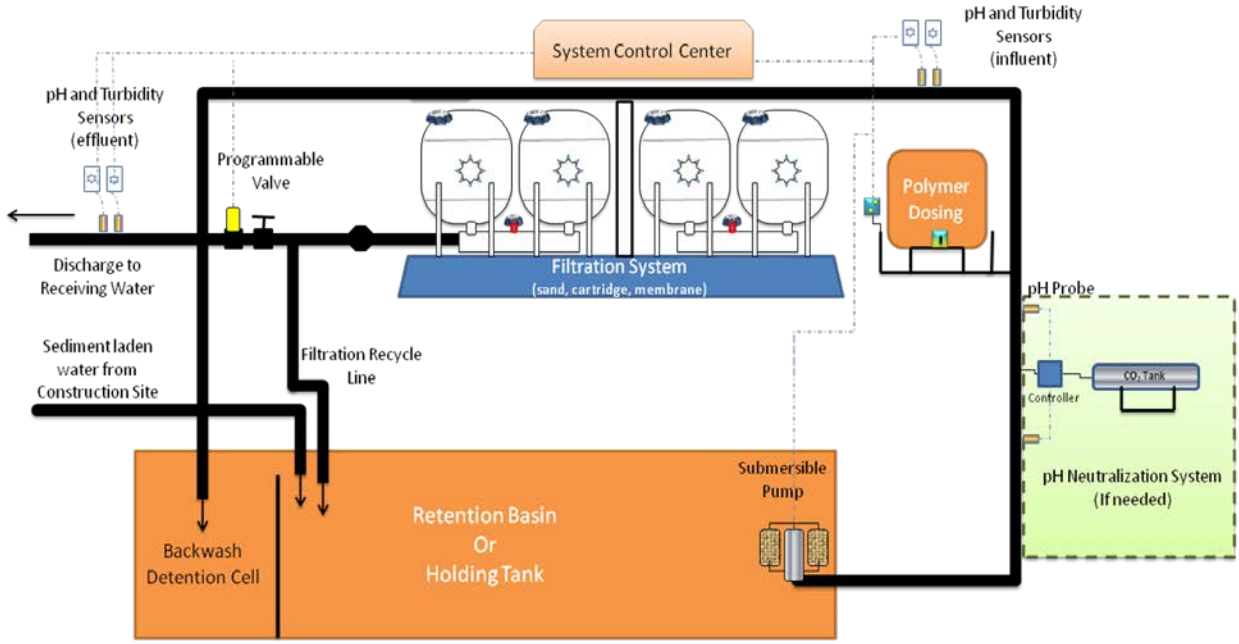


Figure has been adapted from Port of Seattle response to Washington Dept. of Ecology Action Order 2948

Batch Treatment

Batch Treatment systems consist of the stormwater collection system (either temporary diversion or the permanent site drainage system); a sediment basin, trap or holding tanks; pumps; a chemical feed system; treatment cells; and, interconnecting piping.

Batch treatment systems should use a minimum of two lined treatment cells. Multiple treatment cells allow for clarification of treated water while other cells are being filled or emptied. Treatment cells may be basins, traps, or tanks. Portable tanks may also be suitable for some sites.

The following equipment should be located in a secured, covered location:

- The chemical injector
- Secondary contaminant for acid, caustic, buffering compound, and treatment chemical
- Emergency shower and eyewash
- Monitoring equipment which consists of a pH meter and a turbidimeter (if not already within the instrumentation panel of the chemical injector)

Flow-through Treatment

At a minimum, a flow-through ATS system consists of the stormwater collection system (either temporary diversion or the permanent site drainage system), an untreated stormwater storage pond or holding tank, and a chemically enhanced filtration system.

Stormwater is collected at interception point(s) on the site and is diverted by gravity or by pumping to an untreated stormwater storage pond or other untreated stormwater holding area.

The stormwater is stored until treatment occurs. It is important that the holding pond be large enough to provide adequate storage.

Stormwater is then pumped from the untreated stormwater storage pond to the chemically enhanced filtration system where polymer is added. Adjustments to pH may be necessary before chemical addition. The filtration system continually monitors the stormwater for turbidity and pH. If the discharge water is out of the acceptable turbidity or pH range, the water is recycled to the untreated stormwater pond (or holding tank) where it can be retreated. Flow through systems must ensure that:

- Cumulative flow volume shall be recorded daily. The data recording system shall have the capacity to record a minimum of seven days of continuous data.
- Instrumentation systems are interfaced with system control to provide auto shutoff or recirculation in the event that effluent measurements exceed turbidity or pH.
- Upon system upset, power failure, or other catastrophic event, the ATS will default to a recirculation mode or safe shut down.
- The instrumentation system provides a method for controlling coagulant dose, to prevent potential overdosing.

Sizing Criteria

An ATS shall be designed and approved by a Certified Professional in Erosion and Sediment Control (CPESC), a Certified Professional in Storm Water Quality (CPSWQ); a California registered civil engineer; or any other California registered engineer.

ATS must be designed to capture and treat (within 72 hours) runoff from the 10-year 24-hour storm event. The runoff volume of the watershed area to be treated from this size storm event is required to be calculated using the Rational Method with a runoff coefficient of 1.

If sediment basins are used to capture flow-through or batch treatment, see SE-2, Sediment Basin, for design criteria. Bypass should be provided around the ATS to accommodate extreme storm events. Primary settling should be encouraged in the sediment basin/storage pond. A forebay with access for maintenance may be beneficial.

The permissible discharge rate governed by potential downstream effect should be used to calculate the recommended size of the treatment cells. Local requirements related to Phase I or Phase II NPDES permit thresholds should be considered in developing maximum discharge rates the ATS Plan.

Costs

Costs for ATS may be significant due to equipment rental requirements and cost of chemicals. ATS cost is lower on a treated unit-basis for large construction sites with large volumes of runoff.

Inspection and Maintenance

ATS must be operated and maintained by individuals with experience in their use and trained in accordance with training requirements below. ATS should be monitored continuously while in

use. A designated responsible person shall be on site daily at all times during treatment operations. Daily on-site visual monitoring of the system for proper performance shall be conducted and recorded in the project data log. The name, phone number, and training documentation of the person responsible for system operation and monitoring shall be included in the project data log.

The following monitoring requirements and results should be recorded in the data log:

Operational and Compliance Monitoring

- Effluent flow rate and volume shall be continuously monitored and recorded at 15- minute or less intervals.
- Influent and effluent pH must be continuously monitored and recorded at 15-minute or less intervals.
- Influent and effluent turbidity (expressed in NTU) must be continuously monitored and recorded at 15-minute or less intervals.
- The type and amount of chemical used for pH adjustment, if any, shall be monitored and recorded.
- Dose rate of chemical used in the ATS system (expressed in mg/L) shall be monitored and reported 15-minutes after startup and every 8 hours of operation.
- Laboratory duplicates – monthly laboratory duplicates for residual coagulant analysis must be performed and records shall be maintained onsite.
- Effluent shall be monitored and recorded for residual chemical/additive levels.
- If a residual chemical/additive test does not exist and the ATS is operating in a batch treatment mode of operation refer to the toxicity monitoring requirements below.

Toxicity Monitoring

Batch Treatment

Toxicity testing for systems operated in batch treatment mode should be made in accordance with the following:

- Acute toxicity testing on effluent samples representing effluent from each batch prior to discharge shall be undertaken. All bioassays shall be sent to a laboratory certified by the Department of Health Services (DHS) Environmental Laboratory Accreditation Program (ELAP). The required field of testing number for Whole Effluent Toxicity (WET) testing is E113.
- Acute toxicity tests shall be conducted with the following species and protocols. The methods to be used in the acute toxicity testing shall be those outlined for a 96-hour acute test in "Methods for Measuring the Acute Toxicity of Effluents and Receiving Water to Freshwater and Marine Organisms, USEPA-841-R-02-012" for Fathead minnow, *Pimephales promelas*. Rainbow trout, *Oncorhynchus mykiss*, may be used as a substitute for fathead minnow.

All toxicity tests shall meet quality assurance criteria and test acceptability criteria in the most recent versions of the EPA test method for WET testing.

Flow-through Treatment

Toxicity testing for systems operated in flow-through treatment mode should be made in accordance with the following:

- A residual chemical test method shall be used that has a method detection limit (MDL) of 10% or less than the maximum allowable threshold concentration (MATC) for the specific coagulant in use and for the most sensitive species of the chemical used. The MATC is equal to the geometric mean of the No Observed Effect Concentration (NOEC) and Lowest Observed Effect Concentration (LOEC) Acute and Chronic toxicity results for most sensitive species determined for the specific coagulant.
- The residual chemical test method shall produce a result within one hour of sampling.
- A California State certified laboratory shall validate the selected residual chemical test. Specifically the lab will review the test protocol, test parameters, and the detection limit of the coagulant. The discharger shall electronically submit this documentation as part of the ATS Plan.

Numeric Effluent Limit (NEL) Compliance:

All chemically treated stormwater must be sampled and tested for compliance with pH and turbidity limits. These limits have been established by the Construction General Permit. Sampling and testing for other pollutants may also be necessary at some sites. Turbidity limits have been set as 10 NTU as a daily flow-weighted average or 20 NTU from a single sample. pH must be within the range of 6.0 to 9.0 standard units. It is often possible to discharge treated stormwater that has a lower turbidity than the receiving water and that matches the pH.

Treated stormwater samples and measurements should be taken from the discharge pipe or another location representative of the nature of the treated stormwater discharge. Samples used for determining compliance with the water quality standards in the receiving water should not be taken from the treatment pond prior to decanting. Compliance with the water quality standards is determined in the receiving water.

Operator Training:

Operators shall have training specific to using an ATS and liquid coagulants for stormwater discharges in California. The training shall be in the form of a formal class with a certificate and requirements for testing and certificate renewal. Training shall include a minimum of eight hours classroom and 32 hours field training.

Standard BMPs:

Erosion and sediment control BMPs should be implemented throughout the site to prevent erosion and discharge of sediment to the ATS. Some types of chemical coagulation and flocculation are only achievable in water below a certain turbidity; therefore minimizing the amount of sediment reaching the system will increase the likelihood of meeting effluent limits and will potentially lower costs of chemical dosing.

Sediment Removal and Disposal

- Sediment shall be removed from the storage or treatment cells as necessary to ensure that the cells maintain their required water storage (i.e., volume) capability.
- Handling and disposal of all solids generated during ATS operations shall be done in accordance with all local, state, and federal laws and regulations.
- If sediment is determined to be non-toxic, it may be incorporated into the site away from drainages.

References

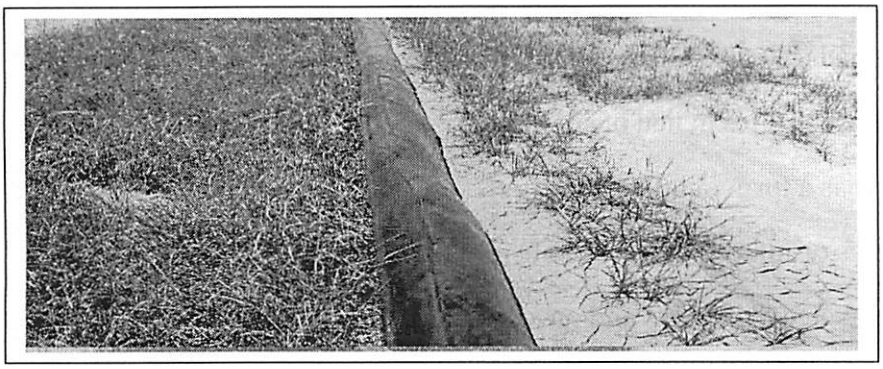
Engineering and Design – Precipitation/Coagulation/Flocculation. United States Army Corps of Engineers, EM 1110-1-4012, 2001.

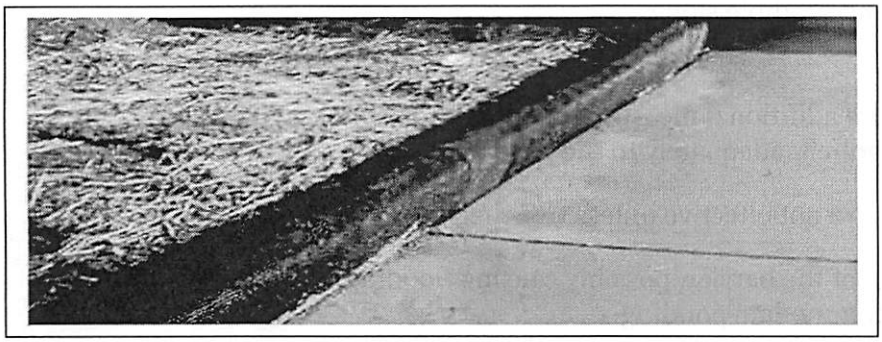
Evaluation of Active Treatment Systems (ATS) for Construction Site Runoff. California Building and Industry Association (prepared by Geosyntec Consultants), 2008.

Stormwater Management Manual for Western Washington, Volume II – Construction Stormwater Pollution Prevention, Washington State Department of Ecology, August 2001.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Temporary Silt Dike SE-12





Categories

EC	Erosion Control	☒
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☒
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Roll

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

Description and Purpose

Temporary silt dikes are pre-manufactured devices that are typically specified and installed for drainage and sediment control on the perimeter of disturbed sites or stockpiles and as check dams within channels. Manufactured products include flexible and rigid silt dikes. Both types of temporary silt dikes can be reused. Flexible temporary silt dikes typically consist of a triangular foam or recycled rubber core covered in geotextile fabric. Rigid temporary silt dikes typically consist of an outer jacket made of a rigid High Density Polyethylene (HDPE) matrix and contain an integrated HDPE or polypropylene geotextile filter or a tubular assembly of overlapping layers of porous synthetic materials (frequently called synthetic sediment control rolls). Temporary silt dikes come in a variety of profiles including triangular, round, rectangular, L-shaped, I-shaped, and T-shaped.

Suitable Applications

Temporary silt dikes are generally used in areas as a substitute for fiber rolls and silt fences in sediment control applications to slow down runoff water, divert drainage or contain fines and sediment. Temporary silt dikes are a linear control and application suitability varies based on the specific product type. They may be suitable for:

- On paved surfaces for perimeter protection.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- As check structures in channels.
- Along the perimeter of disturbed sites in lieu of silt fence.
- At operational storm drains as a form of inlet protection.
- Around temporary stockpiles or material/equipment storage areas.
- At the interface between graveled driveways and pavement.
- Along the toe of exposed and erodible slopes.

Limitations

- Temporary silt dikes require additional measures to adhere to asphalt in cold and windy climates, as glue may not adhere adequately to the pavement.
- Rigid temporary silt dikes are not effective unless trenched-in and staked.
- Runoff will pond upstream of the barrier, possibly causing flooding or bypass if sufficient space does not exist to accommodate ponding.
- Temporary silt dikes may require frequent maintenance especially when used near vehicle traffic or to detain concentrated flows (e.g. check dams or inlet protection).
- When used to detain concentrated flows, maintenance requirements increase.
- Temporary silt dikes are not biodegradable and should be removed after construction activities are complete and disturbed soil areas have been stabilized.
- Temporary silt dikes may not be suitable for application as linear slope controls (slope interruptions).
- Temporary silt dikes should not be used on slopes subject to creep, slumping, or landslide.

Implementation

General

When appropriately placed, temporary silt dikes intercept and slow sheet flow runoff, causing temporary ponding. The temporary ponding provides quiescent conditions allowing sediment to settle. The device is porous, which allows the ponded runoff to flow slowly through the silt dike, releasing the runoff as sheet flows. Generally, temporary silt dikes should be used in conjunction with temporary soil stabilization controls up-slope to provide an effective combination of erosion and sediment control.

Design and Layout

- Temporary silt dikes used on soil should be trenched or attached to the ground per manufacturer specifications in a manner that precludes runoff or ponded water from flowing around or under the silt dike.
- Temporary silt dikes used on asphalt or concrete may be attached using a variety of methods, including nailing the dikes to the pavement, or using a high strength adhesive.

- Follow manufacturer specifications when installing temporary silt dikes.
- Allow sufficient space up slope from the silt dike to allow ponding, and to provide room for sediment storage.
- For installation near the toe of the slope, temporary silt dike should be set back three feet from the slope toe to facilitate cleaning. Where site conditions do not allow set back, the silt dike may be constructed on the toe of the slope. To prevent flows behind the barrier, sand or gravel bags can be placed perpendicular and between the silt dike and slope to serve as a barrier to parallel flow.
- Drainage area should not exceed 5 acres.
- Butt ends of temporary silt dike tightly. Overlaps should be sealed in accordance with the manufacturer's detail.
- Ends of runs should be sloped uphill to prevent concentrated end-around flows.
- For installations as check dams, see SE-4.

Materials

- Several manufactured products are available.

Costs

- Flexible silt dike averages $35-45 per 7 ft. section.
- Rigid silt dike averages $1.80-$7.00 per foot.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Temporary silt dike exposed to sunlight will need to be replaced more frequently due to photo-degradation.
- Reshape or replace sections of damaged temporary silt dike as needed.
- Repair washouts or other damage as needed.
- Sediment that accumulates behind the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height.
- Remove temporary silt dikes when no longer needed. Remove sediment accumulation and clean, re-grade, and stabilize the area. Removed sediment should be incorporated in the project or disposed of properly.

References

City of Elko Construction Site Best Management Practices Handbook, December 2005

Construction Site Best Management Practices Handbook, June 2008 Update, Truckee Meadows Regional Stormwater Quality Management Program, June 2008

Complying with the Edwards Aquifer Rules Technical Guidance on Best Management Practices, Texas Commission on Environmental Quality, Revised July 2005, Addendum Sheet, January26, 2011

Stormwater Management Manual for Western Washington Volume II, Construction Stormwater Pollution Prevention, Washington State Department of Ecology, February 2005

Compost Socks and Berms SE-13



Description and Purpose

Compost socks and berms act as three-dimensional biodegradable filtering structures to intercept runoff where sheet flow occurs and are generally placed at the site perimeter or at intervals on sloped areas. Compost socks are generally a mesh sock containing compost and a compost berm is a dike of compost, trapezoidal in cross section. When employed to intercept sheet flow, both BMPs are placed perpendicular to the flow of runoff, allowing filtered runoff to pass through the compost and retaining sediment (and potentially other pollutants). A compost sock can be assembled on site by filling a mesh sock (e.g. with a pneumatic blower). The compost berm should be constructed using a backhoe or equivalent and/or a pneumatic delivery (blower) system and should be properly compacted. Compost socks and berms act as filters, reduce runoff velocities, and in some cases, aid in establishing vegetation.

Compost is organic, biodegradable, and renewable. Compost provides soil structure that allows water to infiltrate the compost medium which helps prevent rill erosion and the retained moisture promotes seed germination and vegetation growth, in addition to providing organic matter and nutrients important for fostering vegetation. Compost improves soil quality and productivity, as well as erosion and sediment control.

Categories

EC	Erosion Control	☒
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	☒
Bacteria	☒
Oil and Grease	☒
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Roll

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-14 Biofilter Bags

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

The compost of the compost sock or berm can be selected that targets site specific objectives in capturing sediment and other pollutants, supporting vegetation, or additional erosion control.

Compost is typically derived from combinations of feedstocks, biosolids, leaf and yard trimmings, manure, wood, or mixed solid waste. Many types of compost are products of municipal recycle or "Greenwaste" programs. Compost is organic and biodegradable and can be left onsite. There are many types of compost with a variety of properties with specific functions, and accordingly compost selection is an important design consideration in the application of this type of erosion and sediment control.

Suitable Applications

- Along the toe, top, face, and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow (compost berms should only be used at the top of slopes or on slopes 4:1 (H:V) or flatter, all other slope applications should use compost socks)
- Along the perimeter of a project
- As check dams in unlined ditches (compost socks only)
- Down-slope of exposed soil areas
- At operational storm drains as a form of inlet protection (compost socks only)
- Around temporary stockpiles

Compost socks and berms do not require special trenching or BMP removal compared to other sediment control methods (e.g. silt fence or fiber rolls). Compost socks and berms can remain in place after earth disturbing activities are completed or the compost components can be spread over the site providing nutrients for plant growth and augmenting soil structure. BMPs that remain in place are particularly advantageous below embankments, especially adjacent streams, by limiting re-entry and the disturbance to sensitive areas.

Compost can be pre-seeded prior to application (recommended by the EPA for construction site stormwater runoff control and required for compost socks) or seeded after installation (for compost berms only). The compost medium can also remove pollutants in stormwater including heavy metals; oil and grease; and hydrocarbons.

Limitations

- Compost can potentially leach nutrients (dissolved phosphorus and nitrogen) into runoff and potentially impact water quality. Compost should not be used directly upstream from nutrient impaired waterbodies (Adams et. al, 2008).
- Compost may also contain other undesirable constituents that are detrimental to water quality. Compost should be obtained from a supplier certified by the California Integrated Waste Management Board or compost should otherwise meet the environmental health standards of Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7. Carefully consider the qualifications and experience of any compost producer/supplier.

- Application by hand is more time intensive and potentially costly. Using a pneumatic blower truck is the recommended cost effective method of assembly.
- Compost socks and berms should not be employed at the base of slopes greater than 2:1 (H:V). They can be employed with other erosion control methods for steeper slopes.
- Difficult to move once saturated.
- Compost berms should not be applied in areas of concentrated flows.
- Compost socks and berms are easy to fix; however, they are susceptible to damage by frequent traffic. Compost socks can be used around heavy machinery, but regular disturbance decreases sock performance.

Implementation

Compost Materials

- California Compost Regulations (Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7, Section 17868.3) define and require a quality of compost for application. Compost should comply with all physical and chemical requirements. Specific requirements are provided in **Table 1**, taken from Caltrans Standard Special Provision 10-1 (SSP 10-1), Erosion Control (Compost Blanket).
- The compost producer should be fully permitted as specified under the California Integrated Waste Management Board, Local Enforcement Agencies and any other State and Local Agencies that regulate Solid Waste Facilities. If exempt from State permitting requirements, the composting facility should certify that it follows guidelines and procedures for production of compost meeting the environmental health standards of Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7.
- The compost producer should be a participant in United States Composting Council's Seal of Testing Assurance program.
- Compost medium parameter specifications for compost socks and berms have been developed to assist in compost selection, such as those provided by the American Association of State Highway Transportation Officials (AASHTO).
- Particle size is important parameter for selecting compost. Well consolidated coarser grades of compost (e.g. small and large pieces) perform better for filtration objectives, while finer grades better support vegetation. Particle size of the compost should be selected based on site conditions, such as expected precipitation, and filtration goals and / or long term plant nutrients.
- Compost moisture should be considered for composition quality and application purposes. A range of 30-50% is typical. Compost that is too dry is hard to apply and compost that is too wet is more difficult (and more expensive) to transport. For arid or semi-arid areas, or for application during the dry season, use compost with greater moisture content than areas with wetter climates. For wetter or more humid climates or for application during the wet season, drier composts can be used as the compost will absorb moisture from the ambient air.

- If vegetation establishment is a desired function of the compost, a compost sample should be inspected by a qualified individual. Vegetation has different nutrient and moisture needs.
- Organic content of the compost is also important and should range from 30 to 65% depending on site conditions.
- Compost should not be derived from mixed municipal solid waste and should be reasonably free of visible contaminates.
- Compost should not contain paint, petroleum products, pesticides or any other chemical residues harmful to animal life or plant growth. Metal concentrations in compost should not exceed the maximum metal concentrations listed under Title 14, California Code of Regulations, Division 7, Chapter 3.1, Section 17868.2.
- Compost should not possess objectionable odors.
- Compost should be weed free.

Table 1. Physical/Chemical Requirements of Compost
Reference - Caltrans SSP-10 Erosion Control Blanket (Compost)

Property	Test Method	Requirement
pH	*TMECC 04.11-A Elastometric pH 1:5 Slurry Method pH Units	6.0–8.0
Soluble Salts	TMECC 04.10-A Electrical Conductivity 1:5 Slurry Method dS/m (mmhos/cm)	0-10.0
Moisture Content	TMECC 03.09-A Total Solids & Moisture at 70+/- 5 deg C % Wet Weight Basis	30-60
Organic Matter Content	TMECC 05.07-A Loss-On-Ignition Organic Matter Method (LOI) % Dry Weight Basis	30–65
Maturity	TMECC 05.05-A Germination and Vigor Seed Emergence Seedling Vigor % Relative to Positive Control	 80 or Above 80 or Above
Stability	TMECC 05.08-B Carbon Dioxide Evolution Rate mg CO_2-C/g OM per day	8 or below
Particle Size	TMECC 02.02-B Sample Sieving for Aggregate Size Classification % Dry Weight Basis	100% Passing, 3 inch 90-100% Passing, 1 inch 65-100% Passing, 3/4 inch 0 - 75% Passing, 1/4 inch Maximum length 6 inches
Pathogen	TMECC 07.01-B Fecal Coliform Bacteria < 1000 MPN/gram dry wt.	Pass
Pathogen	TMECC 07.01-B Salmonella < 3 MPN/4 grams dry wt.	Pass
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Plastic, Glass and Metal % > 4mm fraction	Combined Total: < 1.0
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Sharps (Sewing needles, straight pins and hypodermic needles) % > 4mm fraction	None Detected

*TMECC refers to "Test Methods for the Examination of Composting and Compost," published by the United States Department of Agriculture and the United States Compost Council (USCC).

Installation

- Prior to application, prepare locations for socks and berms by removing brush and thick vegetation. The compost of the sock and/or berm should be allowed to come in full contact with the ground surface.

- Select method to apply the compost sock or berm. A pneumatic blower is most cost effective and most adaptive in applying compost to steep, rough terrain, and hard to reach locations.

- The compost of the berm should be distributed evenly to the surface, compacted, and shaped trapezoidal in cross section. Berm design is generally consists of a base two times the height. AASHTO specification MP 9-03 provides compost berm dimensions based on anticipated

site precipitation (AASHTO, 2003 and USEPA, 2009). State agencies, such as Oregon Department of Environmental Quality (ODEQ) have developed berm dimension based on slope steepness and length (ODEQ, 2004).

- Compost socks can be assembled on site by filling mesh socks with the selected compost. Mesh socks can be tied at one end, filled, and then tied at the other end. The ends of socks can be interlocked until the desired length is achieved. The sock diameter is a function of slope steepness and length. Again, ASSHTO provides specifications for various parameters. Compost socks range from 8" to 18", but are typically 12" to 18" in diameter.

- Compost socks are typically placed in contours perpendicular to sheet flow. They can also be placed in V formation on a slope. Compost socks need to be anchored, typically stakes, through the center of the sock. To prevent water flowing around them, the ends of compost socks should be placed upslope.

- Locate compost socks and berms on level contours spaced as follows:

  - Slope inclination of 4:1 (H:V) or flatter: Socks and/or berms should be placed at a maximum interval of 20 ft.

  - Slope inclination between 4:1 and 2:1 (H:V): Socks should be placed at a maximum interval of 15 ft. (a closer spacing is more effective).

  - Slope inclination 2:1 (H:V) or greater: Socks should be placed at a maximum interval of 10 ft. (a closer spacing is more effective).

- Place perimeter socks and berms using a j-hook installation. Use of vegetation will also provide additional anchoring.

- Compost socks and berms can be placed around the perimeter of an affected area, like a silt fence, if the area is flat or on a contour. Do not place these socks and berms where ponded water could become an issue.

- If used at the toe of slopes, the compost sock or berm should at a minimum of 5 to 10 feet away.

- Use additional anchoring and erosion control BMPs in conjunction of the compost socks and berms as needed.

- Consider using compost berms or socks as necessary at the top and/or bottom of the slope for additional erosion control performance.

- Compost socks and berms can also be effective over rocky and frozen ground if installed properly.

- It is recommended that the drainage areas of these compost BMPs do not exceed 0.25 acre per 100 feet placement interval and runoff does not exceed 1 cubic foot per second.

Costs

Recently obtained vendor costs indicated $3.50 per linear foot for compost berm application and $2.00 per linear foot for 8" socks and $2.50 per linear foot for 12"socks. Costs do not include final compost sock or berm functions at the end of construction activities, including spreading or removal, if required. ODEQ estimates that compost berms cost 30 percent less than silt fences to install.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Once damage is identified, mend or reapply the sock or berm as needed. Washed out areas should be replaced. If the sock or berm height is breached during a storm, an additional sock can be stacked to increase the sock height and similarly the berm dimensions can be increased, as applicable. An additional sock or berm may be installed upslope, as needed. It may be necessary to apply an additional type of stormwater BMP, such as a compost blanket.

- Sediment contained by the sock or berm should be removed prior reaching 1/3 of the exposed height of the BMP. The sediment can be stabilized with the compost sock or berm with vegetation at the end of construction activities.

- Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require reapplication of BMPs.

- Limit traffic to minimize damage to BMPs or impede vegetation establishment.

References

An analysis of Composting as an Environmental Remediation Technology, U.S. Environmental Protection Agency (USEPA), Solid Waste and Emergency Response (5305W), EPA530-R-8-008, 1998.

Characteristics of Compost: Moisture Holding and Water Quality Improvement, Center for Research in Water Resources, Kirchoff, C., Malina, J., and Barrett, M., 2003.

Compost Utilization for Erosion Control, The University of Georgia College of Agricultural and Environmental Sciences, pubs.caes.uga.edu/caespubs/pubcd/B1200.htm, Faucette, B. and Risse, M., 2001.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Standard Special Provision 10-1, Erosion Control (Compost Blanket), State of California Department of Transportation (Caltrans). 2007 Update.

Evaluation of Environmental Benefits and Impacts of Compost and Industry Standard Erosion and Sediment Controls Measures Used in Construction Activities, Dissertation, Institute of Ecology, University of Georgia, Faucette, B., 2004.

National Pollutant Discharge Elimination System (NPDES), Compost Blankets, U.S. Environmental Protection Agency (USEPA). http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=118, 2009.

Standard Specifications for Transportation Materials and Methods of Sampling and Testing, Designation MP-9, Compost for Erosion/Sediment Control (Filter Berms), Provisional, American Association of State Highway Transportation Officials (AASHTO), 2003.

Stormwater Best Management Practices (BMPs) Field Trials of Erosion Control Compost in Reclamation of Rock Quarry Operations, Nonpoint Source Protection Program CWA §319(h), Texas Commission on Environmental Quality, Adams, T., McFarland, A., Hauck, L., Barrett, M., and Eck, B., 2008.

Biofilter Bags SE-14



Categories

EC	Erosion Control	
SE	Sediment Control	☑
TR	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence
SE-4 Check Dams
SE-5 Fiber Roll
SE-6 Gravel Bag Berm
SE-8 Sandbag Barrier
SE-10 Storm Drain Inlet Protection

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Biofilter bags, or bio-bags, are a multi-purpose sediment control BMP consisting of a plastic mesh bag filled with 100% recycled wood product waste. Biofilter bags come in a variety of sizes (30" x 18" and 30" x 9" being common) and generally have between 1-2 cubic yards of recycled wood waste (or wood chips). Biofilter bags work by detaining flow and allowing a slow rate of discharge through the wood media. This action removes suspended sediment through gravity settling of the detained water and filtration within the bag.

Suitable Applications

Biofilter bags are a short-term BMP that can be rapidly deployed, maintained, and replaced. Biofilter bags can be an effective short-term solution to place in developed rills to prevent further erosion until permanent measures can be established. Suitable short-term applications include:

- As a linear sediment control measure:
  - Below the toe of slopes and erodible slopes
  - Below other small cleared areas
  - Along the perimeter of a site (with low-expected flow)
  - Down slope of exposed soil areas
  - Around temporary stockpiles and spoil areas
  - Parallel to a roadway to keep sediment off paved areas

- Along streams and channels

- As linear erosion control measure:
  - Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow
  - At the top of slopes to divert runoff away from disturbed slopes
  - As check dams across mildly sloped construction roads
- Inlet Protection (See SE-10)
- Supplement to silt fences or other sediment control devices

Limitations

- Short life-span (maximum usefulness of 2-3 months and should be replaced more frequently if needed); regular maintenance and replacement required to ensure effectiveness. Bags will rapidly fill with sediment and reduce permeability.
- Easily damaged by construction vehicles.
- If not properly staked, will fail on slope applications.
- If improperly installed can allow undercutting or side-cutting flow.
- Not effective where water velocities or volumes are high.
- Potentially buoyant and easily displaced if not properly installed.

Implementation

General

Biofilter bags are a relatively low cost temporary BMP that are easily deployed and have a simple installation that can be performed by hand. Without proper installation, however, biofilter bags can fail due to their light weight, potential displacement, and multiple joint locations. One of the benefits of utilizing biofilter bags is that the media (wood-product) can be recycled or used onsite when no longer needed (where acceptable).

Design and Layout – Linear control

- Locate biofilter bags on level contours.
  - Slopes between 20:1 and 4:1 (H:V): Biofilter bags should be placed at a maximum interval of 20 ft, with the first row near the slope toe.
  - Slopes between 4:1 and 2:1 (H:V): Biofilter bags should be placed at a maximum interval of 15 ft, with the first row near the slope toe.
  - Slopes 2:1 (H:V) or steeper: Biofilter bags should be placed at a maximum interval of 10 ft., with the first row placed the slope toe.

- Turn the ends of the biofilter bag barriers up slope to prevent runoff from going around the berm.
- Allow sufficient space up slope from the biofilter bag berm to allow ponding, and to provide room for sediment storage.
- Stake biofilter bags into a 1 to 2 in. deep trench with a width equal to the bag.
  - Drive one stake at each end of the bag.
  - Use wood stakes with a nominal classification of 0.75 by 0.75 in. and minimum length of 24 in.
- Biofilter bags should be overlapped (6 in.), not abutted.

Costs

Pre-filled biofilter bags cost approximately $2.50-$3.50 per bag, dependent upon size.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Biofilter bags exposed to sunlight will need to be replaced every two to three months due to degrading of the bags.
- Reshape or replace biofilter bags as needed.
- Repair washouts or other damage as needed.
- Sediment that is retained by the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height.
- Remove biofilter bag berms when no longer needed. Remove sediment accumulation and clean, re-grade, and stabilize the area. Biofilter media may be used on-site, if allowed.

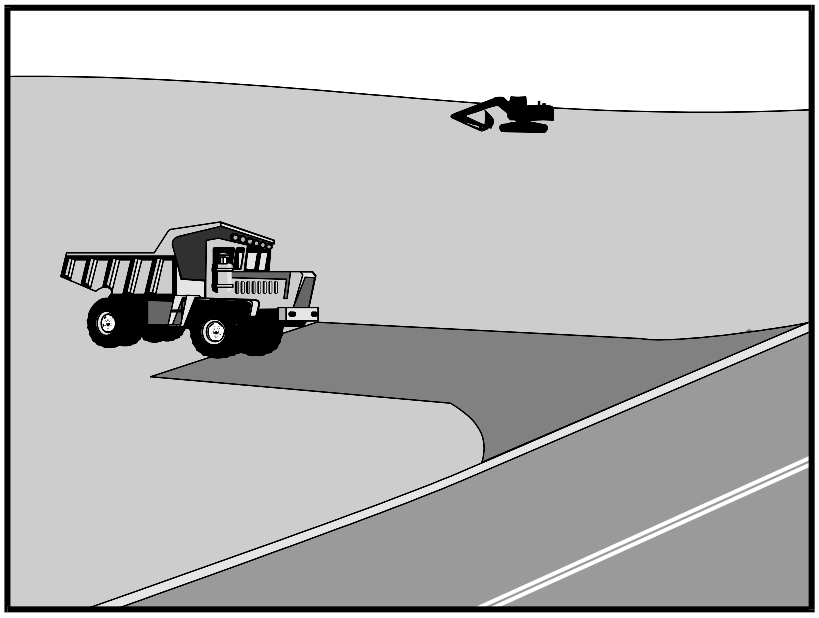
References

Catalog of Stormwater Best Management Practices for Idaho Cities and Counties. Volume 2, Section 7, BMP 34 – Biofilter Bags, Idaho Department of Environmental Quality, 2005.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stabilized Construction Entrance / Exit TC-1



Categories

EC	Erosion Control	☒
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

A stabilized construction access is defined by a point of entrance/exit to a construction site that is stabilized to reduce the tracking of mud and dirt onto public roads by construction vehicles.

Suitable Applications

Use at construction sites:

- Where dirt or mud can be tracked onto public roads.
- Adjacent to water bodies.
- Where poor soils are encountered.
- Where dust is a problem during dry weather conditions.

Limitations

- Entrances and exits require periodic top dressing with additional stones.
- This BMP should be used in conjunction with street sweeping on adjacent public right of way.
- Entrances and exits should be constructed on level ground only.
- Stabilized construction entrances are rather expensive to construct and when a wash rack is included, a sediment trap of some kind must also be provided to collect wash water runoff.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Stabilized Construction Entrance/Exit TC-1

Implementation

General

A stabilized construction entrance is a pad of aggregate underlain with filter cloth located at any point where traffic will be entering or leaving a construction site to or from a public right of way, street, alley, sidewalk, or parking area. The purpose of a stabilized construction entrance is to reduce or eliminate the tracking of sediment onto public rights of way or streets. Reducing tracking of sediments and other pollutants onto paved roads helps prevent deposition of sediments into local storm drains and production of airborne dust.

Where traffic will be entering or leaving the construction site, a stabilized construction entrance should be used. NPDES permits require that appropriate measures be implemented to prevent tracking of sediments onto paved roadways, where a significant source of sediments is derived from mud and dirt carried out from unpaved roads and construction sites.

Stabilized construction entrances are moderately effective in removing sediment from equipment leaving a construction site. The entrance should be built on level ground. Advantages of the Stabilized Construction Entrance/Exit is that it does remove some sediment from equipment and serves to channel construction traffic in and out of the site at specified locations. Efficiency is greatly increased when a washing rack is included as part of a stabilized construction entrance/exit.

Design and Layout

- Construct on level ground where possible.
- Select 3 to 6 in. diameter stones.
- Use minimum depth of stones of 12 in. or as recommended by soils engineer.
- Construct length of 50 ft or maximum site will allow, and 10 ft minimum width or to accommodate traffic.
- Rumble racks constructed of steel panels with ridges and installed in the stabilized entrance/exit will help remove additional sediment and to keep adjacent streets clean.
- Provide ample turning radii as part of the entrance.
- Limit the points of entrance/exit to the construction site.
- Limit speed of vehicles to control dust.
- Properly grade each construction entrance/exit to prevent runoff from leaving the construction site.
- Route runoff from stabilized entrances/exits through a sediment trapping device before discharge.
- Design stabilized entrance/exit to support heaviest vehicles and equipment that will use it.

- Select construction access stabilization (aggregate, asphaltic concrete, concrete) based on longevity, required performance, and site conditions. Do not use asphalt concrete (AC) grindings for stabilized construction access/roadway.
- If aggregate is selected, place crushed aggregate over geotextile fabric to at least 12 in. depth, or place aggregate to a depth recommended by a geotechnical engineer. A crushed aggregate greater than 3 in. but smaller than 6 in. should be used.
- Designate combination or single purpose entrances and exits to the construction site.
- Require that all employees, subcontractors, and suppliers utilize the stabilized construction access.
- Implement SE-7, Street Sweeping and Vacuuming, as needed.
- All exit locations intended to be used for more than a two-week period should have stabilized construction entrance/exit BMPs.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMPs are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect local roads adjacent to the site daily. Sweep or vacuum to remove visible accumulated sediment.
- Remove aggregate, separate and dispose of sediment if construction entrance/exit is clogged with sediment.
- Keep all temporary roadway ditches clear.
- Check for damage and repair as needed.
- Replace gravel material when surface voids are visible.
- Remove all sediment deposited on paved roadways within 24 hours.
- Remove gravel and filter fabric at completion of construction

Costs

Average annual cost for installation and maintenance may vary from $1,200 to $4,800 each, averaging $2,400 per entrance. Costs will increase with addition of washing rack, and sediment trap. With wash rack, costs range from $1,200 - $6,000 each, averaging $3,600 per entrance.

References

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, USEPA Agency, 2002.

Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group Working Paper, USEPA, April 1992.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

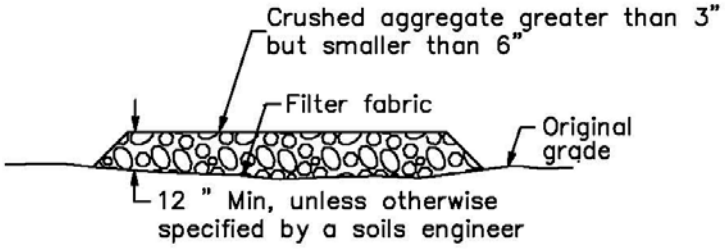
Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Virginia Erosion and Sedimentation Control Handbook, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, 1991.

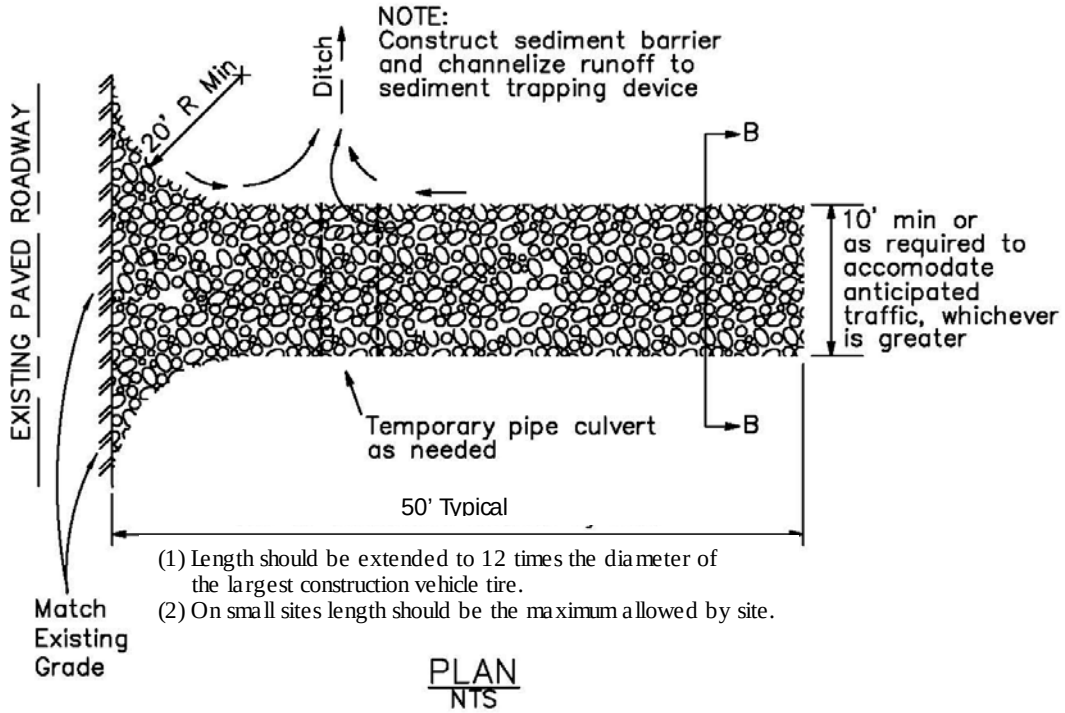
Guidance Specifying Management Measures for Nonpoint Pollution in Coastal Waters, EPA 840-B-9-002, USEPA, Office of Water, Washington, DC, 1993.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Stabilized Construction Entrance / Exit TC-1



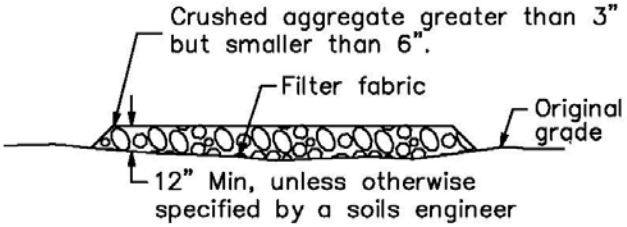
SECTION B–B
NTS



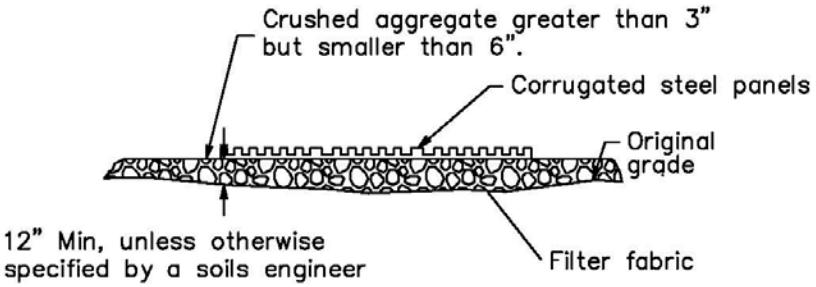
(1) Length should be extended to 12 times the diameter of the largest construction vehicle tire.
(2) On small sites length should be the maximum allowed by site.

PLAN
NTS

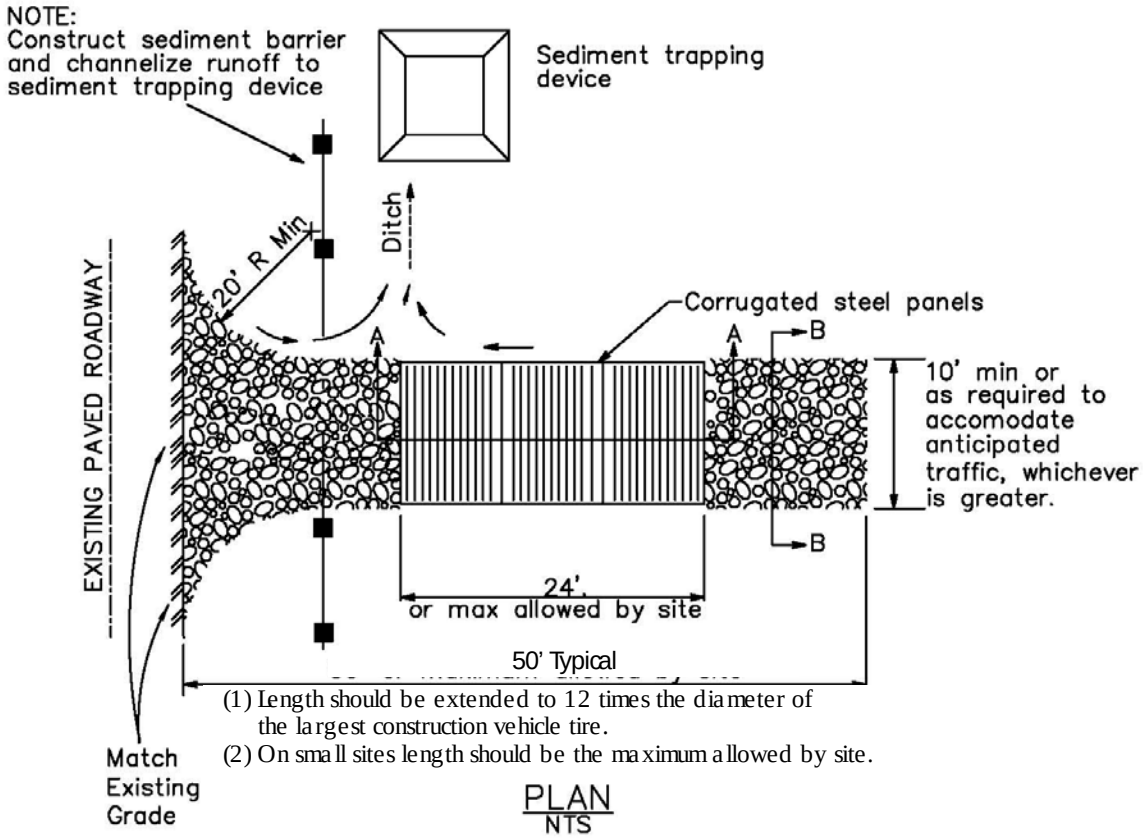
Stabilized Construction Entrance / Exit TC-1



SECTION B–B
NTS



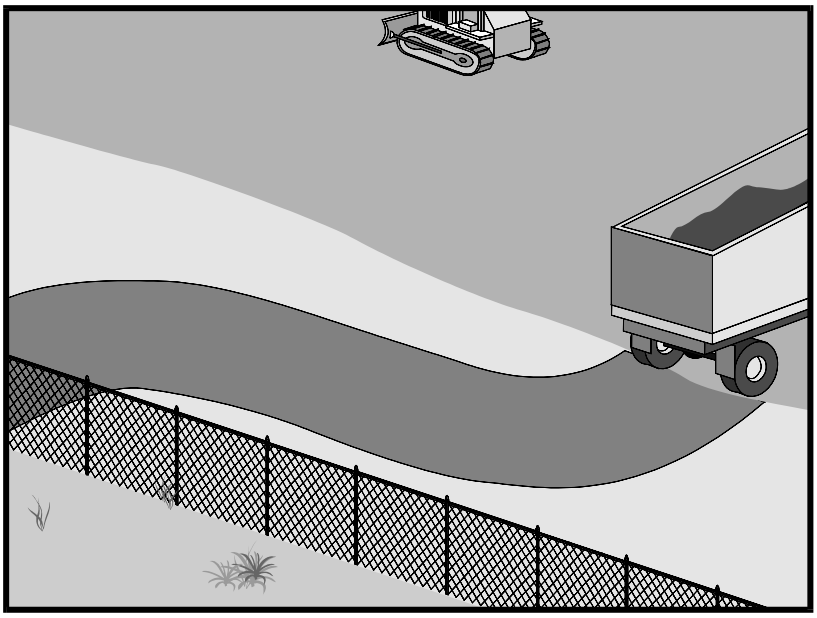
SECTION A–A
NOT TO SCALE



(1) Length should be extended to 12 times the diameter of the largest construction vehicle tire.
(2) On small sites length should be the maximum allowed by site.

PLAN
NTS

Stabilized Construction Roadway TC-2



Categories

EC	Erosion Control	☒
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Access roads, subdivision roads, parking areas, and other onsite vehicle transportation routes should be stabilized immediately after grading, and frequently maintained to prevent erosion and control dust.

Suitable Applications

This BMP should be applied for the following conditions:

- Temporary Construction Traffic:
  - Phased construction projects and offsite road access
  - Construction during wet weather
- Construction roadways and detour roads:
  - Where mud tracking is a problem during wet weather
  - Where dust is a problem during dry weather
  - Adjacent to water bodies
  - Where poor soils are encountered

Limitations

- The roadway must be removed or paved when construction is complete.

- Certain chemical stabilization methods may cause stormwater or soil pollution and should not be used. See WE-1, Wind Erosion Control.
- Management of construction traffic is subject to air quality control measures. Contact the local air quality management agency.
- Materials will likely need to be removed prior to final project grading and stabilization.
- Use of this BMP may not be applicable to very short duration projects.

Implementation

General

Areas that are graded for construction vehicle transport and parking purposes are especially susceptible to erosion and dust. The exposed soil surface is continually disturbed, leaving no opportunity for vegetative stabilization. Such areas also tend to collect and transport runoff waters along their surfaces. During wet weather, they often become muddy quagmires that generate significant quantities of sediment that may pollute nearby streams or be transported offsite on the wheels of construction vehicles. Dirt roads can become so unstable during wet weather that they are virtually unusable.

Efficient construction road stabilization not only reduces onsite erosion but also can significantly speed onsite work, avoid instances of immobilized machinery and delivery vehicles, and generally improve site efficiency and working conditions during adverse weather

Installation/Application Criteria

Permanent roads and parking areas should be paved as soon as possible after grading. As an alternative where construction will be phased, the early application of gravel or chemical stabilization may solve potential erosion and stability problems. Temporary gravel roadway should be considered during the rainy season and on slopes greater than 5%.

Temporary roads should follow the contour of the natural terrain to the maximum extent possible. Slope should not exceed 15%. Roadways should be carefully graded to drain transversely. Provide drainage swales on each side of the roadway in the case of a crowned section or one side in the case of a super elevated section. Simple gravel berms without a trench can also be used.

Installed inlets should be protected to prevent sediment laden water from entering the storm sewer system (SE-10, Storm Drain Inlet Protection). In addition, the following criteria should be considered.

- Road should follow topographic contours to reduce erosion of the roadway.
- The roadway slope should not exceed 15%.
- Chemical stabilizers or water are usually required on gravel or dirt roads to prevent dust (WE-1, Wind Erosion Control).
- Properly grade roadway to prevent runoff from leaving the construction site.
- Design stabilized access to support heaviest vehicles and equipment that will use it.

- Stabilize roadway using aggregate, asphalt concrete, or concrete based on longevity, required performance, and site conditions. The use of cold mix asphalt or asphalt concrete (AC) grindings for stabilized construction roadway is not allowed.
- Coordinate materials with those used for stabilized construction entrance/exit points.
- If aggregate is selected, place crushed aggregate over geotextile fabric to at least 12 in. depth. A crushed aggregate greater than 3 in. but smaller than 6 in. should be used.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Keep all temporary roadway ditches clear.
- When no longer required, remove stabilized construction roadway and re-grade and repair slopes.
- Periodically apply additional aggregate on gravel roads.
- Active dirt construction roads are commonly watered three or more times per day during the dry season.

Costs

Gravel construction roads are moderately expensive, but cost is often balanced by reductions in construction delay. No additional costs for dust control on construction roads should be required above that needed to meet local air quality requirements.

References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

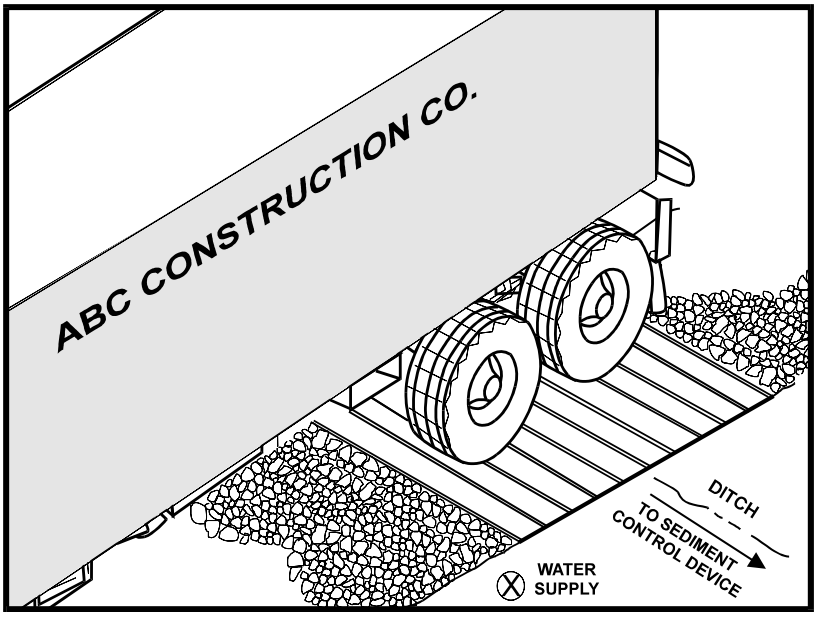
Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Virginia Erosion and Sedimentation Control Handbook, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, 1991.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Entrance/Outlet Tire Wash TC-3



Description and Purpose

A tire wash is an area located at stabilized construction access points to remove sediment from tires and under carriages and to prevent sediment from being transported onto public roadways.

Suitable Applications

Tire washes may be used on construction sites where dirt and mud tracking onto public roads by construction vehicles may occur.

Limitations

- The tire wash requires a supply of wash water.
- A turnout or doublewide exit is required to avoid having entering vehicles drive through the wash area.
- Do not use where wet tire trucks leaving the site leave the road dangerously slick.

Implementation

- Incorporate with a stabilized construction entrance/exit. See TC-1, Stabilized Construction Entrance/Exit.
- Construct on level ground when possible, on a pad of coarse aggregate greater than 3 in. but smaller than 6 in. A geotextile fabric should be placed below the aggregate.
- Wash rack should be designed and constructed/manufactured for anticipated traffic loads.

Categories

EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

TC-1 Stabilized Construction Entrance/Exit

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Provide a drainage ditch that will convey the runoff from the wash area to a sediment trapping device. The drainage ditch should be of sufficient grade, width, and depth to carry the wash runoff.
- Use hoses with automatic shutoff nozzles to prevent hoses from being left on.
- Require that all employees, subcontractors, and others that leave the site with mud caked tires and undercarriages to use the wash facility.
- Implement SC-7, Street Sweeping and Vacuuming, as needed.

Costs

Costs are low for installation of wash rack.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.
- Remove accumulated sediment in wash rack and/or sediment trap to maintain system performance.
- Inspect routinely for damage and repair as needed.

References

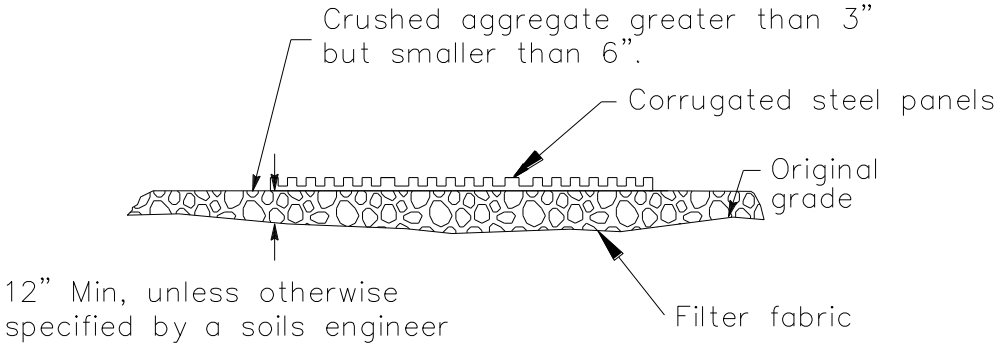
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

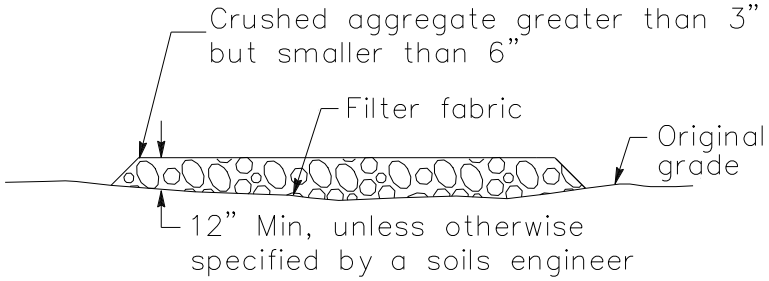
Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

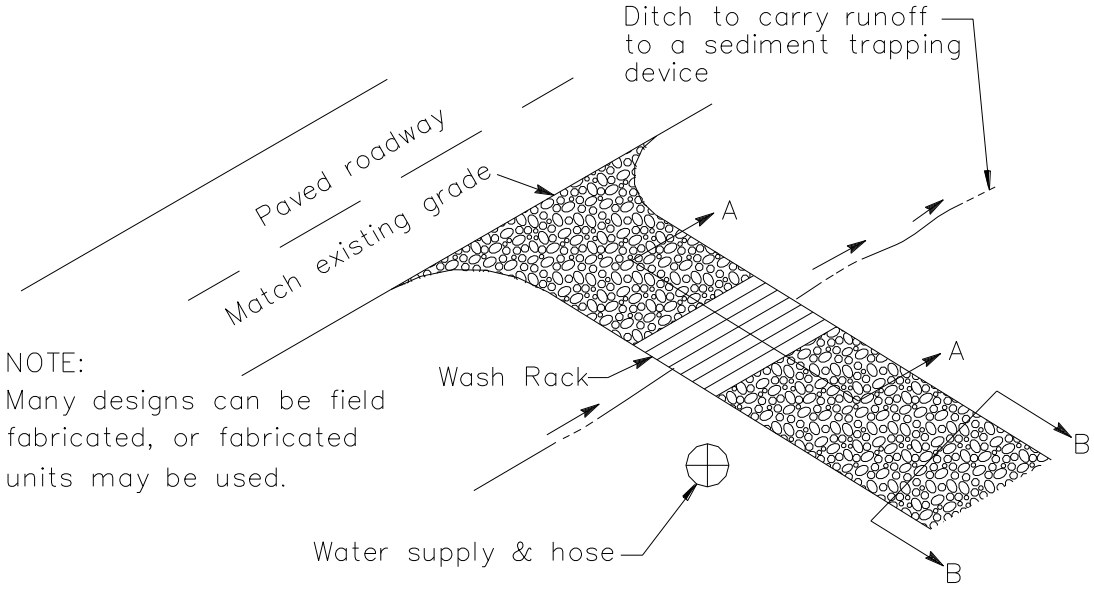
Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.



SECTION A–A
NOT TO SCALE

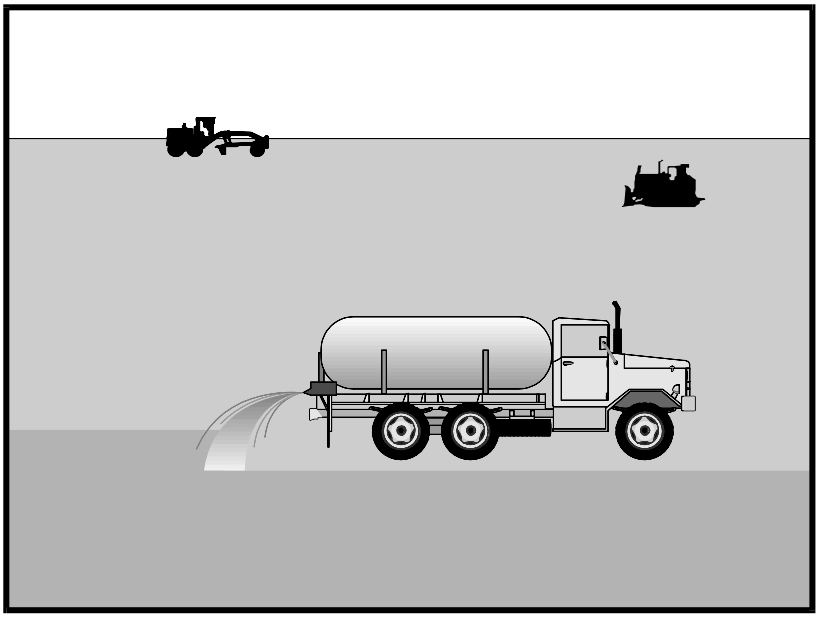


SECTION B–B
NTS



TYPICAL TIRE WASH
NOT TO SCALE

Wind Erosion Control WE-1



Categories

EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	☑
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-5 Soil Binders

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Wind erosion or dust control consists of applying water or other chemical dust suppressants as necessary to prevent or alleviate dust nuisance generated by construction activities. Covering small stockpiles or areas is an alternative to applying water or other dust palliatives.

California's Mediterranean climate, with a short "wet" season and a typically long, hot "dry" season, allows the soils to thoroughly dry out. During the dry season, construction activities are at their peak, and disturbed and exposed areas are increasingly subject to wind erosion, sediment tracking and dust generated by construction equipment. Site conditions and climate can make dust control more of an erosion problem than water based erosion. Additionally, many local agencies, including Air Quality Management Districts, require dust control and/or dust control permits in order to comply with local nuisance laws, opacity laws (visibility impairment) and the requirements of the Clean Air Act. Wind erosion control is required to be implemented at all construction sites greater than 1 acre by the General Permit.

Suitable Applications

Most BMPs that provide protection against water-based erosion will also protect against wind-based erosion and dust control requirements required by other agencies will generally meet wind erosion control requirements for water quality protection. Wind erosion control BMPs are suitable during the following construction activities:

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Construction vehicle traffic on unpaved roads
- Drilling and blasting activities
- Soils and debris storage piles
- Batch drop from front-end loaders
- Areas with unstabilized soil
- Final grading/site stabilization

Limitations

- Watering prevents dust only for a short period (generally less than a few hours) and should be applied daily (or more often) to be effective.
- Over watering may cause erosion and track-out.
- Oil or oil-treated subgrade should not be used for dust control because the oil may migrate into drainageways and/or seep into the soil.
- Chemical dust suppression agents may have potential environmental impacts. Selected chemical dust control agents should be environmentally benign.
- Effectiveness of controls depends on soil, temperature, humidity, wind velocity and traffic.
- Chemical dust suppression agents should not be used within 100 feet of wetlands or water bodies.
- Chemically treated subgrades may make the soil water repellant, interfering with long-term infiltration and the vegetation/re-vegetation of the site. Some chemical dust suppressants may be subject to freezing and may contain solvents and should be handled properly.
- In compacted areas, watering and other liquid dust control measures may wash sediment or other constituents into the drainage system.
- If the soil surface has minimal natural moisture, the affected area may need to be pre-wetted so that chemical dust control agents can uniformly penetrate the soil surface.

Implementation

Dust Control Practices

Dust control BMPs generally stabilize exposed surfaces and minimize activities that suspend or track dust particles. The following table presents dust control practices that can be applied to varying site conditions that could potentially cause dust. For heavily traveled and disturbed areas, wet suppression (watering), chemical dust suppression, gravel asphalt surfacing, temporary gravel construction entrances, equipment wash-out areas, and haul truck covers can be employed as dust control applications. Permanent or temporary vegetation and mulching can be employed for areas of occasional or no construction traffic. Preventive measures include minimizing surface areas to be disturbed, limiting onsite vehicle traffic to 15 mph or less, and controlling the number and activity of vehicles on a site at any given time.

Chemical dust suppressants include: mulch and fiber based dust palliatives (e.g. paper mulch with gypsum binder), salts and brines (e.g. calcium chloride, magnesium chloride), non-petroleum based organics (e.g. vegetable oil, lignosulfonate), petroleum based organics (e.g. asphalt emulsion, dust oils, petroleum resins), synthetic polymers (e.g. polyvinyl acetate, vinyls, acrylic), clay additives (e.g. bentonite, montimorillonite) and electrochemical products (e.g. enzymes, ionic products).

Site Condition	Dust Control Practices							
	Permanent Vegetation	Mulching	Wet Suppression (Watering)	Chemical Dust Suppression	Gravel or Asphalt	Temporary Gravel Construction Entrances/Equipment Wash Down	Synthetic Covers	Minimize Extent of Disturbed Area
Disturbed Areas not Subject to Traffic	x	x	x	x	x			x
Disturbed Areas Subject to Traffic			x	x	x	x		x
Material Stockpiles		x	x	x			x	x
Demolition			x			x	x	
Clearing/ Excavation			x	x				x
Truck Traffic on Unpaved Roads			x	x	x	x	x	
Tracking					x	x		

Additional preventive measures include:

- Schedule construction activities to minimize exposed area (see EC-1, Scheduling).
- Quickly treat exposed soils using water, mulching, chemical dust suppressants, or stone/gravel layering.
- Identify and stabilize key access points prior to commencement of construction.
- Minimize the impact of dust by anticipating the direction of prevailing winds.
- Restrict construction traffic to stabilized roadways within the project site, as practicable.
- Water should be applied by means of pressure-type distributors or pipelines equipped with a spray system or hoses and nozzles that will ensure even distribution.
- All distribution equipment should be equipped with a positive means of shutoff.
- Unless water is applied by means of pipelines, at least one mobile unit should be available at all times to apply water or dust palliative to the project.
- If reclaimed waste water is used, the sources and discharge must meet California Department of Health Services water reclamation criteria and the Regional Water Quality

Control Board (RWQCB) requirements. Non-potable water should not be conveyed in tanks or drain pipes that will be used to convey potable water and there should be no connection between potable and non-potable supplies. Non-potable tanks, pipes, and other conveyances should be marked, "NON-POTABLE WATER - DO NOT DRINK."

- Pave or chemically stabilize access points where unpaved traffic surfaces adjoin paved roads.
- Provide covers for haul trucks transporting materials that contribute to dust.
- Provide for rapid clean up of sediments deposited on paved roads. Furnish stabilized construction road entrances and wheel wash areas.
- Stabilize inactive areas of construction sites using temporary vegetation or chemical stabilization methods.

For chemical stabilization, there are many products available for chemically stabilizing gravel roadways and stockpiles. If chemical stabilization is used, the chemicals should not create any adverse effects on stormwater, plant life, or groundwater and should meet all applicable regulatory requirements.

Costs

Installation costs for water and chemical dust suppression vary based on the method used and the length of effectiveness. Annual costs may be high since some of these measures are effective for only a few hours to a few days.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Check areas protected to ensure coverage.
- Most water-based dust control measures require frequent application, often daily or even multiple times per day. Obtain vendor or independent information on longevity of chemical dust suppressants.

References

Best Management Practices and Erosion Control Manual for Construction Sites, Flood Control District of Maricopa County, Arizona, September 1992.

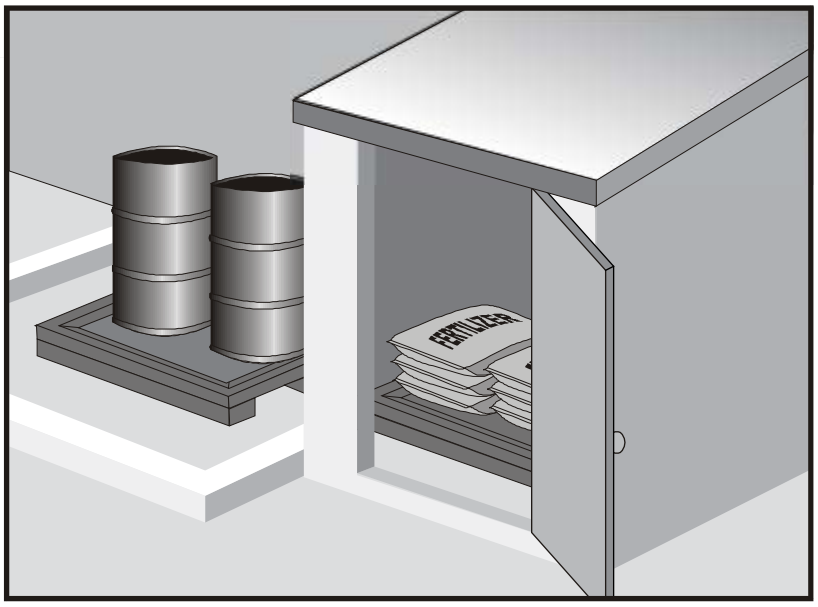
California Air Pollution Control Laws, California Air Resources Board, updated annually.

Construction Manual, Chapter 4, Section 10, "Dust Control"; Section 17, "Watering"; and Section 18, "Dust Palliative", California Department of Transportation (Caltrans), July 2001.

Prospects for Attaining the State Ambient Air Quality Standards for Suspended Particulate Matter (PM10), Visibility Reducing Particles, Sulfates, Lead, and Hydrogen Sulfide, California Air Resources Board, April 1991.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Material Delivery and Storage WM-1



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Description and Purpose

Prevent, reduce, or eliminate the discharge of pollutants from material delivery and storage to the stormwater system or watercourses by minimizing the storage of hazardous materials onsite, storing materials in watertight containers and/or a completely enclosed designated area, installing secondary containment, conducting regular inspections, and training employees and subcontractors.

This best management practice covers only material delivery and storage. For other information on materials, see WM-2, Material Use, or WM-4, Spill Prevention and Control. For information on wastes, see the waste management BMPs in this section.

Suitable Applications

These procedures are suitable for use at all construction sites with delivery and storage of the following materials:

- Soil stabilizers and binders
- Pesticides and herbicides
- Fertilizers
- Detergents
- Plaster
- Petroleum products such as fuel, oil, and grease

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Asphalt and concrete components
- Hazardous chemicals such as acids, lime, glues, adhesives, paints, solvents, and curing compounds
- Concrete compounds
- Other materials that may be detrimental if released to the environment

Limitations

- Space limitation may preclude indoor storage.
- Storage sheds often must meet building and fire code requirements.

Implementation

The following steps should be taken to minimize risk:

- Chemicals must be stored in water tight containers with appropriate secondary containment or in a storage shed.
- When a material storage area is located on bare soil, the area should be lined and bermed.
- Use containment pallets or other practical and available solutions, such as storing materials within newly constructed buildings or garages, to meet material storage requirements.
- Stack erodible landscape material on pallets and cover when not in use.
- Contain all fertilizers and other landscape materials when not in use.
- Temporary storage areas should be located away from vehicular traffic.
- Material Safety Data Sheets (MSDS) should be available on-site for all materials stored that have the potential to effect water quality.
- Construction site areas should be designated for material delivery and storage.
- Material delivery and storage areas should be located away from waterways, if possible.
    - Avoid transport near drainage paths or waterways.
    - Surround with earth berms or other appropriate containment BMP. See EC-9, Earth Dikes and Drainage Swales.
    - Place in an area that will be paved.
- Storage of reactive, ignitable, or flammable liquids must comply with the fire codes of your area. Contact the local Fire Marshal to review site materials, quantities, and proposed storage area to determine specific requirements. See the Flammable and Combustible Liquid Code, NFPA30.
- An up to date inventory of materials delivered and stored onsite should be kept.

- Hazardous materials storage onsite should be minimized.
- Hazardous materials should be handled as infrequently as possible.
- Keep ample spill cleanup supplies appropriate for the materials being stored. Ensure that cleanup supplies are in a conspicuous, labeled area.
- Employees and subcontractors should be trained on the proper material delivery and storage practices.
- Employees trained in emergency spill cleanup procedures must be present when dangerous materials or liquid chemicals are unloaded.
- If significant residual materials remain on the ground after construction is complete, properly remove and dispose of materials and any contaminated soil. See WM-7, Contaminated Soil Management. If the area is to be paved, pave as soon as materials are removed to stabilize the soil.

Material Storage Areas and Practices

- Liquids, petroleum products, and substances listed in 40 CFR Parts 110, 117, or 302 should be stored in approved containers and drums and should not be overfilled. Containers and drums should be placed in temporary containment facilities for storage.
- A temporary containment facility should provide for a spill containment volume able to contain precipitation from a 25 year storm event, plus the greater of 10% of the aggregate volume of all containers or 100% of the capacity of the largest container within its boundary, whichever is greater.
- A temporary containment facility should be impervious to the materials stored therein for a minimum contact time of 72 hours.
- A temporary containment facility should be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills should be collected and placed into drums. These liquids should be handled as a hazardous waste unless testing determines them to be non-hazardous. All collected liquids or non-hazardous liquids should be sent to an approved disposal site.
- Sufficient separation should be provided between stored containers to allow for spill cleanup and emergency response access.
- Incompatible materials, such as chlorine and ammonia, should not be stored in the same temporary containment facility.
- Materials should be covered prior to, and during rain events.
- Materials should be stored in their original containers and the original product labels should be maintained in place in a legible condition. Damaged or otherwise illegible labels should be replaced immediately.

- Bagged and boxed materials should be stored on pallets and should not be allowed to accumulate on the ground. To provide protection from wind and rain throughout the rainy season, bagged and boxed materials should be covered during non-working days and prior to and during rain events.
- Stockpiles should be protected in accordance with WM-3, Stockpile Management.
- Materials should be stored indoors within existing structures or completely enclosed storage sheds when available.
- Proper storage instructions should be posted at all times in an open and conspicuous location.
- An ample supply of appropriate spill clean up material should be kept near storage areas.
- Also see WM-6, Hazardous Waste Management, for storing of hazardous wastes.

Material Delivery Practices

- Keep an accurate, up-to-date inventory of material delivered and stored onsite.
- Arrange for employees trained in emergency spill cleanup procedures to be present when dangerous materials or liquid chemicals are unloaded.

Spill Cleanup

- Contain and clean up any spill immediately.
- Properly remove and dispose of any hazardous materials or contaminated soil if significant residual materials remain on the ground after construction is complete. See WM-7, Contaminated Soil Management.
- See WM-4, Spill Prevention and Control, for spills of chemicals and/or hazardous materials.
- If spills or leaks of materials occur that are not contained and could discharge to surface waters, non-visible sampling of site discharge may be required. Refer to the General Permit or to your project specific Construction Site Monitoring Plan to determine if and where sampling is required.

Cost

- The largest cost of implementation may be in the construction of a materials storage area that is covered and provides secondary containment.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Keep storage areas clean and well organized, including a current list of all materials onsite.
- Inspect labels on containers for legibility and accuracy.

- Repair or replace perimeter controls, containment structures, covers, and liners as needed to maintain proper function.

References

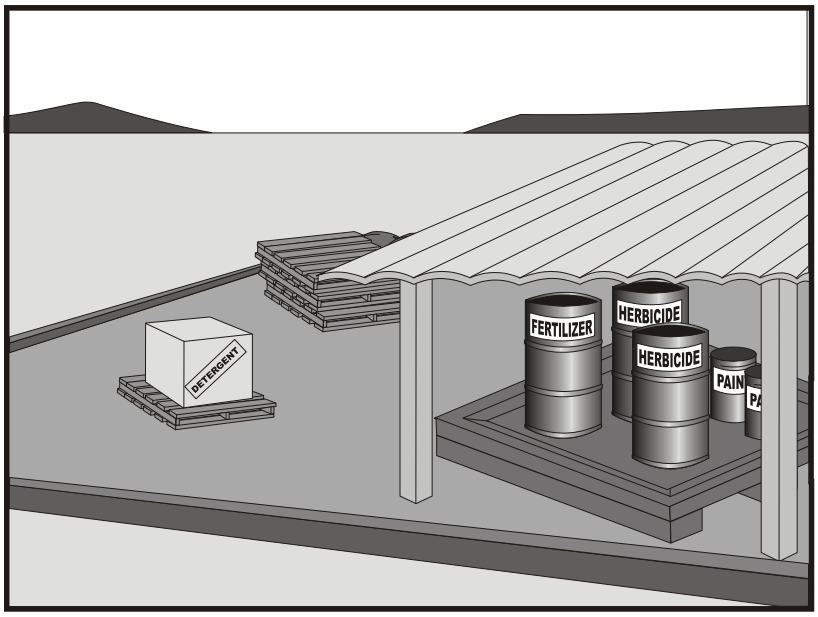
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Material Use WM-2



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Prevent or reduce the discharge of pollutants to the storm drain system or watercourses from material use by using alternative products, minimizing hazardous material use onsite, and training employees and subcontractors.

Suitable Applications

This BMP is suitable for use at all construction projects. These procedures apply when the following materials are used or prepared onsite:

- Pesticides and herbicides
- Fertilizers
- Detergents
- Petroleum products such as fuel, oil, and grease
- Asphalt and other concrete components
- Other hazardous chemicals such as acids, lime, glues, adhesives, paints, solvents, and curing compounds
- Other materials that may be detrimental if released to the environment

Limitations

Safer alternative building and construction products may not be available or suitable in every instance.

Implementation

The following steps should be taken to minimize risk:

- Minimize use of hazardous materials onsite.
- Follow manufacturer instructions regarding uses, protective equipment, ventilation, flammability, and mixing of chemicals.
- Train personnel who use pesticides. The California Department of Pesticide Regulation and county agricultural commissioners license pesticide dealers, certify pesticide applicators, and conduct onsite inspections.
- The preferred method of termiticide application is soil injection near the existing or proposed structure foundation/slab; however, if not feasible, soil drench application of termiticides should follow EPA label guidelines and the following recommendations (most of which are applicable to most pesticide applications):
  - Do not treat soil that is water-saturated or frozen.
  - Application shall not commence within 24-hours of a predicted precipitation event with a 40% or greater probability. Weather tracking must be performed on a daily basis prior to termiticide application and during the period of termiticide application.
  - Do not allow treatment chemicals to runoff from the target area. Apply proper quantity to prevent excess runoff. Provide containment for and divert stormwater from application areas using berms or diversion ditches during application.
  - Dry season: Do not apply within 10 feet of storm drains. Do not apply within 25 feet of aquatic habitats (such as, but not limited to, lakes; reservoirs; rivers; permanent streams; marshes or ponds; estuaries; and commercial fish farm ponds).
  - Wet season: Do not apply within 50 feet of storm drains or aquatic habitats (such as, but not limited to, lakes; reservoirs; rivers; permanent streams; marshes or ponds; estuaries; and commercial fish farm ponds) unless a vegetative buffer is present (if so, refer to dry season requirements).
  - Do not make on-grade applications when sustained wind speeds are above 10 mph (at application site) at nozzle end height.
  - Cover treatment site prior to a rain event in order to prevent run-off of the pesticide into non-target areas. The treated area should be limited to a size that can be backfilled and/or covered by the end of the work shift. Backfilling or covering of the treated area shall be done by the end of the same work shift in which the application is made.
  - The applicator must either cover the soil him/herself or provide written notification of the above requirement to the contractor on site and to the person commissioning the

application (if different than the contractor). If notice is provided to the contractor or the person commissioning the application, then they are responsible under the Federal Insecticide Fungicide, and Rodenticide Act (FIFRA) to ensure that: 1) if the concrete slab cannot be poured over the treated soil within 24 hours of application, the treated soil is covered with a waterproof covering (such as polyethylene sheeting), and 2) the treated soil is covered if precipitation is predicted to occur before the concrete slab is scheduled to be poured.

- Do not over-apply fertilizers, herbicides, and pesticides. Prepare only the amount needed. Follow the recommended usage instructions. Over-application is expensive and environmentally harmful. Unless on steep slopes, till fertilizers into the soil rather than hydraulic application. Apply surface dressings in several smaller applications, as opposed to one large application, to allow time for infiltration and to avoid excess material being carried offsite by runoff. Do not apply these chemicals before predicted rainfall.
- Train employees and subcontractors in proper material use.
- Supply Material Safety Data Sheets (MSDS) for all materials.
- Dispose of latex paint and paint cans, used brushes, rags, absorbent materials, and drop cloths, when thoroughly dry and are no longer hazardous, with other construction debris.
- Do not remove the original product label; it contains important safety and disposal information. Use the entire product before disposing of the container.
- Mix paint indoors or in a containment area. Never clean paintbrushes or rinse paint containers into a street, gutter, storm drain, or watercourse. Dispose of any paint thinners, residue, and sludge(s) that cannot be recycled, as hazardous waste.
- For water-based paint, clean brushes to the extent practicable, and rinse to a drain leading to a sanitary sewer where permitted, or contain for proper disposal off site. For oil-based paints, clean brushes to the extent practicable, and filter and reuse thinners and solvents.
- Use recycled and less hazardous products when practical. Recycle residual paints, solvents, non-treated lumber, and other materials.
- Use materials only where and when needed to complete the construction activity. Use safer alternative materials as much as possible. Reduce or eliminate use of hazardous materials onsite when practical.
- Document the location, time, chemicals applied, and applicator's name and qualifications.
- Keep an ample supply of spill clean up material near use areas. Train employees in spill clean up procedures.
- Avoid exposing applied materials to rainfall and runoff unless sufficient time has been allowed for them to dry.
- Discontinue use of erodible landscape material within 2 days prior to a forecasted rain event and materials should be covered and/or bermed.

- Provide containment for material use areas such as masons' areas or paint mixing/preparation areas to prevent materials/pollutants from entering stormwater.

Costs

All of the above are low cost measures.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Ensure employees and subcontractors throughout the job are using appropriate practices.

References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

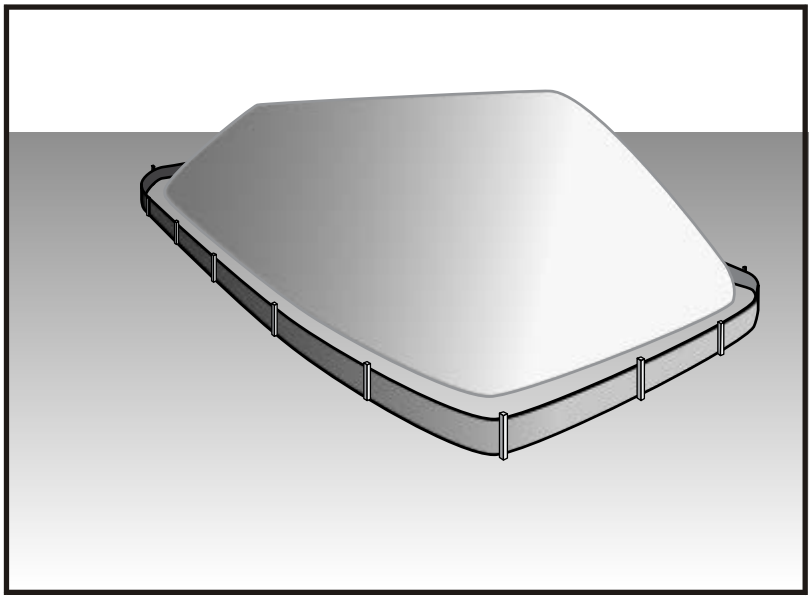
Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

Comments on Risk Assessments Risk Reduction Options for Cypermethrin: Docket No. OPP–2005–0293; California Stormwater Quality Association (CASQA) letter to USEPA, 2006.Environmental Hazard and General Labeling for Pyrethroid Non-Agricultural Outdoor Products, EPA-HQ-OPP-2008-0331-0021; USEPA, 2008.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Stockpile Management WM-3



Categories		
EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☒
WM	Waste Management and Materials Pollution Control	☑

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents	
Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Stockpile management procedures and practices are designed to reduce or eliminate air and stormwater pollution from stockpiles of soil, soil amendments, sand, paving materials such as portland cement concrete (PCC) rubble, asphalt concrete (AC), asphalt concrete rubble, aggregate base, aggregate sub base or pre-mixed aggregate, asphalt minder (so called "cold mix" asphalt), and pressure treated wood.

Suitable Applications

Implement in all projects that stockpile soil and other loose materials.

Limitations

- Plastic sheeting as a stockpile protection is temporary and hard to manage in windy conditions. Where plastic is used, consider use of plastic tarps with nylon reinforcement which may be more durable than standard sheeting.
- Plastic sheeting can increase runoff volume due to lack of infiltration and potentially cause perimeter control failure.
- Plastic sheeting breaks down faster in sunlight.
- The use of Plastic materials and photodegradable plastics should be avoided.

Implementation

Protection of stockpiles is a year-round requirement. To properly manage stockpiles:

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- On larger sites, a minimum of 50 ft separation from concentrated flows of stormwater, drainage courses, and inlets is recommended.
- After 14 days of inactivity, a stockpile is non-active and requires further protection described below. All stockpiles are required to be protected as non-active stockpiles immediately if they are not scheduled to be used within 14 days.
- Protect all stockpiles from stormwater runon using temporary perimeter sediment barriers such as compost berms (SE-13), temporary silt dikes (SE-12), fiber rolls (SE-5), silt fences (SE-1), sandbags (SE-8), gravel bags (SE-6), or biofilter bags (SE-14). Refer to the individual fact sheet for each of these controls for installation information.
- Implement wind erosion control practices as appropriate on all stockpiled material. For specific information, see WE-1, Wind Erosion Control.
- Manage stockpiles of contaminated soil in accordance with WM-7, Contaminated Soil Management.
- Place bagged materials on pallets and under cover.
- Ensure that stockpile coverings are installed securely to protect from wind and rain.
- Some plastic covers withstand weather and sunlight better than others. Select cover materials or methods based on anticipated duration of use.

Protection of Non-Active Stockpiles

A stockpile is considered non-active if it either is not used for 14 days or if it is scheduled not to be used for 14 days or more. Stockpiles need to be protected immediately if they are not scheduled to be used within 14 days. Non-active stockpiles of the identified materials should be protected as follows:

Soil stockpiles

- Soil stockpiles should be covered or protected with soil stabilization measures and a temporary perimeter sediment barrier at all times.
- Temporary vegetation should be considered for topsoil piles that will be stockpiled for extended periods.

Stockpiles of Portland cement concrete rubble, asphalt concrete, asphalt concrete rubble, aggregate base, or aggregate sub base

- Stockpiles should be covered and protected with a temporary perimeter sediment barrier at all times.

Stockpiles of "cold mix"

- Cold mix stockpiles should be placed on and covered with plastic sheeting or comparable material at all times and surrounded by a berm.

Stockpiles of fly ash, stucco, hydrated lime

- Stockpiles of materials that may raise the pH of runoff (i.e., basic materials) should be covered with plastic and surrounded by a berm.

Stockpiles/Storage of wood (Pressure treated with chromated copper arsenate or ammoniacal copper zinc arsenate

- Treated wood should be covered with plastic sheeting or comparable material at all times and surrounded by a berm.

Protection of Active Stockpiles

A stockpile is active when it is being used or is scheduled to be used within 14 days of the previous use. Active stockpiles of the identified materials should be protected as follows:

- All stockpiles should be covered and protected with a temporary linear sediment barrier prior to the onset of precipitation.
- Stockpiles of "cold mix" and treated wood, and basic materials should be placed on and covered with plastic sheeting or comparable material and surrounded by a berm prior to the onset of precipitation.
- The downstream perimeter of an active stockpile should be protected with a linear sediment barrier or berm and runoff should be diverted around or away from the stockpile on the upstream perimeter.

Costs

For cost information associated with stockpile protection refer to the individual erosion or sediment control BMP fact sheet considered for implementation (For example, refer to SE-1 Silt Fence for installation of silt fence around the perimeter of a stockpile.)

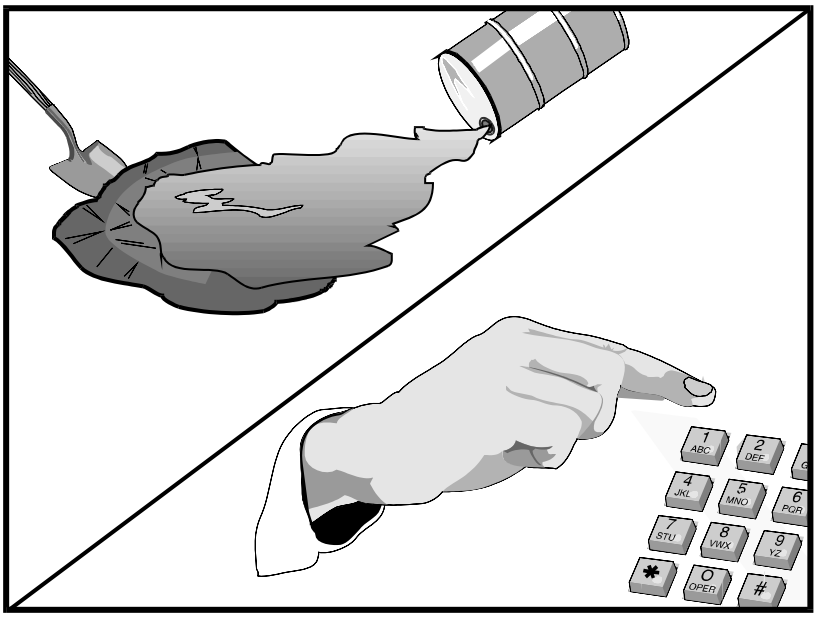
Inspection and Maintenance

- Stockpiles must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- It may be necessary to inspect stockpiles covered with plastic sheeting more frequently during certain conditions (for example, high winds or extreme heat).
- Repair and/or replace perimeter controls and covers as needed to keep them functioning properly.
- Sediment shall be removed when it reaches one-third of the barrier height.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Spill Prevention and Control WM-4



Description and Purpose

Prevent or reduce the discharge of pollutants to drainage systems or watercourses from leaks and spills by reducing the chance for spills, stopping the source of spills, containing and cleaning up spills, properly disposing of spill materials, and training employees.

This best management practice covers only spill prevention and control. However, WM-1, Materials Delivery and Storage, and WM-2, Material Use, also contain useful information, particularly on spill prevention. For information on wastes, see the waste management BMPs in this section.

Suitable Applications

This BMP is suitable for all construction projects. Spill control procedures are implemented anytime chemicals or hazardous substances are stored on the construction site, including the following materials:

- Soil stabilizers/binders
- Dust palliatives
- Herbicides
- Growth inhibitors
- Fertilizers
- Deicing/anti-icing chemicals

Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Fuels
- Lubricants
- Other petroleum distillates

Limitations

- In some cases it may be necessary to use a private spill cleanup company.
- This BMP applies to spills caused by the contractor and subcontractors.
- Procedures and practices presented in this BMP are general. Contractor should identify appropriate practices for the specific materials used or stored onsite

Implementation

The following steps will help reduce the stormwater impacts of leaks and spills:

Education

- Be aware that different materials pollute in different amounts. Make sure that each employee knows what a "significant spill" is for each material they use, and what is the appropriate response for "significant" and "insignificant" spills.
- Educate employees and subcontractors on potential dangers to humans and the environment from spills and leaks.
- Hold regular meetings to discuss and reinforce appropriate disposal procedures (incorporate into regular safety meetings).
- Establish a continuing education program to indoctrinate new employees.
- Have contractor's superintendent or representative oversee and enforce proper spill prevention and control measures.

General Measures

- To the extent that the work can be accomplished safely, spills of oil, petroleum products, substances listed under 40 CFR parts 110,117, and 302, and sanitary and septic wastes should be contained and cleaned up immediately.
- Store hazardous materials and wastes in covered containers and protect from vandalism.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Train employees in spill prevention and cleanup.
- Designate responsible individuals to oversee and enforce control measures.
- Spills should be covered and protected from stormwater runon during rainfall to the extent that it doesn't compromise clean up activities.
- Do not bury or wash spills with water.

- Store and dispose of used clean up materials, contaminated materials, and recovered spill material that is no longer suitable for the intended purpose in conformance with the provisions in applicable BMPs.
- Do not allow water used for cleaning and decontamination to enter storm drains or watercourses. Collect and dispose of contaminated water in accordance with WM-10, Liquid Waste Management.
- Contain water overflow or minor water spillage and do not allow it to discharge into drainage facilities or watercourses.
- Place proper storage, cleanup, and spill reporting instructions for hazardous materials stored or used on the project site in an open, conspicuous, and accessible location.
- Keep waste storage areas clean, well organized, and equipped with ample cleanup supplies as appropriate for the materials being stored. Perimeter controls, containment structures, covers, and liners should be repaired or replaced as needed to maintain proper function.

Cleanup

- Clean up leaks and spills immediately.
- Use a rag for small spills on paved surfaces, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to either a certified laundry (rags) or disposed of as hazardous waste.
- Never hose down or bury dry material spills. Clean up as much of the material as possible and dispose of properly. See the waste management BMPs in this section for specific information.

Minor Spills

- Minor spills typically involve small quantities of oil, gasoline, paint, etc. which can be controlled by the first responder at the discovery of the spill.
- Use absorbent materials on small spills rather than hosing down or burying the spill.
- Absorbent materials should be promptly removed and disposed of properly.
- Follow the practice below for a minor spill:
  - Contain the spread of the spill.
  - Recover spilled materials.
  - Clean the contaminated area and properly dispose of contaminated materials.

Semi-Significant Spills

- Semi-significant spills still can be controlled by the first responder along with the aid of other personnel such as laborers and the foreman, etc. This response may require the cessation of all other activities.

- Spills should be cleaned up immediately:
  - Contain spread of the spill.
  - Notify the project foreman immediately.
  - If the spill occurs on paved or impermeable surfaces, clean up using "dry" methods (absorbent materials, cat litter and/or rags). Contain the spill by encircling with absorbent materials and do not let the spill spread widely.
  - If the spill occurs in dirt areas, immediately contain the spill by constructing an earthen dike. Dig up and properly dispose of contaminated soil.
  - If the spill occurs during rain, cover spill with tarps or other material to prevent contaminating runoff.

Significant/Hazardous Spills

- For significant or hazardous spills that cannot be controlled by personnel in the immediate vicinity, the following steps should be taken:
  - Notify the local emergency response by dialing 911. In addition to 911, the contractor will notify the proper county officials. It is the contractor's responsibility to have all emergency phone numbers at the construction site.
  - Notify the Governor's Office of Emergency Services Warning Center, (916) 845-8911.
  - For spills of federal reportable quantities, in conformance with the requirements in 40 CFR parts 110,119, and 302, the contractor should notify the National Response Center at (800) 424-8802.
  - Notification should first be made by telephone and followed up with a written report.
  - The services of a spills contractor or a Haz-Mat team should be obtained immediately. Construction personnel should not attempt to clean up until the appropriate and qualified staffs have arrived at the job site.
  - Other agencies which may need to be consulted include, but are not limited to, the Fire Department, the Public Works Department, the Coast Guard, the Highway Patrol, the City/County Police Department, Department of Toxic Substances, California Division of Oil and Gas, Cal/OSHA, etc.

Reporting

- Report significant spills to local agencies, such as the Fire Department; they can assist in cleanup.
- Federal regulations require that any significant oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hours).

Use the following measures related to specific activities:

Vehicle and Equipment Maintenance

- If maintenance must occur onsite, use a designated area and a secondary containment, located away from drainage courses, to prevent the runon of stormwater and the runoff of spills.
- Regularly inspect onsite vehicles and equipment for leaks and repair immediately
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Place drip pans or absorbent materials under paving equipment when not in use.
- Use absorbent materials on small spills rather than hosing down or burying the spill. Remove the absorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around
- Oil filters disposed of in trashcans or dumpsters can leak oil and pollute stormwater. Place the oil filter in a funnel over a waste oil-recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask the oil supplier or recycler about recycling oil filters.
- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Vehicle and Equipment Fueling

- If fueling must occur onsite, use designate areas, located away from drainage courses, to prevent the runon of stormwater and the runoff of spills.
- Discourage "topping off" of fuel tanks.
- Always use secondary containment, such as a drain pan, when fueling to catch spills/ leaks.

Costs

Prevention of leaks and spills is inexpensive. Treatment and/ or disposal of contaminated soil or water can be quite expensive.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.
- Keep ample supplies of spill control and cleanup materials onsite, near storage, unloading, and maintenance areas.
- Update your spill prevention and control plan and stock cleanup materials as changes occur in the types of chemicals onsite.

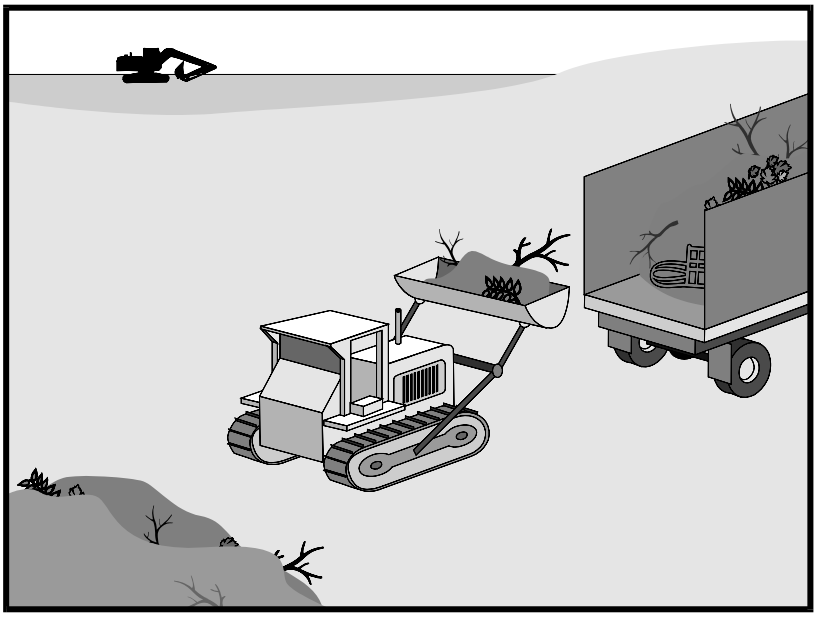
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Solid Waste Management WM-5



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Solid waste management procedures and practices are designed to prevent or reduce the discharge of pollutants to stormwater from solid or construction waste by providing designated waste collection areas and containers, arranging for regular disposal, and training employees and subcontractors.

Suitable Applications

This BMP is suitable for construction sites where the following wastes are generated or stored:

- Solid waste generated from trees and shrubs removed during land clearing, demolition of existing structures (rubble), and building construction
- Packaging materials including wood, paper, and plastic
- Scrap or surplus building materials including scrap metals, rubber, plastic, glass pieces, and masonry products
- Domestic wastes including food containers such as beverage cans, coffee cups, paper bags, plastic wrappers, and cigarettes
- Construction wastes including brick, mortar, timber, steel and metal scraps, pipe and electrical cuttings, non-hazardous equipment parts, styrofoam and other materials used to transport and package construction materials

- Highway planting wastes, including vegetative material, plant containers, and packaging materials

Limitations

Temporary stockpiling of certain construction wastes may not necessitate stringent drainage related controls during the non-rainy season or in desert areas with low rainfall.

Implementation

The following steps will help keep a clean site and reduce stormwater pollution:

- Select designated waste collection areas onsite.
- Inform trash-hauling contractors that you will accept only watertight dumpsters for onsite use. Inspect dumpsters for leaks and repair any dumpster that is not watertight.
- Locate containers in a covered area or in a secondary containment.
- Provide an adequate number of containers with lids or covers that can be placed over the container to keep rain out or to prevent loss of wastes when it is windy.
- Cover waste containers at the end of each work day and when it is raining.
- Plan for additional containers and more frequent pickup during the demolition phase of construction.
- Collect site trash daily, especially during rainy and windy conditions.
- Remove this solid waste promptly since erosion and sediment control devices tend to collect litter.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.
- Do not hose out dumpsters on the construction site. Leave dumpster cleaning to the trash hauling contractor.
- Arrange for regular waste collection before containers overflow.
- Clean up immediately if a container does spill.
- Make sure that construction waste is collected, removed, and disposed of only at authorized disposal areas.

Education

- Have the contractor's superintendent or representative oversee and enforce proper solid waste management procedures and practices.
- Instruct employees and subcontractors on identification of solid waste and hazardous waste.
- Educate employees and subcontractors on solid waste storage and disposal procedures.

- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).
- Require that employees and subcontractors follow solid waste handling and storage procedures.
- Prohibit littering by employees, subcontractors, and visitors.
- Minimize production of solid waste materials wherever possible.

Collection, Storage, and Disposal

- Littering on the project site should be prohibited.
- To prevent clogging of the storm drainage system, litter and debris removal from drainage grates, trash racks, and ditch lines should be a priority.
- Trash receptacles should be provided in the contractor's yard, field trailer areas, and at locations where workers congregate for lunch and break periods.
- Litter from work areas within the construction limits of the project site should be collected and placed in watertight dumpsters at least weekly, regardless of whether the litter was generated by the contractor, the public, or others. Collected litter and debris should not be placed in or next to drain inlets, stormwater drainage systems, or watercourses.
- Dumpsters of sufficient size and number should be provided to contain the solid waste generated by the project.
- Full dumpsters should be removed from the project site and the contents should be disposed of by the trash hauling contractor.
- Construction debris and waste should be removed from the site biweekly or more frequently as needed.
- Construction material visible to the public should be stored or stacked in an orderly manner.
- Stormwater runon should be prevented from contacting stored solid waste through the use of berms, dikes, or other temporary diversion structures or through the use of measures to elevate waste from site surfaces.
- Solid waste storage areas should be located at least 50 ft from drainage facilities and watercourses and should not be located in areas prone to flooding or ponding.
- Except during fair weather, construction and highway planting waste not stored in watertight dumpsters should be securely covered from wind and rain by covering the waste with tarps or plastic.
- Segregate potentially hazardous waste from non-hazardous construction site waste.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.

- For disposal of hazardous waste, see WM-6, Hazardous Waste Management. Have hazardous waste hauled to an appropriate disposal and/or recycling facility.

- Salvage or recycle useful vegetation debris, packaging and surplus building materials when practical. For example, trees and shrubs from land clearing can be used as a brush barrier, or converted into wood chips, then used as mulch on graded areas. Wood pallets, cardboard boxes, and construction scraps can also be recycled.

Costs

All of the above are low cost measures.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur

- Inspect construction waste area regularly.

- Arrange for regular waste collection.

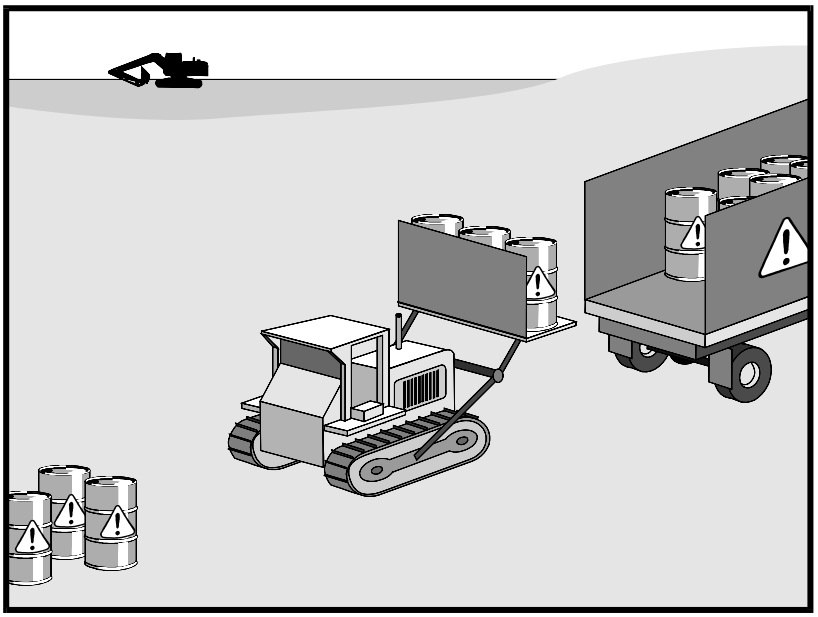
References

Processes, Procedures and Methods to Control Pollution Resulting from All Construction Activity, 430/9-73-007, USEPA, 1973.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Hazardous Waste Management WM-6



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Prevent or reduce the discharge of pollutants to stormwater from hazardous waste through proper material use, waste disposal, and training of employees and subcontractors.

Suitable Applications

This best management practice (BMP) applies to all construction projects. Hazardous waste management practices are implemented on construction projects that generate waste from the use of:

- Petroleum Products
- Asphalt Products
- Concrete Curing Compounds
- Pesticides
- Palliatives
- Acids
- Septic Wastes
- Paints
- Stains
- Solvents
- Wood Preservatives
- Roofing Tar
- Any materials deemed a hazardous waste in California, Title 22 Division 4.5, or listed in 40 CFR Parts 110, 117, 261, or 302

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

In addition, sites with existing structures may contain wastes, which must be disposed of in accordance with federal, state, and local regulations. These wastes include:

- Sandblasting grit mixed with lead-, cadmium-, or chromium-based paints
- Asbestos
- PCBs (particularly in older transformers)

Limitations

- Hazardous waste that cannot be reused or recycled must be disposed of by a licensed hazardous waste hauler.
- Nothing in this BMP relieves the contractor from responsibility for compliance with federal, state, and local laws regarding storage, handling, transportation, and disposal of hazardous wastes.
- This BMP does not cover aerially deposited lead (ADL) soils. For ADL soils refer to WM-7, Contaminated Soil Management.

Implementation

The following steps will help reduce stormwater pollution from hazardous wastes:

Material Use

- Wastes should be stored in sealed containers constructed of a suitable material and should be labeled as required by Title 22 CCR, Division 4.5 and 49 CFR Parts 172, 173, 178, and 179.
- All hazardous waste should be stored, transported, and disposed as required in Title 22 CCR, Division 4.5 and 49 CFR 261-263.
- Waste containers should be stored in temporary containment facilities that should comply with the following requirements:
  - Temporary containment facility should provide for a spill containment volume equal to 1.5 times the volume of all containers able to contain precipitation from a 25 year storm event, plus the greater of 10% of the aggregate volume of all containers or 100% of the capacity of the largest tank within its boundary, whichever is greater.
  - Temporary containment facility should be impervious to the materials stored there for a minimum contact time of 72 hours.
  - Temporary containment facilities should be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills should be placed into drums after each rainfall. These liquids should be handled as a hazardous waste unless testing determines them to be non-hazardous. Non-hazardous liquids should be sent to an approved disposal site.
  - Sufficient separation should be provided between stored containers to allow for spill cleanup and emergency response access.

- Incompatible materials, such as chlorine and ammonia, should not be stored in the same temporary containment facility.

- Throughout the rainy season, temporary containment facilities should be covered during non-working days, and prior to rain events. Covered facilities may include use of plastic tarps for small facilities or constructed roofs with overhangs.

- Drums should not be overfilled and wastes should not be mixed.

- Unless watertight, containers of dry waste should be stored on pallets.

- Do not over-apply herbicides and pesticides. Prepare only the amount needed. Follow the recommended usage instructions. Over application is expensive and environmentally harmful. Apply surface dressings in several smaller applications, as opposed to one large application. Allow time for infiltration and avoid excess material being carried offsite by runoff. Do not apply these chemicals just before it rains. People applying pesticides must be certified in accordance with federal and state regulations.

- Paint brushes and equipment for water and oil based paints should be cleaned within a contained area and should not be allowed to contaminate site soils, watercourses, or drainage systems. Waste paints, thinners, solvents, residues, and sludges that cannot be recycled or reused should be disposed of as hazardous waste. When thoroughly dry, latex paint and paint cans, used brushes, rags, absorbent materials, and drop cloths should be disposed of as solid waste.

- Do not clean out brushes or rinse paint containers into the dirt, street, gutter, storm drain, or stream. "Paint out" brushes as much as possible. Rinse water-based paints to the sanitary sewer. Filter and reuse thinners and solvents. Dispose of excess oil-based paints and sludge as hazardous waste.

- The following actions should be taken with respect to temporary contaminant:

  - Ensure that adequate hazardous waste storage volume is available.

  - Ensure that hazardous waste collection containers are conveniently located.

  - Designate hazardous waste storage areas onsite away from storm drains or watercourses and away from moving vehicles and equipment to prevent accidental spills.

  - Minimize production or generation of hazardous materials and hazardous waste on the job site.

  - Use containment berms in fueling and maintenance areas and where the potential for spills is high.

  - Segregate potentially hazardous waste from non-hazardous construction site debris.

  - Keep liquid or semi-liquid hazardous waste in appropriate containers (closed drums or similar) and under cover.

- Clearly label all hazardous waste containers with the waste being stored and the date of accumulation.
- Place hazardous waste containers in secondary containment.
- Do not allow potentially hazardous waste materials to accumulate on the ground.
- Do not mix wastes.
- Use all of the product before disposing of the container.
- Do not remove the original product label; it contains important safety and disposal information.

Waste Recycling Disposal

- Select designated hazardous waste collection areas onsite.
- Hazardous materials and wastes should be stored in covered containers and protected from vandalism.
- Place hazardous waste containers in secondary containment.
- Do not mix wastes, this can cause chemical reactions, making recycling impossible and complicating disposal.
- Recycle any useful materials such as used oil or water-based paint.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.
- Arrange for regular waste collection before containers overflow.
- Make sure that hazardous waste (e.g., excess oil-based paint and sludge) is collected, removed, and disposed of only at authorized disposal areas.

Disposal Procedures

- Waste should be disposed of by a licensed hazardous waste transporter at an authorized and licensed disposal facility or recycling facility utilizing properly completed Uniform Hazardous Waste Manifest forms.
- A Department of Health Services certified laboratory should sample waste to determine the appropriate disposal facility.
- Properly dispose of rainwater in secondary containment that may have mixed with hazardous waste.
- Attention is directed to "Hazardous Material", "Contaminated Material", and "Aerially Deposited Lead" of the contract documents regarding the handling and disposal of hazardous materials.

Education

- Educate employees and subcontractors on hazardous waste storage and disposal procedures.
- Educate employees and subcontractors on potential dangers to humans and the environment from hazardous wastes.
- Instruct employees and subcontractors on safety procedures for common construction site hazardous wastes.
- Instruct employees and subcontractors in identification of hazardous and solid waste.
- Hold regular meetings to discuss and reinforce hazardous waste management procedures (incorporate into regular safety meetings).
- The contractor's superintendent or representative should oversee and enforce proper hazardous waste management procedures and practices.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.
- Warning signs should be placed in areas recently treated with chemicals.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- If a container does spill, clean up immediately.

Costs

All of the above are low cost measures.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events..
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur
- Hazardous waste should be regularly collected.
- A foreman or construction supervisor should monitor onsite hazardous waste storage and disposal procedures.
- Waste storage areas should be kept clean, well organized, and equipped with ample cleanup supplies as appropriate for the materials being stored.
- Perimeter controls, containment structures, covers, and liners should be repaired or replaced as needed to maintain proper function.

- Hazardous spills should be cleaned up and reported in conformance with the applicable Material Safety Data Sheet (MSDS) and the instructions posted at the project site.
- The National Response Center, at (800) 424-8802, should be notified of spills of federal reportable quantities in conformance with the requirements in 40 CFR parts 110, 117, and 302. Also notify the Governors Office of Emergency Services Warning Center at (916) 845-8911.
- A copy of the hazardous waste manifests should be provided.

References

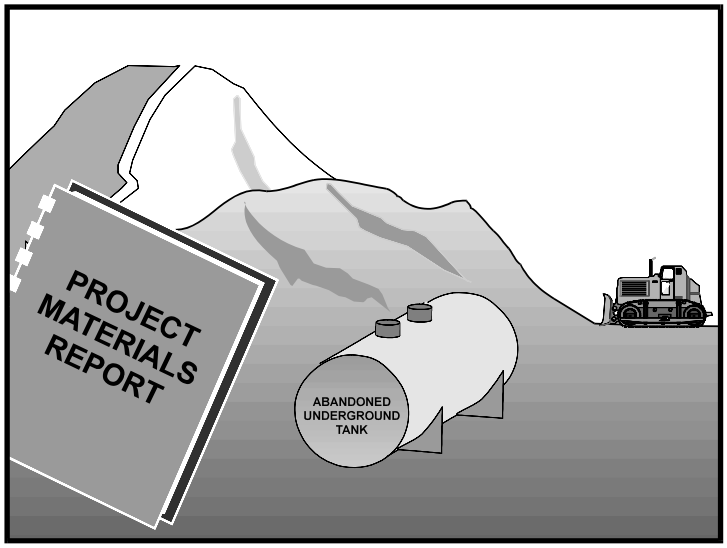
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Processes, Procedures and Methods to Control Pollution Resulting from All Construction Activity, 430/9-73-007, USEPA, 1973.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Contaminated Soil Management WM-7



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:
☑ **Primary Objective**
☒ **Secondary Objective**

Description and Purpose

Prevent or reduce the discharge of pollutants to stormwater from contaminated soil and highly acidic or alkaline soils by conducting pre-construction surveys, inspecting excavations regularly, and remediating contaminated soil promptly.

Suitable Applications

Contaminated soil management is implemented on construction projects in highly urbanized or industrial areas where soil contamination may have occurred due to spills, illicit discharges, aerial deposition, past use and leaks from underground storage tanks.

Limitations

Contaminated soils that cannot be treated onsite must be disposed of offsite by a licensed hazardous waste hauler. The presence of contaminated soil may indicate contaminated water as well. See NS-2, Dewatering Operations, for more information.

The procedures and practices presented in this BMP are general. The contractor should identify appropriate practices and procedures for the specific contaminants known to exist or discovered onsite.

Implementation

Most owners and developers conduct pre-construction environmental assessments as a matter of routine. Contaminated soils are often identified during project planning and development with known locations identified in the plans, specifications and in the SWPPP. The contractor should review applicable reports and investigate appropriate call-outs in the

Targeted Constituents	
Sediment	
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

plans, specifications, and SWPPP. Recent court rulings holding contractors liable for cleanup costs when they unknowingly move contaminated soil highlight the need for contractors to confirm a site assessment is completed before earth moving begins.

The following steps will help reduce stormwater pollution from contaminated soil:

- Conduct thorough, pre-construction inspections of the site and review documents related to the site. If inspection or reviews indicated presence of contaminated soils, develop a plan before starting work.
- Look for contaminated soil as evidenced by discoloration, odors, differences in soil properties, abandoned underground tanks or pipes, or buried debris.
- Prevent leaks and spills. Contaminated soil can be expensive to treat and dispose of properly. However, addressing the problem before construction is much less expensive than after the structures are in place.
- The contractor may further identify contaminated soils by investigating:
  - Past site uses and activities
  - Detected or undetected spills and leaks
  - Acid or alkaline solutions from exposed soil or rock formations high in acid or alkaline forming elements
  - Contaminated soil as evidenced by discoloration, odors, differences in soil properties, abandoned underground tanks or pipes, or buried debris.
  - Suspected soils should be tested at a certified laboratory.

Education

- Have employees and subcontractors complete a safety training program which meets 29 CFR 1910.120 and 8 CCR 5192 covering the potential hazards as identified, prior to performing any excavation work at the locations containing material classified as hazardous.
- Educate employees and subcontractors in identification of contaminated soil and on contaminated soil handling and disposal procedures.
- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).

Handling Procedures for Material with Aerially Deposited Lead (ADL)

- Materials from areas designated as containing (ADL) may, if allowed by the contract special provisions, be excavated, transported, and used in the construction of embankments and/or backfill.
- Excavation, transportation, and placement operations should result in no visible dust.
- Caution should be exercised to prevent spillage of lead containing material during transport.

- Quality should be monitored during excavation of soils contaminated with lead.

Handling Procedures for Contaminated Soils

- Minimize onsite storage. Contaminated soil should be disposed of properly in accordance with all applicable regulations. All hazardous waste storage will comply with the requirements in Title 22, CCR, Sections 66265.250 to 66265.260.
- Test suspected soils at an approved certified laboratory.
- Work with the local regulatory agencies to develop options for treatment or disposal if the soil is contaminated.
- Avoid temporary stockpiling of contaminated soils or hazardous material.
- Take the following precautions if temporary stockpiling is necessary:
  - Cover the stockpile with plastic sheeting or tarps.
  - Install a berm around the stockpile to prevent runoff from leaving the area.
  - Do not stockpile in or near storm drains or watercourses.
- Remove contaminated material and hazardous material on exteriors of transport vehicles and place either into the current transport vehicle or into the excavation prior to the vehicle leaving the exclusion zone.
- Monitor the air quality continuously during excavation operations at all locations containing hazardous material.
- Procure all permits and licenses, pay all charges and fees, and give all notices necessary and incident to the due and lawful prosecution of the work, including registration for transporting vehicles carrying the contaminated material and the hazardous material.
- Collect water from decontamination procedures and treat or dispose of it at an appropriate disposal site.
- Collect non-reusable protective equipment, once used by any personnel, and dispose of at an appropriate disposal site.
- Install temporary security fence to surround and secure the exclusion zone. Remove fencing when no longer needed.
- Excavate, transport, and dispose of contaminated material and hazardous material in accordance with the rules and regulations of the following agencies (the specifications of these agencies supersede the procedures outlined in this BMP):
  - United States Department of Transportation (USDOT)
  - United States Environmental Protection Agency (USEPA)
  - California Environmental Protection Agency (CAL-EPA)

- California Division of Occupation Safety and Health Administration (CAL-OSHA)
- Local regulatory agencies

Procedures for Underground Storage Tank Removals

- Prior to commencing tank removal operations, obtain the required underground storage tank removal permits and approval from the federal, state, and local agencies that have jurisdiction over such work.
- To determine if it contains hazardous substances, arrange to have tested, any liquid or sludge found in the underground tank prior to its removal.
- Following the tank removal, take soil samples beneath the excavated tank and perform analysis as required by the local agency representative(s).
- The underground storage tank, any liquid or sludge found within the tank, and all contaminated substances and hazardous substances removed during the tank removal and transported to disposal facilities permitted to accept such waste.

Water Control

- All necessary precautions and preventive measures should be taken to prevent the flow of water, including ground water, from mixing with hazardous substances or underground storage tank excavations. Such preventative measures may consist of, but are not limited to, berms, cofferdams, grout curtains, freeze walls, and seal course concrete or any combination thereof.
- If water does enter an excavation and becomes contaminated, such water, when necessary to proceed with the work, should be discharged to clean, closed top, watertight transportable holding tanks, treated, and disposed of in accordance with federal, state, and local laws.

Costs

Prevention of leaks and spills is inexpensive. Treatment or disposal of contaminated soil can be quite expensive.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Arrange for contractor's Water Pollution Control Manager, foreman, and/or construction supervisor to monitor onsite contaminated soil storage and disposal procedures.
- Monitor air quality continuously during excavation operations at all locations containing hazardous material.
- Coordinate contaminated soils and hazardous substances/waste management with the appropriate federal, state, and local agencies.

- Implement WM-4, Spill Prevention and Control, to prevent leaks and spills as much as possible.

References

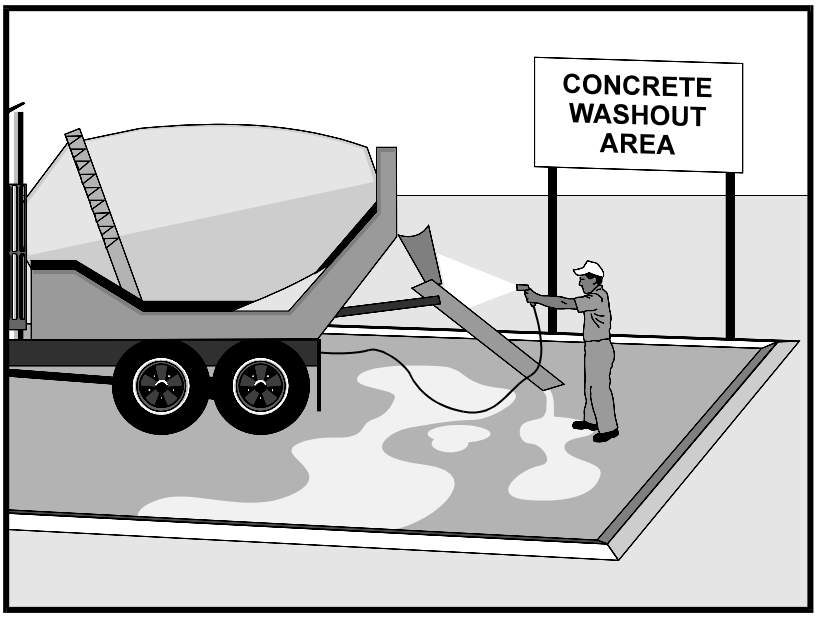
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Processes, Procedures and Methods to Control Pollution Resulting from All Construction Activity, 430/9-73-007, USEPA, 1973.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Concrete Waste Management WM-8



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☒
WM	Waste Management and Materials Pollution Control	☑

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	☑
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Prevent the discharge of pollutants to stormwater from concrete waste by conducting washout onsite or offsite in a designated area, and by employee and subcontractor training.

The General Permit incorporates Numeric Action Levels (NAL) for pH (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements).

Many types of construction materials, including mortar, concrete, stucco, cement and block and their associated wastes have basic chemical properties that can raise pH levels outside of the permitted range. Additional care should be taken when managing these materials to prevent them from coming into contact with stormwater flows and raising pH to levels outside the accepted range.

Suitable Applications

Concrete waste management procedures and practices are implemented on construction projects where:

- Concrete is used as a construction material or where concrete dust and debris result from demolition activities.
- Slurries containing portland cement concrete (PCC) are generated, such as from saw cutting, coring, grinding, grooving, and hydro-concrete demolition.
- Concrete trucks and other concrete-coated equipment are washed onsite.

- Mortar-mixing stations exist.
- Stucco mixing and spraying.
- See also NS-8, Vehicle and Equipment Cleaning.

Limitations

- Offsite washout of concrete wastes may not always be possible.
- Multiple washouts may be needed to assure adequate capacity and to allow for evaporation.

Implementation

The following steps will help reduce stormwater pollution from concrete wastes:

- Incorporate requirements for concrete waste management into material supplier and subcontractor agreements.
- Store dry and wet materials under cover, away from drainage areas. Refer to WM-1, Material Delivery and Storage for more information.
- Avoid mixing excess amounts of concrete.
- Perform washout of concrete trucks in designated areas only, where washout will not reach stormwater.
- Do not wash out concrete trucks into storm drains, open ditches, streets, streams or onto the ground. Trucks should always be washed out into designated facilities.
- Do not allow excess concrete to be dumped onsite, except in designated areas.
- For onsite washout:
  - On larger sites, it is recommended to locate washout areas at least 50 feet from storm drains, open ditches, or water bodies. Do not allow runoff from this area by constructing a temporary pit or bermed area large enough for liquid and solid waste.
  - Washout wastes into the temporary washout where the concrete can set, be broken up, and then disposed properly.
  - Washouts shall be implemented in a manner that prevents leaching to underlying soils. Washout containers must be water tight and washouts on or in the ground must be lined with a suitable impervious liner, typically a plastic type material.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile or dispose in the trash.
- See typical concrete washout installation details at the end of this fact sheet.

Education

- Educate employees, subcontractors, and suppliers on the concrete waste management techniques described herein.

- Arrange for contractor's superintendent or representative to oversee and enforce concrete waste management procedures.
- Discuss the concrete management techniques described in this BMP (such as handling of concrete waste and washout) with the ready-mix concrete supplier before any deliveries are made.

Concrete Demolition Wastes

- Stockpile concrete demolition waste in accordance with BMP WM-3, Stockpile Management.
- Dispose of or recycle hardened concrete waste in accordance with applicable federal, state or local regulations.

Concrete Slurry Wastes

- PCC and AC waste should not be allowed to enter storm drains or watercourses.
- PCC and AC waste should be collected and disposed of or placed in a temporary concrete washout facility (as described in Onsite Temporary Concrete Washout Facility, Concrete Transit Truck Washout Procedures, below).
- A foreman or construction supervisor should monitor onsite concrete working tasks, such as saw cutting, coring, grinding and grooving to ensure proper methods are implemented.
- Saw-cut concrete slurry should not be allowed to enter storm drains or watercourses. Residue from grinding operations should be picked up by means of a vacuum attachment to the grinding machine or by sweeping. Saw cutting residue should not be allowed to flow across the pavement and should not be left on the surface of the pavement. See also NS-3, Paving and Grinding Operations; and WM-10, Liquid Waste Management.
- Concrete slurry residue should be disposed in a temporary washout facility (as described in Onsite Temporary Concrete Washout Facility, Concrete Transit Truck Washout Procedures, below) and allowed to dry. Dispose of dry slurry residue in accordance with WM-5, Solid Waste Management.

Onsite Temporary Concrete Washout Facility, Transit Truck Washout Procedures

- Temporary concrete washout facilities should be located a minimum of 50 ft from storm drain inlets, open drainage facilities, and watercourses. Each facility should be located away from construction traffic or access areas to prevent disturbance or tracking.
- A sign should be installed adjacent to each washout facility to inform concrete equipment operators to utilize the proper facilities.
- Temporary concrete washout facilities should be constructed above grade or below grade at the option of the contractor. Temporary concrete washout facilities should be constructed and maintained in sufficient quantity and size to contain all liquid and concrete waste generated by washout operations.

- Temporary washout facilities should have a temporary pit or bermed areas of sufficient volume to completely contain all liquid and waste concrete materials generated during washout procedures.
- Temporary washout facilities should be lined to prevent discharge to the underlying ground or surrounding area.
- Washout of concrete trucks should be performed in designated areas only.
- Only concrete from mixer truck chutes should be washed into concrete wash out.
- Concrete washout from concrete pumper bins can be washed into concrete pumper trucks and discharged into designated washout area or properly disposed of or recycled offsite.
- Once concrete wastes are washed into the designated area and allowed to harden, the concrete should be broken up, removed, and disposed of per WM-5, Solid Waste Management. Dispose of or recycle hardened concrete on a regular basis.
- Temporary Concrete Washout Facility (Type Above Grade)
  - Temporary concrete washout facility (type above grade) should be constructed as shown on the details at the end of this BMP, with a recommended minimum length and minimum width of 10 ft; however, smaller sites or jobs may only need a smaller washout facility. With any washout, always maintain a sufficient quantity and volume to contain all liquid and concrete waste generated by washout operations.
  - Materials used to construct the washout area should conform to the provisions detailed in their respective BMPs (e.g., SE-8 Sandbag Barrier).
  - Plastic lining material should be a minimum of 10 mil in polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.
  - Alternatively, portable removable containers can be used as above grade concrete washouts. Also called a “roll-off”; this concrete washout facility should be properly sealed to prevent leakage, and should be removed from the site and replaced when the container reaches 75% capacity.
- Temporary Concrete Washout Facility (Type Below Grade)
  - Temporary concrete washout facilities (type below grade) should be constructed as shown on the details at the end of this BMP, with a recommended minimum length and minimum width of 10 ft. The quantity and volume should be sufficient to contain all liquid and concrete waste generated by washout operations.
  - Lath and flagging should be commercial type.
  - Plastic lining material should be a minimum of 10 mil polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.

- The base of a washout facility should be free of rock or debris that may damage a plastic liner.

Removal of Temporary Concrete Washout Facilities

- When temporary concrete washout facilities are no longer required for the work, the hardened concrete should be removed and properly disposed or recycled in accordance with federal, state or local regulations. Materials used to construct temporary concrete washout facilities should be removed from the site of the work and properly disposed or recycled in accordance with federal, state or local regulations..

- Holes, depressions or other ground disturbance caused by the removal of the temporary concrete washout facilities should be backfilled and repaired.

Costs

All of the above are low cost measures. Roll-0ff concrete washout facilities can be more costly than other measures due to removal and replacement; however, provide a cleaner alternative to traditional washouts. The type of washout facility, size, and availability of materials will determine the cost of the washout.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Temporary concrete washout facilities should be maintained to provide adequate holding capacity with a minimum freeboard of 4 in. for above grade facilities and 12 in. for below grade facilities. Maintaining temporary concrete washout facilities should include removing and disposing of hardened concrete and returning the facilities to a functional condition. Hardened concrete materials should be removed and properly disposed or recycled in accordance with federal, state or local regulations.

- Washout facilities must be cleaned, or new facilities must be constructed and ready for use once the washout is 75% full.

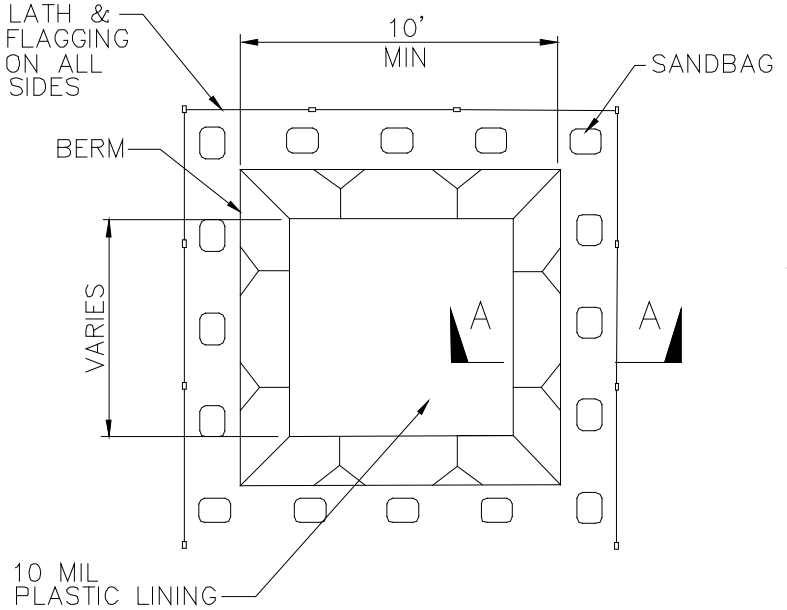
- Inspect washout facilities for damage (e.g. torn liner, evidence of leaks, signage, etc.). Repair all identified damage.

References

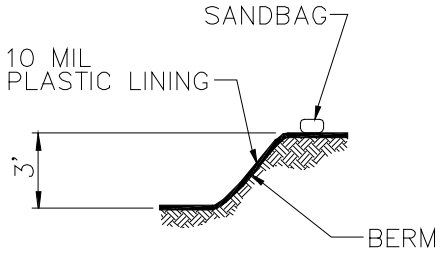
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000, Updated March 2003.

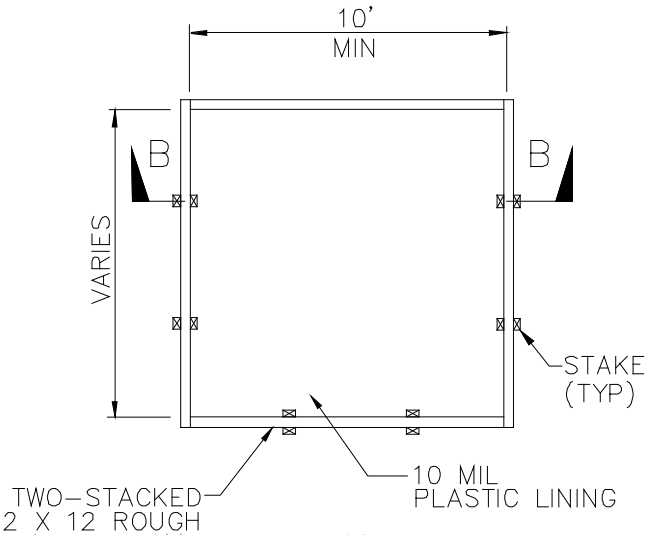
Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.



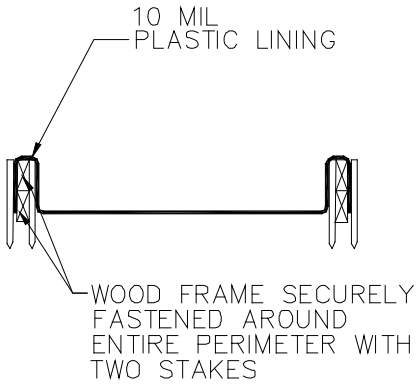
PLAN
NOT TO SCALE
TYPE "BELOW GRADE"



SECTION A–A
NOT TO SCALE



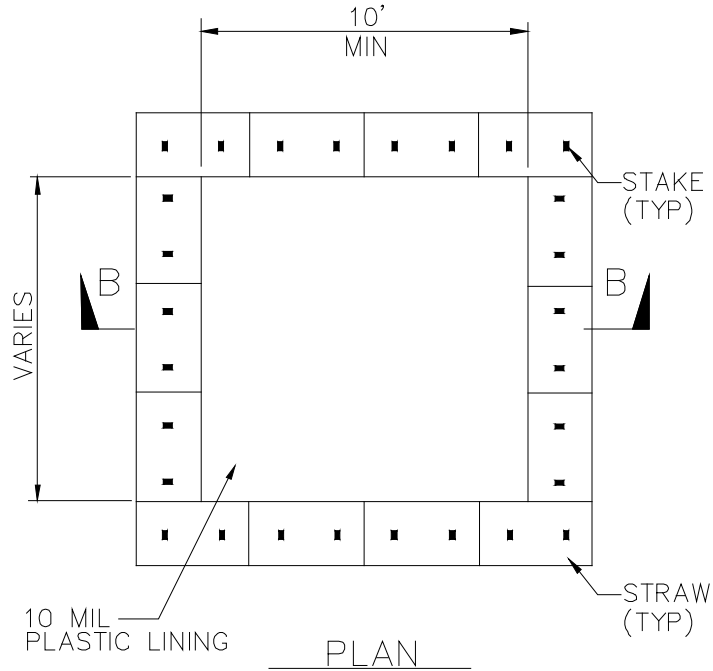
PLAN
NOT TO SCALE
TYPE "ABOVE GRADE"



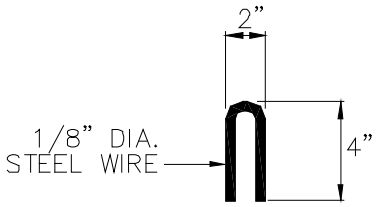
SECTION B–B
NOT TO SCALE

NOTES

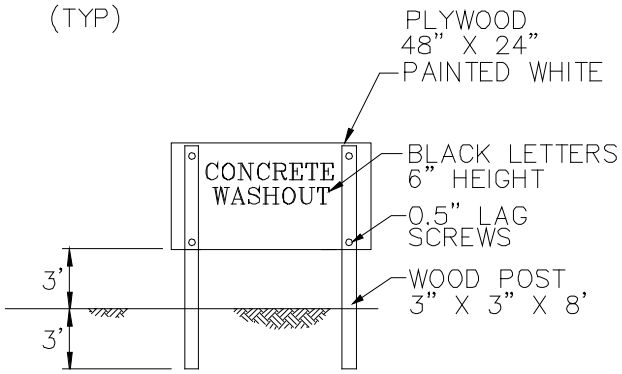
1. ACTUAL LAYOUT DETERMINED IN FIELD.
2. THE CONCRETE WASHOUT SIGN SHALL BE INSTALLED WITHIN 30 FT. OF THE TEMPORARY CONCRETE WASHOUT FACILITY.



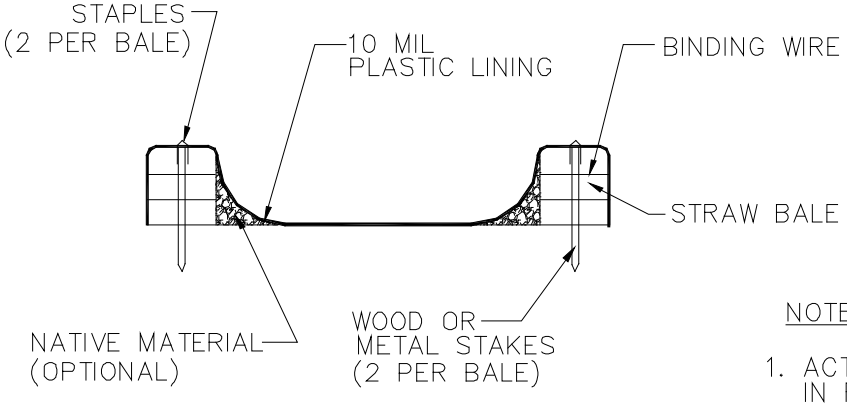
PLAN
NOT TO SCALE
TYPE "ABOVE GRADE"
WITH STRAW BALES



STAPLE DETAIL



CONCRETE WASHOUT
SIGN DETAIL
(OR EQUIVALENT)

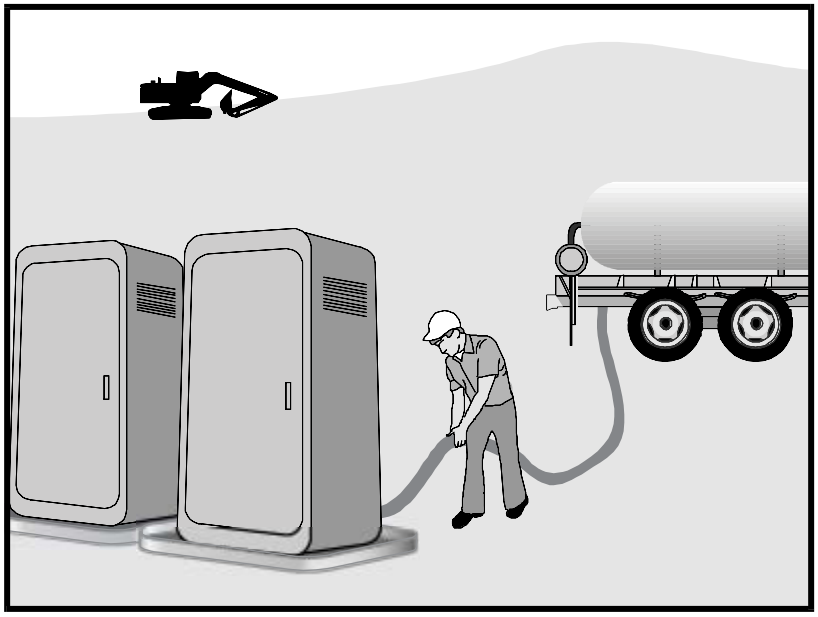


SECTION B–B
NOT TO SCALE

NOTES

1. ACTUAL LAYOUT DETERMINED IN FIELD.
2. THE CONCRETE WASHOUT SIGN SHALL BE INSTALLED WITHIN 30 FT. OF THE TEMPORARY CONCRETE WASHOUT FACILITY.

Sanitary/Septic Waste Management WM-9



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	
Nutrients	☑
Trash	☑
Metals	
Bacteria	☑
Oil and Grease	
Organics	☑

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Proper sanitary and septic waste management prevent the discharge of pollutants to stormwater from sanitary and septic waste by providing convenient, well-maintained facilities, and arranging for regular service and disposal.

Suitable Applications

Sanitary septic waste management practices are suitable for use at all construction sites that use temporary or portable sanitary and septic waste systems.

Limitations

None identified.

Implementation

Sanitary or septic wastes should be treated or disposed of in accordance with state and local requirements. In many cases, one contract with a local facility supplier will be all that it takes to make sure sanitary wastes are properly disposed.

Storage and Disposal Procedures

- Temporary sanitary facilities should be located away from drainage facilities, watercourses, and from traffic circulation. If site conditions allow, place portable facilities a minimum of 50 feet from drainage conveyances and traffic areas. When subjected to high winds or risk of high winds, temporary sanitary facilities should be secured to prevent overturning.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Temporary sanitary facilities must be equipped with containment to prevent discharge of pollutants to the stormwater drainage system of the receiving water.
- Consider safety as well as environmental implications before placing temporary sanitary facilities.
- Wastewater should not be discharged or buried within the project site.
- Sanitary and septic systems that discharge directly into sanitary sewer systems, where permissible, should comply with the local health agency, city, county, and sewer district requirements.
- Only reputable, licensed sanitary and septic waste haulers should be used.
- Sanitary facilities should be located in a convenient location.
- Temporary septic systems should treat wastes to appropriate levels before discharging.
- If using an onsite disposal system (OSDS), such as a septic system, local health agency requirements must be followed.
- Temporary sanitary facilities that discharge to the sanitary sewer system should be properly connected to avoid illicit discharges.
- Sanitary and septic facilities should be maintained in good working order by a licensed service.
- Regular waste collection by a licensed hauler should be arranged before facilities overflow.
- If a spill does occur from a temporary sanitary facility, follow federal, state and local regulations for containment and clean-up.

Education

- Educate employees, subcontractors, and suppliers on sanitary and septic waste storage and disposal procedures.
- Educate employees, subcontractors, and suppliers of potential dangers to humans and the environment from sanitary and septic wastes.
- Instruct employees, subcontractors, and suppliers in identification of sanitary and septic waste.
- Hold regular meetings to discuss and reinforce the use of sanitary facilities (incorporate into regular safety meetings).
- Establish a continuing education program to indoctrinate new employees.

Costs

All of the above are low cost measures.

Inspection and Maintenance

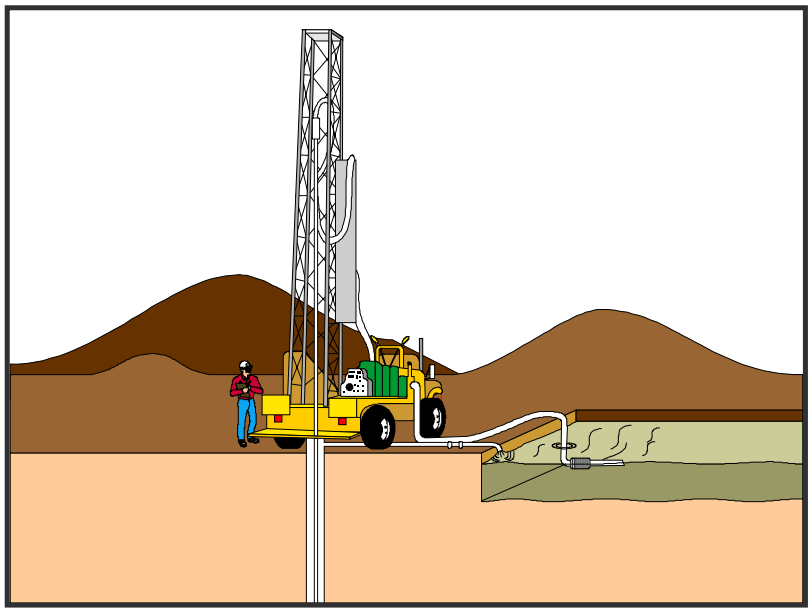
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Arrange for regular waste collection.
- If high winds are expected, portable sanitary facilities must be secured with spikes or weighed down to prevent over turning.
- If spills or leaks from sanitary or septic facilities occur that are not contained and discharge from the site, non-visible sampling of site discharge may be required. Refer to the General Permit or to your project specific Construction Site Monitoring Plan to determine if and where sampling is required.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Liquid Waste Management WM-10



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

Description and Purpose

Liquid waste management includes procedures and practices to prevent discharge of pollutants to the storm drain system or to watercourses as a result of the creation, collection, and disposal of non-hazardous liquid wastes.

Suitable Applications

Liquid waste management is applicable to construction projects that generate any of the following non-hazardous by-products, residuals, or wastes:

- Drilling slurries and drilling fluids
- Grease-free and oil-free wastewater and rinse water
- Dredgings
- Other non-stormwater liquid discharges not permitted by separate permits

Limitations

- Disposal of some liquid wastes may be subject to specific laws and regulations or to requirements of other permits secured for the construction project (e.g., NPDES permits, Army Corps permits, Coastal Commission permits, etc.).
- Liquid waste management does not apply to dewatering operations (NS-2 Dewatering Operations), solid waste management (WM-5, Solid Waste Management), hazardous wastes (WM-6, Hazardous Waste Management), or

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

concrete slurry residue (WM-8, Concrete Waste Management).

- Typical permitted non-stormwater discharges can include: water line flushing; landscape irrigation; diverted stream flows; rising ground waters; uncontaminated pumped ground water; discharges from potable water sources; foundation drains; irrigation water; springs; water from crawl space pumps; footing drains; lawn watering; flows from riparian habitats and wetlands; and discharges or flows from emergency fire fighting activities.

Implementation

General Practices

- Instruct employees and subcontractors how to safely differentiate between non-hazardous liquid waste and potential or known hazardous liquid waste.
- Instruct employees, subcontractors, and suppliers that it is unacceptable for any liquid waste to enter any storm drainage device, waterway, or receiving water.
- Educate employees and subcontractors on liquid waste generating activities and liquid waste storage and disposal procedures.
- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).
- Verify which non-stormwater discharges are permitted by the statewide NPDES permit; different regions might have different requirements not outlined in this permit.
- Apply NS-8, Vehicle and Equipment Cleaning for managing wash water and rinse water from vehicle and equipment cleaning operations.

Containing Liquid Wastes

- Drilling residue and drilling fluids should not be allowed to enter storm drains and watercourses and should be disposed of.
- If an appropriate location is available, drilling residue and drilling fluids that are exempt under Title 23, CCR § 2511(g) may be dried by infiltration and evaporation in a containment facility constructed in conformance with the provisions concerning the Temporary Concrete Washout Facilities detailed in WM-8, Concrete Waste Management.
- Liquid wastes generated as part of an operational procedure, such as water-laden dredged material and drilling mud, should be contained and not allowed to flow into drainage channels or receiving waters prior to treatment.
- Liquid wastes should be contained in a controlled area such as a holding pit, sediment basin, roll-off bin, or portable tank.
- Containment devices must be structurally sound and leak free.
- Containment devices must be of sufficient quantity or volume to completely contain the liquid wastes generated.

- Precautions should be taken to avoid spills or accidental releases of contained liquid wastes. Apply the education measures and spill response procedures outlined in WM-4, Spill Prevention and Control.

- Containment areas or devices should not be located where accidental release of the contained liquid can threaten health or safety or discharge to water bodies, channels, or storm drains.

Capturing Liquid Wastes

- Capture all liquid wastes that have the potential to affect the storm drainage system (such as wash water and rinse water from cleaning walls or pavement), before they run off a surface.

- Do not allow liquid wastes to flow or discharge uncontrolled. Use temporary dikes or berms to intercept flows and direct them to a containment area or device for capture.

- Use a sediment trap (SE-3, Sediment Trap) for capturing and treating sediment laden liquid waste or capture in a containment device and allow sediment to settle.

Disposing of Liquid Wastes

- A typical method to handle liquid waste is to dewater the contained liquid waste, using procedures such as described in NS-2, Dewatering Operations, and SE-2, Sediment Basin, and dispose of resulting solids per WM-5, Solid Waste Management.

- Methods of disposal for some liquid wastes may be prescribed in Water Quality Reports, NPDES permits, Environmental Impact Reports, 401 or 404 permits, and local agency discharge permits, etc. Review the SWPPP to see if disposal methods are identified.

- Liquid wastes, such as from dredged material, may require testing and certification whether it is hazardous or not before a disposal method can be determined.

- For disposal of hazardous waste, see WM-6, Hazardous Waste Management.

- If necessary, further treat liquid wastes prior to disposal. Treatment may include, though is not limited to, sedimentation, filtration, and chemical neutralization.

Costs

Prevention costs for liquid waste management are minimal. Costs increase if cleanup or fines are involved.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.

- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.

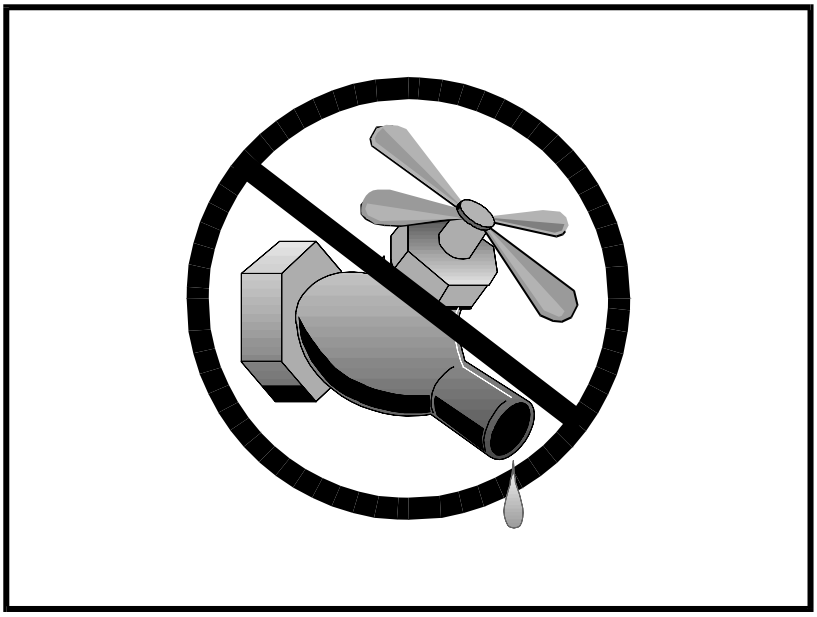
- Remove deposited solids in containment areas and capturing devices as needed and at the completion of the task. Dispose of any solids as described in WM-5, Solid Waste Management.

- Inspect containment areas and capturing devices and repair as needed.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Water Conservation Practices NS-1



Categories		
EC	Erosion Control	☒
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Objective**
☒ **Secondary Objective**

Description and Purpose

Water conservation practices are activities that use water during the construction of a project in a manner that avoids causing erosion and the transport of pollutants offsite. These practices can reduce or eliminate non-stormwater discharges.

Suitable Applications

Water conservation practices are suitable for all construction sites where water is used, including piped water, metered water, trucked water, and water from a reservoir.

Limitations

- None identified.

Implementation

- Keep water equipment in good working condition.
- Stabilize water truck filling area.
- Repair water leaks promptly.
- Washing of vehicles and equipment on the construction site is discouraged.
- Avoid using water to clean construction areas. If water must be used for cleaning or surface preparation, surface should be swept and vacuumed first to remove dirt. This will minimize amount of water required.

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Direct construction water runoff to areas where it can soak into the ground or be collected and reused.
- Authorized non-stormwater discharges to the storm drain system, channels, or receiving waters are acceptable with the implementation of appropriate BMPs.
- Lock water tank valves to prevent unauthorized use.

Costs

The cost is small to none compared to the benefits of conserving water.

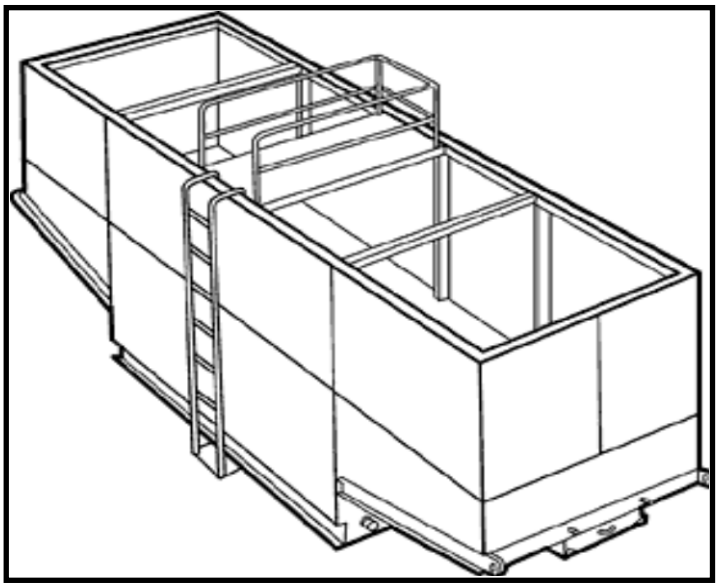
Inspection and Maintenance

- Inspect and verify that activity based BMPs are in place prior to the commencement of authorized non-stormwater discharges.
- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges are occuring.
- Repair water equipment as needed to prevent unintended discharges.
  - Water trucks
  - Water reservoirs (water buffalos)
  - Irrigation systems
  - Hydrant connections

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Dewatering Operations NS-2



Categories		
EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

SE-5: Fiber Roll

SE-6: Gravel Bag Berm

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Dewatering operations are practices that manage the discharge of pollutants when non-stormwater and accumulated precipitation (stormwater) must be removed from a work location to proceed with construction work or to provide vector control.

The General Permit incorporates Numeric Action Levels (NAL) for turbidity (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements).

Discharges from dewatering operations can contain high levels of fine sediment that, if not properly treated, could lead to exceedances of the General Permit requirements or Basin Plan standards.

The dewatering operations described in this fact sheet are not Active Treatment Systems (ATS) and do not include the use of chemical coagulations, chemical flocculation or electrocoagulation.

Suitable Applications

These practices are implemented for discharges of non-stormwater from construction sites. Non-stormwaters include, but are not limited to, groundwater, water from cofferdams, water diversions, and waters used during construction activities that must be removed from a work area to facilitate construction.

Practices identified in this section are also appropriate for implementation when managing the removal of accumulated

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

precipitation (stormwater) from depressed areas at a construction site.

Stormwater mixed with non-stormwater should be managed as non-stormwater.

Limitations

- Dewatering operations will require, and should comply with applicable local and project-specific permits and regulations. In some areas, all dewatering activities, regardless of the discharge volume, require a dewatering permit.
- Site conditions will dictate design and use of dewatering operations.
- The controls discussed in this fact sheet primarily address sediment. Other secondary pollutant removal benefits are discussed where applicable.
- The controls detailed in this fact sheet only allow for minimal settling time for sediment particles. Use only when site conditions restrict the use of the other control methods.
- Avoid dewatering discharges where possible by using the water for dust control.

Implementation

- A Construction Site Monitoring Plan (CSMP) should be included in the project Stormwater Pollution Prevention Plan (SWPPP).
- Regional Water Quality Control Board (RWQCB) Regions may require notification and approval prior to any discharge of water from construction sites.
- The destination of discharge from dewatering activities will typically determine the type of permit required for the discharge. For example, when discharging to a water of the U.S., a dewatering permit may be required through the site's governing RWQCB. When discharging to a sanitary sewer or Municipal Separate Storm Sewer System (MS4), a permit may need to be obtained from the owner of the sanitary sewer or MS4 in addition to obtaining an RWQCB dewatering permit. Additional permits or permissions from other agencies may be required for dewatering cofferdams or diversions.
- Dewatering discharges should not cause erosion at the discharge point. Appropriate BMPs should be implemented to maintain compliance with all applicable permits.
- Maintain dewatering records in accordance with all local and project-specific permits and regulations.

Sediment Treatment

A variety of methods can be used to treat water during dewatering operations. Several devices are presented below and provide options to achieve sediment removal. The sediment particle size and permit or receiving water limitations on sediment or turbidity are key considerations for selecting sediment treatment option(s); in some cases, the use of multiple devices may be appropriate. Use of other enhanced treatment methods (i.e., introduction of chemicals or electric current to enhance flocculation and removal of sediment) must comply with: 1) for storm drain or surface water discharges, the requirements for Active Treatment Systems (see SE-11); or 2) for sanitary sewer discharges, the requirements of applicable sanitary sewer discharge permits.

Sediment Basin (see also SE-2)

Description:

- A sediment basin is a temporary basin with a controlled release structure that is formed by excavation or construction of an embankment to detain sediment-laden runoff and allow sediment to settle out before discharging. Sediment basins are generally larger than Sediment Traps (SE-3) and have a designed outlet structure.

Appropriate Applications:

- Effective for the removal of trash, gravel, sand, silt, some metals that settle out with the sediment.

Implementation:

- Excavation and construction of related facilities is required.
- Temporary sediment basins should be fenced if safety is a concern.
- Outlet protection is required to prevent erosion at the outfall location.

Maintenance:

- Maintenance is required for safety fencing, vegetation, embankment, inlet and outlet, as well as other features.
- Removal of sediment is required when the storage volume is reduced by one-third.

Sediment Trap (See also SE-3)

Description:

- A sediment trap is a temporary basin formed by excavation and/or construction of an earthen embankment across a waterway or low drainage area to detain sediment-laden runoff and allow sediment to settle out before discharging. Sediment traps are generally smaller than Sediment Basins (SE-2) and do not have a designed outlet (but do have a spillway or overflow).

Appropriate Applications:

Effective for the removal of large and medium sized particles (sand and gravel) and some metals that settle out with the sediment.

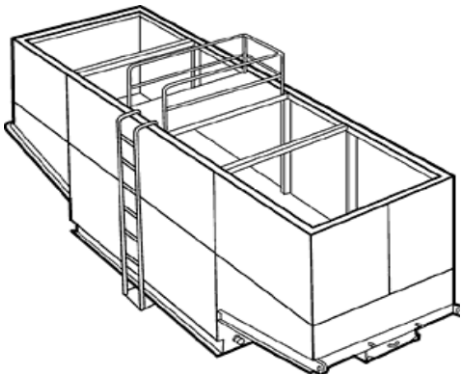
Implementation:

- Excavation and construction of related facilities is required.
- Trap inlets should be located to maximize the travel distance to the trap outlet.
- Use rock or vegetation to protect the trap outlets against erosion.

Maintenance:

- Maintenance is required for vegetation, embankment, inlet and outfall structures, as well as other features.
- Removal of sediment is required when the storage volume is reduced by one-third.

Weir Tanks



Description:

- A weir tank separates water and waste by using weirs. The configuration of the weirs (over and under weirs) maximizes the residence time in the tank and determines the waste to be removed from the water, such as oil, grease, and sediments.

Appropriate Applications:

- The tank removes trash, some settleable solids (gravel, sand, and silt), some visible oil and grease, and some metals (removed with sediment). To achieve high levels of flow, multiple tanks can be used in parallel. If additional treatment is desired, the tanks can be placed in series or as pre-treatment for other methods.

Implementation:

- Tanks are delivered to the site by the vendor, who can provide assistance with set-up and operation.
- Tank size will depend on flow volume, constituents of concern, and residency period required. Vendors should be consulted to appropriately size tank.
- Treatment capacity (i.e., volume and number of tanks) should provide at a minimum the required volume for discrete particle settling for treatment design flows.

Maintenance:

- Periodic cleaning is required based on visual inspection or reduced flow.
- Oil and grease disposal should be conducted by a licensed waste disposal company.

Dewatering Tanks



Description:

- A dewatering tank removes debris and sediment. Flow enters the tank through the top, passes through a fabric filter, and is discharged through the bottom of the tank. The filter separates the solids from the liquids.

Appropriate Applications:

- The tank removes trash, gravel, sand, and silt, some visible oil and grease, and some metals (removed with sediment). To achieve high levels of flow, multiple tanks can be used in parallel. If additional treatment is desired, the tanks can be placed in series or as pre-treatment for other methods.

Implementation:

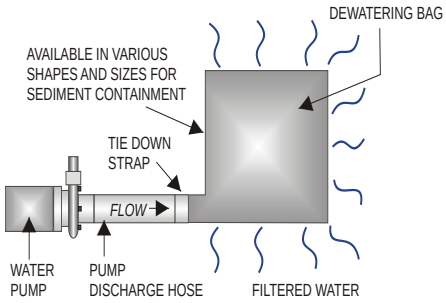
- Tanks are delivered to the site by the vendor, who can provide assistance with set-up and operation.
- Tank size will depend on flow volume, constituents of concern, and residency period required. Vendors should be consulted to appropriately size tank.

Maintenance:

- Periodic cleaning is required based on visual inspection or reduced flow.
- Oil and grease disposal should be conducted by licensed waste disposal company.

Gravity Bag Filter





Description:

- A gravity bag filter, also referred to as a dewatering bag, is a square or rectangular bag made of non-woven geotextile fabric that collects gravel, sand, silt, and fines.

Appropriate Applications:

- Effective for the removal of sediments (gravel, sand, silt, and fines). Some metals are removed with the sediment.

Implementation:

- Water is pumped into one side of the bag and seeps through the top, bottom, and sides of the bag.
- Place filter bag on pavement or a gravel bed or paved surface. Avoid placing a dewatering bag on unprotected bare soil. If placing the bag on bare soil is unavoidable, a secondary barrier should be used, such as a rock filter bed placed beneath and beyond the edges of the bag to, prevent erosion and capture sediments that escape the bag.
- Perimeter control around the downstream end of the bag should be implemented. Secondary sediment controls are important especially in the initial stages of discharge, which tend to allow fines to pass through the bag.

Maintenance:

- Inspection of the flow conditions, bag condition, bag capacity, and the secondary barrier (as applicable) is required.
- Replace the bag when it no longer filters sediment or passes water at a reasonable rate.
- Caution should be taken when removing and disposing of the bag, to prevent the release of captured sediment
- Properly dispose of the bag offsite. If sediment is removed from the bag prior to disposal (bags can potentially be reused depending upon their condition), dispose of sediment in accordance with the general maintenance procedures described at the end of this BMP Fact Sheet.

Sand Media Particulate Filter





Description:

- Water is treated by passing it through canisters filled with sand media. Generally, sand filters provide a final level of treatment. They are often used as a secondary or higher level of treatment after a significant amount of sediment and other pollutants have been removed using other methods.

Appropriate Applications:

- Effective for the removal of trash, gravel, sand, and silt and some metals, as well as the reduction of biochemical oxygen demand (BOD) and turbidity.
- Sand filters can be used for stand-alone treatment or in conjunction with bag and cartridge filtration if further treatment is required.
- Sand filters can also be used to provide additional treatment to water treated via settling or basic filtration.

Implementation:

- The filters require delivery to the site and initial set up. The vendor can provide assistance with installation and operation.

Maintenance:

- The filters require regular service to monitor and maintain the level of the sand media. If subjected to high loading rates, filters can plug quickly.
- Venders generally provide data on maximum head loss through the filter. The filter should be monitored daily while in use, and cleaned when head loss reaches target levels.
- If cleaned by backwashing, the backwash water may need to be hauled away for disposal, or returned to the upper end of the treatment train for another pass through the series of dewatering BMPs.

Pressurized Bag Filter





Description:

- A pressurized bag filter is a unit composed of single filter bags made from polyester felt material. The water filters through the unit and is discharged through a header. Vendors provide bag filters in a variety of configurations. Some units include a combination of bag filters and cartridge filters for enhanced contaminant removal.

Appropriate Applications:

- Effective for the removal of sediment (sand and silt) and some metals, as well as the reduction of BOD, turbidity, and hydrocarbons. Oil absorbent bags are available for hydrocarbon removal.

- Filters can be used to provide secondary treatment to water treated via settling or basic filtration.

Implementation:

- The filters require delivery to the site and initial set up. The vendor can provide assistance with installation and operation.

Maintenance:

- The filter bags require replacement when the pressure differential equals or exceeds the manufacturer's recommendation.

Cartridge Filter



Description:

- Cartridge filters provide a high degree of pollutant removal by utilizing a number of individual cartridges as part of a larger filtering unit. They are often used as a secondary or higher (polishing) level of treatment after a significant amount of sediment and other pollutants are removed. Units come with various cartridge configurations (for use in series with bag filters) or with a larger single cartridge filtration unit (with multiple filters within).

Appropriate Applications:

- Effective for the removal of sediment (sand, silt, and some clays) and metals, as well as the reduction of BOD, turbidity, and hydrocarbons. Hydrocarbons can effectively be removed with special resin cartridges.

- Filters can be used to provide secondary treatment to water treated via settling or basic filtration.

Implementation:

- The filters require delivery to the site and initial set up. The vendor can provide assistance.

Maintenance:

- The cartridges require replacement when the pressure differential equals or exceeds the manufacturer's recommendation.

Costs

- Sediment control costs vary considerably depending on the dewatering and sediment treatment system that is selected. Pressurized filters tend to be more expensive than gravity settling, but are often more effective. Simple tanks are generally rented on a long-term basis (one or more months) and can range from $360 per month for a 1,000 gallon tank to $2,660 per month for a 10,000 gallon tank. Mobilization and demobilization costs vary considerably.

Inspection and Maintenance

- Inspect and verify that dewatering BMPs are in place and functioning prior to the commencement of activities requiring dewatering.

- Inspect dewatering BMPs daily while dewatering activities are being conducted.

- Inspect all equipment before use. Monitor dewatering operations to ensure they do not cause offsite discharge or erosion.
- Sample dewatering discharges as required by the General Permit.
- Unit-specific maintenance requirements are included with the description of each unit.
- Sediment removed during the maintenance of a dewatering device may be either spread onsite and stabilized, or disposed of at a disposal site as approved by the owner.
- Sediment that is commingled with other pollutants should be disposed of in accordance with all applicable laws and regulations and as approved by the owner.

References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

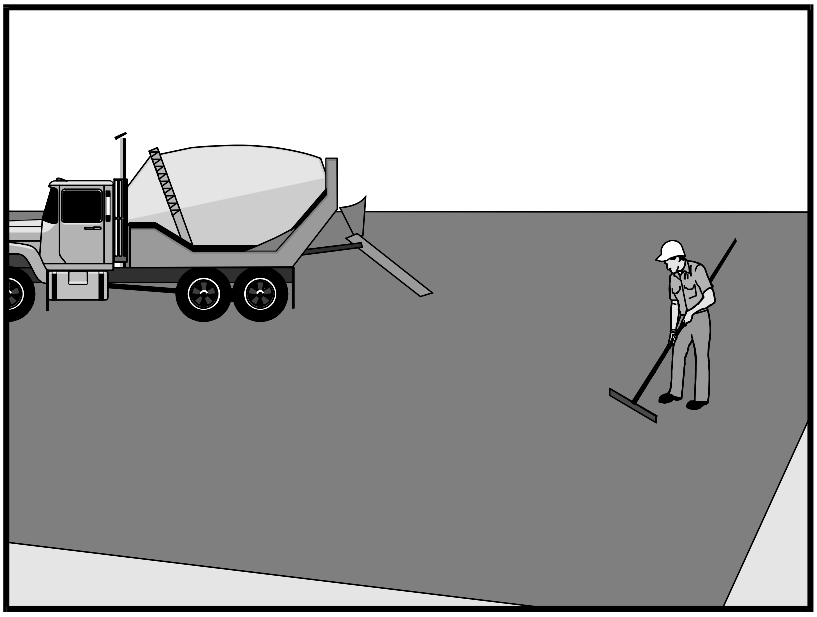
Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003; Updated March 2004.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Labor Surcharge & Equipment Rental Rates, April 1, 2002 through March 31, 2003, California Department of Transportation (Caltrans).

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Paving and Grinding Operations NS-3



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	☒

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Prevent or reduce the discharge of pollutants from paving operations, using measures to prevent runon and runoff pollution, properly disposing of wastes, and training employees and subcontractors.

The General Permit incorporates Numeric Action Levels (NAL) for pH and turbidity (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements).

Many types of construction materials associated with paving and grinding operations, including mortar, concrete, and cement and their associated wastes have basic chemical properties that can raise pH levels outside of the permitted range. Additional care should be taken when managing these materials to prevent them from coming into contact with stormwater flows, which could lead to exceedances of the General Permit requirements.

Suitable Applications

These procedures are implemented where paving, surfacing, resurfacing, or sawcutting, may pollute stormwater runoff or discharge to the storm drain system or watercourses.

Limitations

- Paving opportunities may be limited during wet weather.

  Discharges of freshly paved surfaces may raise pH to environmentally harmful levels and trigger permit violations.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Implementation

General

- Avoid paving during the wet season when feasible.
- Reschedule paving and grinding activities if rain is forecasted.
- Train employees and sub-contractors in pollution prevention and reduction.
- Store materials away from drainage courses to prevent stormwater runon (see WM-1, Material Delivery and Storage).
- Protect drainage courses, particularly in areas with a grade, by employing BMPs to divert runoff or to trap and filter sediment.
- Stockpile material removed from roadways away from drain inlets, drainage ditches, and watercourses. These materials should be stored consistent with WM-3, Stockpile Management.
- Disposal of PCC (Portland cement concrete) and AC (asphalt concrete) waste should be in conformance with WM-8, Concrete Waste Management.

Saw Cutting, Grinding, and Pavement Removal

- Shovel or vacuum saw-cut slurry and remove from site. Cover or barricade storm drains during saw cutting to contain slurry.
- When paving involves AC, the following steps should be implemented to prevent the discharge of grinding residue, uncompacted or loose AC, tack coats, equipment cleaners, or unrelated paving materials:
  - AC grindings, pieces, or chunks used in embankments or shoulder backing should not be allowed to enter any storm drains or watercourses. Install inlet protection and perimeter controls until area is stabilized (i.e. cutting, grinding or other removal activities are complete and loose material has been properly removed and disposed of)or permanent controls are in place. Examples of temporary perimeter controls can be found in EC-9, Earth Dikes and Drainage Swales; SE-1, Silt Fence; SE-5, Fiber Rolls, or SE-13 Compost Socks and Berms
  - Collect and remove all broken asphalt and recycle when practical. Old or spilled asphalt should be recycled or disposed of properly.
- Do not allow saw-cut slurry to enter storm drains or watercourses. Residue from grinding operations should be picked up by a vacuum attachment to the grinding machine, or by sweeping, should not be allowed to flow across the pavement, and should not be left on the surface of the pavement. See also WM-8, Concrete Waste Management, and WM-10, Liquid Waste Management.
- Pavement removal activities should not be conducted in the rain.
- Collect removed pavement material by mechanical or manual methods. This material may be recycled for use as shoulder backing or base material.

- If removed pavement material cannot be recycled, transport the material back to an approved storage site.

Asphaltic Concrete Paving

- If paving involves asphaltic cement concrete, follow these steps:

  - Do not allow sand or gravel placed over new asphalt to wash into storm drains, streets, or creeks. Vacuum or sweep loose sand and gravel and properly dispose of this waste by referring to WM-5, Solid Waste Management.

  - Old asphalt should be disposed of properly. Collect and remove all broken asphalt from the site and recycle whenever possible.

Portland Cement Concrete Paving

- Do not wash sweepings from exposed aggregate concrete into a storm drain system. Collect waste materials by dry methods, such as sweeping or shoveling, and return to aggregate base stockpile or dispose of properly. Allow aggregate rinse to settle. Then, either allow rinse water to dry in a temporary pit as described in WM-8, Concrete Waste Management, or pump the water to the sanitary sewer if authorized by the local wastewater authority.

Sealing Operations

- During chip seal application and sweeping operations, petroleum or petroleum covered aggregate should not be allowed to enter any storm drain or water courses. Apply temporary perimeter controls until structure is stabilized (i.e. all sealing operations are complete and cured and loose materials have been properly removed and disposed).

- Inlet protection (SE-10, Storm Drain Inlet Protection) should be used during application of seal coat, tack coat, slurry seal, and fog seal.

- Seal coat, tack coat, slurry seal, or fog seal should not be applied if rainfall is predicted to occur during the application or curing period.

Paving Equipment

- Leaks and spills from paving equipment can contain toxic levels of heavy metals and oil and grease. Place drip pans or absorbent materials under paving equipment when not in use. Clean up spills with absorbent materials and dispose of in accordance with the applicable regulations. See NS-10, Vehicle and Equipment Maintenance, WM-4, Spill Prevention and Control, and WM-10, Liquid Waste Management.

- Substances used to coat asphalt transport trucks and asphalt spreading equipment should not contain soap and should be non-foaming and non-toxic.

- Paving equipment parked onsite should be parked over plastic to prevent soil contamination.

- Clean asphalt coated equipment offsite whenever possible. When cleaning dry, hardened asphalt from equipment, manage hardened asphalt debris as described in WM-5, Solid Waste Management. Any cleaning onsite should follow NS-8, Vehicle and Equipment Cleaning.

Thermoplastic Striping

- Thermoplastic striper and pre-heater equipment shutoff valves should be inspected to ensure that they are working properly to prevent leaking thermoplastic from entering drain inlets, the stormwater drainage system, or watercourses.
- Pre-heaters should be filled carefully to prevent splashing or spilling of hot thermoplastic. Leave six inches of space at the top of the pre-heater container when filling thermoplastic to allow room for material to move.
- Do not pre-heat, transfer, or load thermoplastic near drain inlets or watercourses.
- Clean truck beds daily of loose debris and melted thermoplastic. When possible, recycle thermoplastic material.

Raised/Recessed Pavement Marker Application and Removal

- Do not transfer or load bituminous material near drain inlets, the stormwater drainage system, or watercourses.
- Melting tanks should be loaded with care and not filled to beyond six inches from the top to leave room for splashing.
- When servicing or filling melting tanks, ensure all pressure is released before removing lids to avoid spills.
- On large-scale projects, use mechanical or manual methods to collect excess bituminous material from the roadway after removal of markers.

Costs

- All of the above are low cost measures.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of paving and grinding operations.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Sample stormwater runoff required by the General Permit.
- Keep ample supplies of drip pans or absorbent materials onsite.
- Inspect and maintain machinery regularly to minimize leaks and drips.

References

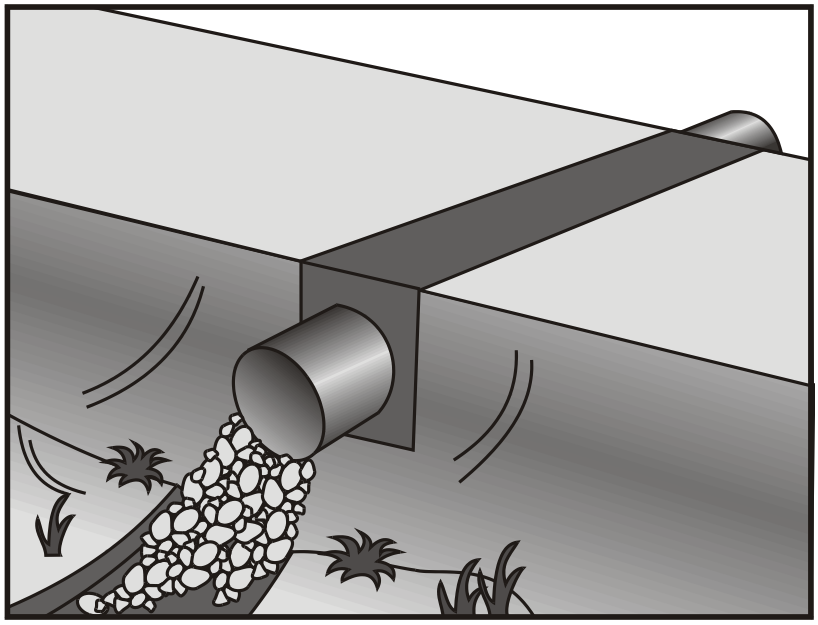
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Hot Mix Asphalt-Paving Handbook AC 150/5370-14, Appendix I, U.S. Army Corps of Engineers, July 1991.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Temporary Stream Crossing NS-4



Description and Purpose

A temporary stream crossing is a temporary culvert, ford or bridge placed across a waterway to provide access for construction purposes for a period of less than one year. Temporary access crossings are not intended to maintain traffic for the public. The temporary access will eliminate erosion and downstream sedimentation caused by vehicles.

Suitable Applications

Temporary stream crossings should be installed at all designated crossings of perennial and intermittent streams on the construction site, as well as for dry channels that may be significantly eroded by construction traffic.

Temporary streams crossings are installed at sites:

- Where appropriate permits have been secured (404 Permits, and 401 Certifications)
- Where construction equipment or vehicles need to frequently cross a waterway
- When alternate access routes impose significant constraints
- When crossing perennial streams or waterways causes significant erosion
- Where construction activities will not last longer than one year

Categories

EC	Erosion Control	☒
SE	Sediment Control	☒
TC	Tracking Control	☒
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Where appropriate permits have been obtained for the stream crossing

Limitations

The following limitations may apply:

- Installation and removal will usually disturb the waterway.
- Installation may require Regional Water Quality Control Board (RWQCB) 401 Certification, U.S. Army Corps of Engineers 404 permit and approval by California Department of Fish and Game. If numerical-based water quality standards are mentioned in any of these and other related permits, testing and sampling may be required.
- Installation may require dewatering or temporary diversion of the stream. See NS-2, Dewatering Operations and NS-5, Clear Water Diversion.
- Installation may cause a constriction in the waterway, which can obstruct flood flow and cause flow backups or washouts. If improperly designed, flow backups can increase the pollutant load through washouts and scouring.
- Use of natural or other gravel in the stream for construction of Cellular Confinement System (CCS) ford crossing will be contingent upon approval by fisheries agencies.
- Ford crossings may degrade water quality due to contact with vehicles and equipment.
- May be expensive for a temporary improvement.
- Requires other BMPs to minimize soil disturbance during installation and removal.
- Fords should only be used in dry weather.

Implementation

General

The purpose of this BMP is to provide a safe, erosion-free access across a stream for construction equipment. Minimum standards and specifications for the design, construction, maintenance, and removal of the structure should be established by an engineer registered in California. Temporary stream crossings may be necessary to prevent construction equipment from causing erosion of the stream and tracking sediment and other pollutants into the stream.

Temporary stream crossings are used as access points to construction sites when other detour routes may be too long or burdensome for the construction equipment. Often heavy construction equipment must cross streams or creeks, and detour routes may impose too many constraints such as being too narrow or poor soil strength for the equipment loadings. Additionally, the contractor may find a temporary stream crossing more economical for light–duty vehicles to use for frequent crossings, and may have less environmental impact than construction of a temporary access road.

Location of the temporary stream crossing should address:

- Site selection where erosion potential is low.

- Areas where the side slopes from site runoff will not spill into the side slopes of the crossing.

The following types of temporary stream crossings should be considered:

- **Culverts** – A temporary culvert is effective in controlling erosion but will cause erosion during installation and removal. A temporary culvert can be easily constructed and allows for heavy equipment loads.

- **Fords** - Appropriate during the dry season in arid areas. Used on dry washes and ephemeral streams, and low-flow perennial streams. CCS, a type of ford crossing, is also appropriate for use in streams that would benefit from an influx of gravels. A temporary ford provides little sediment and erosion control and is ineffective in controlling erosion in the stream channel. A temporary ford is the least expensive stream crossing and allows for maximum load limits. It also offers very low maintenance. Fords are more appropriate during the dry ice season and in arid areas of California.

- **Bridges** - Appropriate for streams with high flow velocities, steep gradients and where temporary restrictions in the channel are not allowed.

Design

During the long summer construction season in much of California, rainfall is infrequent and many streams are dry. Under these conditions, a temporary ford may be sufficient. A ford is not appropriate if construction will continue through the winter rainy season, if summer thunderstorms are likely, or if the stream flows during most of the year. Temporary culverts and bridges should then be considered and, if used, should be sized to pass a significant design storm (i.e., at least a 10-year storm). The temporary stream crossing should be protected against erosion, both to prevent excessive sedimentation in the stream and to prevent washout of the crossing.

Design and installation requires knowledge of stream flows and soil strength. Designs should be prepared under direction of, and approved by, a registered civil engineer and for bridges, a registered structural engineer. Both hydraulic and construction loading requirements should be considered with the following:

- Comply with any special requirements for culvert and bridge crossings, particularly if the temporary stream crossing will remain through the rainy season.

- Provide stability in the crossing and adjacent areas to withstand the design flow. The design flow and safety factor should be selected based on careful evaluation of the risks due to over topping, flow backups, or washout.

- Install sediment traps immediately downstream of crossings to capture sediments. See SE-3, Sediment Trap.

- Avoid oil or other potentially hazardous materials for surface treatment.

- Culverts are relatively easy to construct and able to support heavy equipment loads.

- Fords are the least expensive of the crossings, with maximum load limits.

- CCS crossing structures consist of clean, washed gravel and cellular confinement system blocks. CCS are appropriate for streams that would benefit from an influx of gravel; for example, salmonid streams, streams or rivers below reservoirs, and urban, channelized streams. Many urban stream systems are gravel-deprived due to human influences, such as dams, gravel mines, and concrete channels.
- CCS allow designers to use either angular or naturally occurring rounded gravel, because the cells provide the necessary structure and stability. In fact, natural gravel is optimal for this technique, because of the habitat improvement it will provide after removal of the CCS.
- A gravel depth of 6 to 12 in. for a CCS structure is sufficient to support most construction equipment.
- An advantage of a CCS crossing structure is that relatively little rock or gravel is needed, because the CCS provides the stability.
- Bridges are generally more expensive to design and construct, but provide the least disturbance of the streambed and constriction of the waterway flows.

Construction and Use

- Stabilize construction roadways, adjacent work area, and stream bottom against erosion.
- Construct during dry periods to minimize stream disturbance and reduce costs.
- Construct at or near the natural elevation of the streambed to prevent potential flooding upstream of the crossing.
- Install temporary erosion control BMPs in accordance with erosion control BMP fact sheets to minimize erosion of embankment into flow lines.
- Any temporary artificial obstruction placed within flowing water should only be built from material, such as clean gravel or sandbags, that will not introduce sediment or silt into the watercourse.
- Temporary water body crossings and encroachments should be constructed to minimize scour. Cobbles used for temporary water body crossings or encroachments should be clean, rounded river cobble.
- Vehicles and equipment should not be driven, operated, fueled, cleaned, maintained, or stored in the wet or dry portions of a water body where wetland vegetation, riparian vegetation, or aquatic organisms may be destroyed.
- The exterior of vehicles and equipment that will encroach on the water body within the project should be maintained free of grease, oil, fuel, and residues.
- Drip pans should be placed under all vehicles and equipment placed on docks, barges, or other structures over water bodies when the vehicle or equipment is planned to be idle for more than one hour.

- Disturbance or removal of vegetation should not exceed the minimum necessary to complete operations. Precautions should be taken to avoid damage to vegetation by people or equipment. Disturbed vegetation should be replaced with the appropriate soil stabilization measures.

- Riparian vegetation, when removed pursuant to the provisions of the work, should be cut off no lower than ground level to promote rapid re-growth. Access roads and work areas built over riparian vegetation should be covered by a sufficient layer of clean river run cobble to prevent damage to the underlying soil and root structure. The cobble must be removed upon completion of project activities.

- Conceptual temporary stream crossings are shown in the attached figures.

Costs

Caltrans Construction Cost index for temporary bridge crossings is $45-$95/ft^2.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Check for blockage in the channel, sediment buildup or trapped debris in culverts, blockage behind fords or under bridges.

- Check for erosion of abutments, channel scour, riprap displacement, or piping in the soil.

- Check for structural weakening of the temporary crossings, such as cracks, and undermining of foundations and abutments.

- Remove sediment that collects behind fords, in culverts, and under bridges periodically.

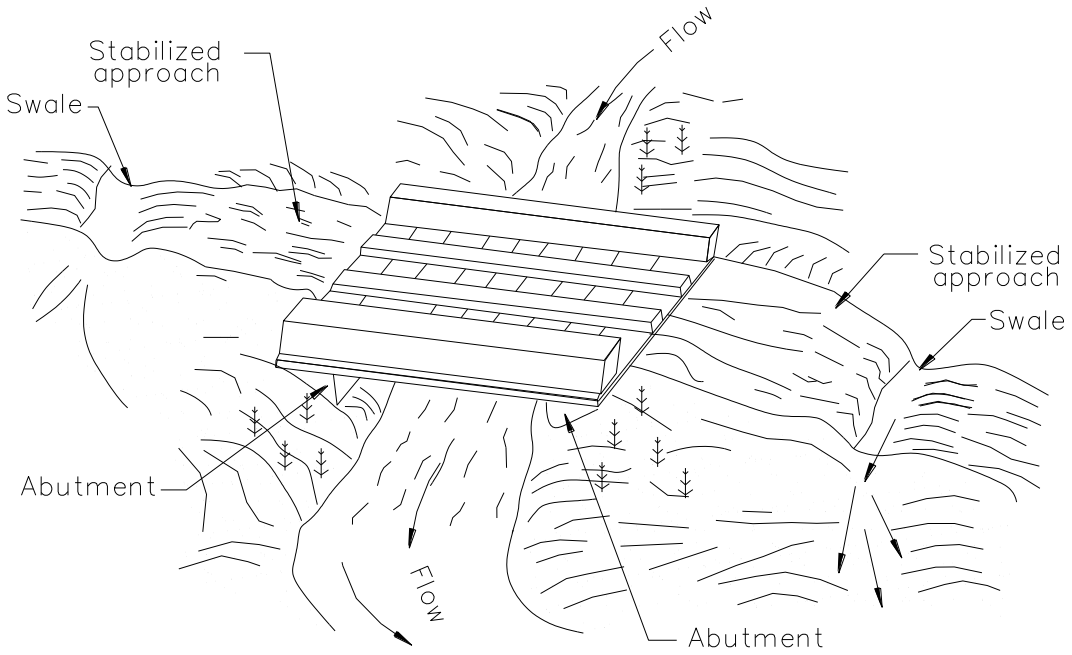
- Replace lost or displaced aggregate from inlets and outlets of culverts and cellular confinement systems.

- Remove temporary crossing promptly when it is no longer needed.

References

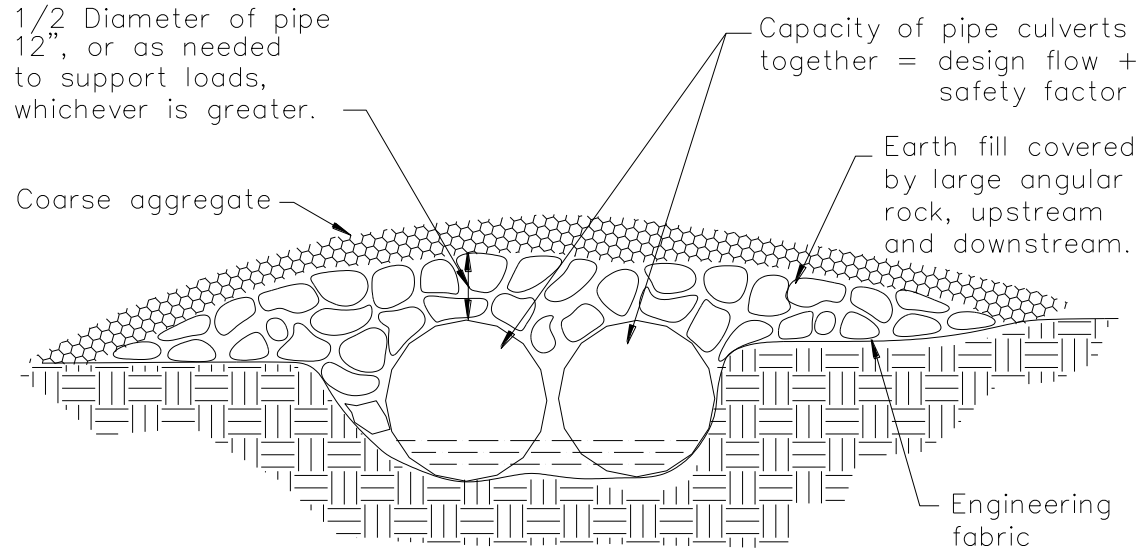
California Bank and Shore Rock Slope Protection Design – Practitioners Guide and Field Evaluations of Riprap Methods, Caltrans Study No. F90TL03, October 2000.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

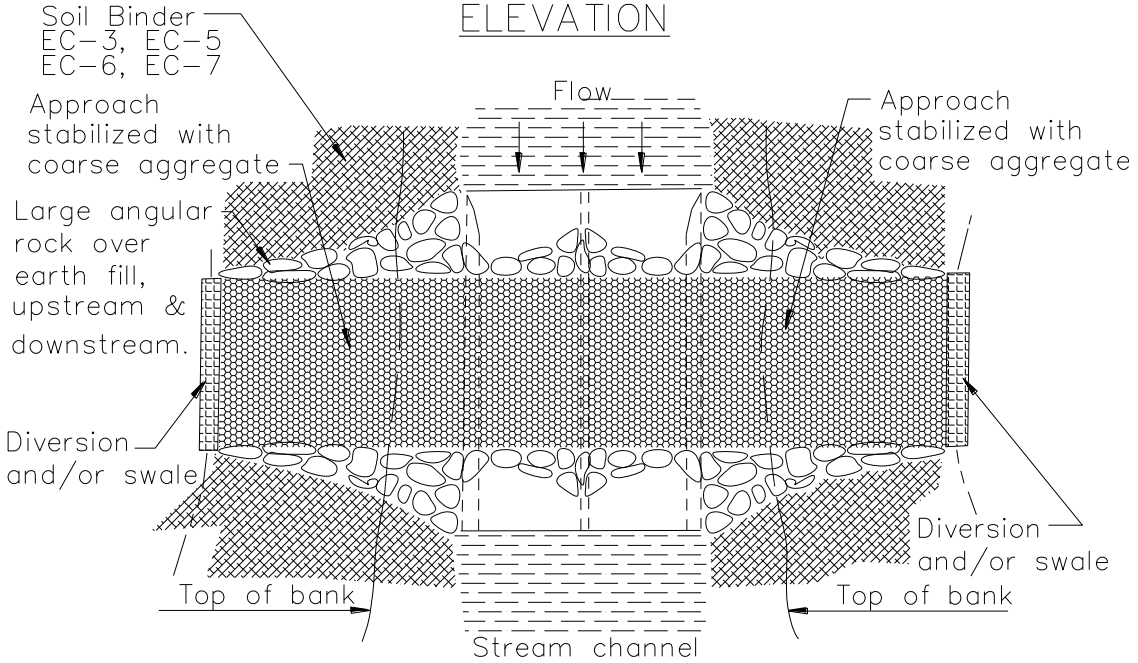


NOTE:
Surface flow of road diverted by swale and/or dike.

TYPICAL BRIDGE CROSSING
NOT TO SCALE

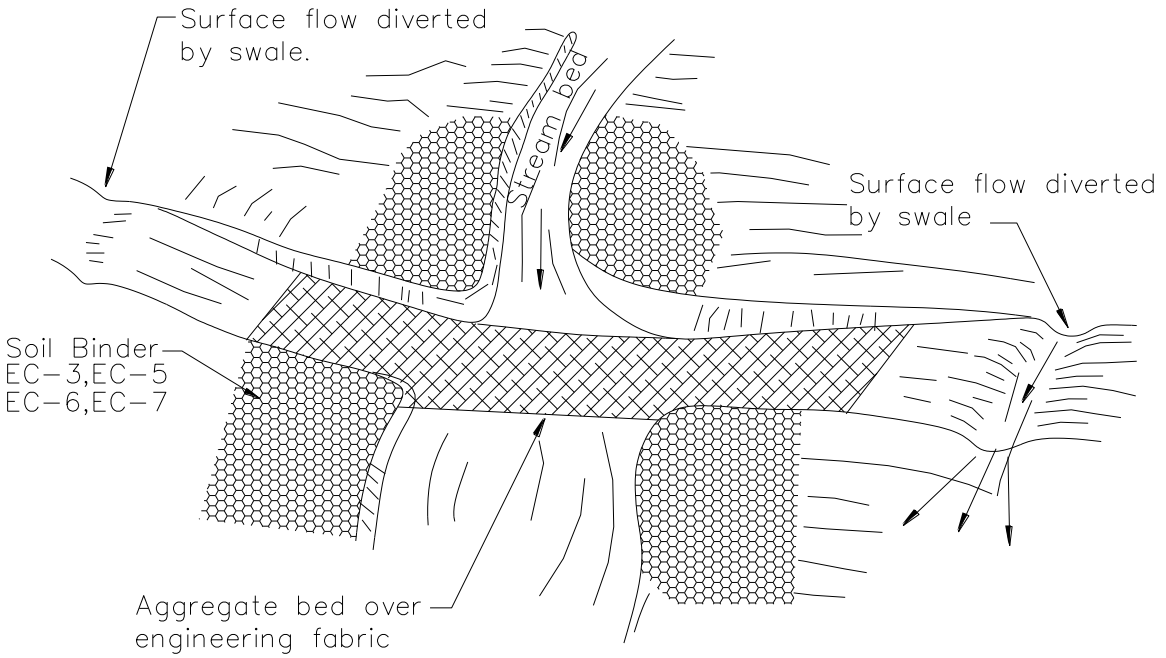


ELEVATION

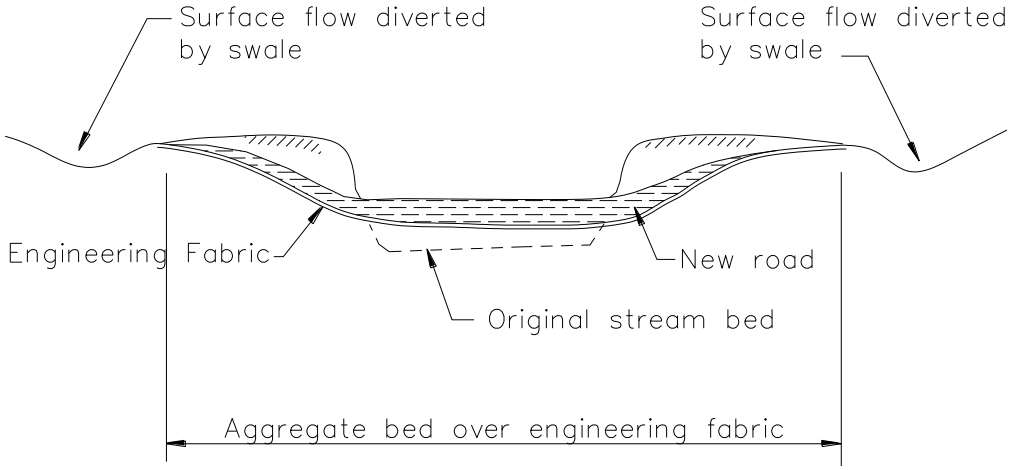


PLAN VIEW

TYPICAL CULVERT CROSSING
NOT TO SCALE

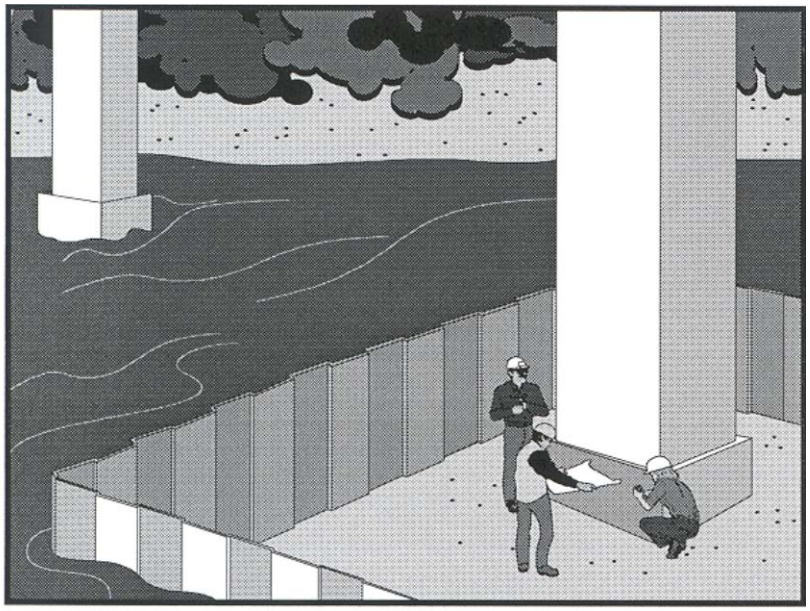


Aggregate approch
1:5 (V:H) Maximum slope on road



TYPICAL FORD CROSSING
NOT TO SCALE

Clear Water Diversion NS-5



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Objective**
☒ **Secondary Objective**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Clear water diversion consists of a system of structures and measures that intercept clear surface water runoff upstream of a project, transport it around the work area, and discharge it downstream with minimal water quality degradation from either the project construction operations or the construction of the diversion. Clear water diversions are used in a waterway to enclose a construction area and reduce sediment pollution from construction work occurring in or adjacent to water. Structures commonly used as part of this system include diversion ditches, berms, dikes, slope drains, rock, gravel bags, wood, aqua barriers, cofferdams, filter fabric or turbidity curtains, drainage and interceptor swales, pipes, or flumes.

Suitable Applications

A clear water diversion is typically implemented where appropriate permits (1601 Agreement) have been secured and work must be performed in a flowing stream or water body.

- Clear water diversions are appropriate for isolating construction activities occurring within or near a water body such as streambank stabilization, or culvert, bridge, pier or abutment installation. They may also be used in combination with other methods, such as clear water bypasses and/or pumps.
- Pumped diversions are suitable for intermittent and low flow streams.
- Excavation of a temporary bypass channel, or passing the flow through a heavy pipe (called a “flume”) with a trench

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

excavated under it, is appropriate for the diversion of streams less than 20 ft wide, with flow rates less than 100 cfs.

- Clear water diversions incorporating clean washed gravel may be appropriate for use in salmonid spawning streams.

Limitations

- Diversion and encroachment activities will usually disturb the waterway during installation and removal of diversion structures.
- Installation may require Regional Water Quality Control Board (RWQCB) 401 Certification, U.S. Army Corps of Engineers 404 permit and approval by California Department of Fish and Game. If numerical-based water quality standards are mentioned in any of these and other related permits, testing and sampling may be required.
- Diversion and encroachment activities may constrict the waterway, which can obstruct flood flows and cause flooding or washouts. Diversion structures should not be installed without identifying potential impacts to the stream channel.
- Diversion or isolation activities are not appropriate in channels where there is insufficient stream flow to support aquatic species in the area dewatered as a result of the diversion.
- Diversion or isolation activities are inappropriate in deep water unless designed or reviewed by an engineer registered in California.
- Diversion or isolation activities should not completely dam stream flow.
- Dewatering and removal may require additional sediment control or water treatment. See NS-2, Dewatering Operations.
- Not appropriate if installation, maintenance, and removal of the structures will disturb sensitive aquatic species of concern.

Implementation

General

- Implement guidelines presented in EC-12, Streambank Stabilization to minimize impacts to streambanks.
- Where working areas encroach on flowing streams, barriers adequate to prevent the flow of muddy water into streams should be constructed and maintained between working areas and streams. During construction of the barriers, muddying of streams should be held to a minimum.
- Diversion structures must be adequately designed to accommodate fluctuations in water depth or flow volume due to tides, storms, flash floods, etc.
- Heavy equipment driven in wet portions of a water body to accomplish work should be completely clean of petroleum residue, and water levels should be below the fuel tanks, gearboxes, and axles of the equipment unless lubricants and fuels are sealed such that inundation by water will not result in discharges of fuels, oils, greases, or hydraulic fluids.

- Excavation equipment buckets may reach out into the water for the purpose of removing or placing fill materials. Only the bucket of the crane/ excavator/backhoe may operate in a water body. The main body of the crane/excavator/backhoe should not enter the water body except as necessary to cross the stream to access the work site.
- Stationary equipment such as motors and pumps located within or adjacent to a water body, should be positioned over drip pans.
- When any artificial obstruction is being constructed, maintained, or placed in operation, sufficient water should, at all times, be allowed to pass downstream to maintain aquatic life.
- Equipment should not be parked below the high water mark unless allowed by a permit.
- Disturbance or removal of vegetation should not exceed the minimum necessary to complete operations. Precautions should be taken to avoid damage to vegetation by people or equipment. Disturbed vegetation should be replaced with the appropriate erosion control measures.
- Riparian vegetation approved for trimming as part of the project should be cut off no lower than ground level to promote rapid re-growth. Access roads and work areas built over riparian vegetation should be covered by a sufficient layer of clean river run cobble to prevent damage to the underlying soil and root structure. The cobble should be removed upon completion of project activities.
- Drip pans should be placed under all vehicles and equipment placed on docks, barges, or other structures over water bodies when the vehicle or equipment is planned to be idle for more than 1 hour.
- Where possible, avoid or minimize diversion and encroachment impacts by scheduling construction during periods of low flow or when the stream is dry. Scheduling should also consider seasonal releases of water from dams, fish migration and spawning seasons, and water demands due to crop irrigation.
- Construct diversion structures with materials free of potential pollutants such as soil, silt, sand, clay, grease, or oil.

Temporary Diversions and Encroachments

- Construct diversion channels in accordance with EC-9, Earth Dikes and Drainage Swales.
- In high flow velocity areas, stabilize slopes of embankments and diversion ditches using an appropriate liner, in accordance with EC-7, Geotextiles and Mats, or use rock slope protection.
- Where appropriate, use natural streambed materials such as large cobbles and boulders for temporary embankment and slope protection, or other temporary soil stabilization methods.
- Provide for velocity dissipation at transitions in the diversion, such as the point where the stream is diverted to the channel and the point where the diverted stream is returned to its natural channel. See also EC-10, Velocity Dissipation Devices.

Temporary Dry Construction Areas

- When dewatering behind temporary structures to create a temporary dry construction area, such as cofferdams, pass pumped water through a sediment-settling device, such as a portable tank or settling basin, before returning water to the water body. See also NS-2, Dewatering Operations.

- Any substance used to assemble or maintain diversion structures, such as form oil, should be non-toxic and non-hazardous.

- Any material used to minimize seepage underneath diversion structures, such as grout, should be non-toxic, non-hazardous, and as close to a neutral pH as possible.

Comparison of Diversion and Isolation Techniques:

- Gravel bags are relatively inexpensive, but installation and removal can be labor intensive. It is also difficult to dewater the isolated area. Sandbags should not be used for this technique in rivers or streams, as sand should never be put into or adjacent to a stream, even if encapsulated in geotextile.

- Gravel Bag Berms (SE-6) used in conjunction with an impermeable membrane are cost effective, and can be dewatered relatively easily. If spawning gravel is used, the impermeable membrane can be removed from the stream, and the gravel can be spread out and left as salmonid spawning habitat if approved in the permit. Only clean, washed gravel should be used for both the gravel bag and gravel berm techniques.

- Cofferdams are relatively expensive, but frequently allow full dewatering. Also, many options now available are relatively easy to install.

- Sheet pile enclosures are a much more expensive solution, but do allow full dewatering. This technique is not well suited to small streams, but can be effective on large rivers or lakes, and where staging and heavy equipment access areas are available.

- K-rails are an isolation method that does not allow full dewatering, but can be used in small to large watercourses, and in fast-water situations.

- A relatively inexpensive isolation method is filter fabric isolation. This method involves placement of gravel bags or continuous berms to 'key-in' the fabric, and subsequently staking the fabric in place. This method should be used in relatively calm water, and can be used in smaller streams. Note that this is not a dewatering method, but rather a sediment isolation method.

- Turbidity curtains should be used where sediment discharge to a stream is unavoidable. They can also be used for in-stream construction, when dewatering an area is not required.

- When used in watercourses or streams, cofferdams must be used in accordance with permit requirements.

- Manufactured diversion structures should be installed following manufacturer's specifications.

- Filter fabric and turbidity curtain isolation installation methods can be found in the specific technique descriptions that follow.

Filter Fabric Isolation Technique

Definition and Purpose

A filter fabric isolation structure is a temporary structure built into a waterway to enclose a construction area and reduce sediment pollution from construction work in or adjacent to water. This structure is composed of filter fabric, gravel bags, and steel t-posts.

Appropriate Applications

- Filter fabric may be used for construction activities such as streambank stabilization, or culvert, bridge, pier or abutment installation. It may also be used in combination with other methods, such as clean water bypasses and/or pumps.
- Filter fabric isolation is relatively inexpensive. This method involves placement of gravel bags or continuous berms to 'key-in' the fabric, and subsequently staking the fabric in place.
- If spawning gravel is used, all other components of the isolation can be removed from the stream, and the gravel may be spread out and left as salmonid spawning habitat if approved in the permit. Whether spawning gravel or other types of gravel are used, only clean washed gravel should be used as infill for the gravel bags or continuous berm.
- This method should be used in relatively calm water, and can be used in smaller streams. This is not a dewatering method, but rather a sediment isolation method.
- Water levels inside and outside the fabric curtain must be about the same, as differential heads will cause the curtain to collapse.

Limitations

- Do not use if the installation, maintenance and removal of the structures will disturb sensitive aquatic species of concern.
- Filter fabrics are not appropriate for projects where dewatering is necessary.
- Filter fabrics are not appropriate to completely dam stream flow.

Design and Installation

- For the filter fabric isolation method, a non-woven or heavy-duty fabric is recommended over standard silt fence. Using rolled geotextiles allows non-standard widths to be used.
- Anchor filter fabric with gravel bags filled with clean, washed gravel. Do not use sand. If a bag should split open, the gravel can be left in the stream, where it can provide aquatic habitat benefits. If a sandbag splits open in a watercourse, the sand could cause a decrease in water quality, and could bury sensitive aquatic habitat.
- Another anchor alternative is a continuous berm, made with the Continuous Berm Machine. This is a gravel-filled bag that can be made in very long segments. The length of the berms is usually limited to 18 ft for ease of handling (otherwise, it gets too heavy to move).

- Place the fabric on the bottom of the stream, and place either a bag of clean, washed gravel or a continuous berm over the bottom of the silt fence fabric, such that a bag-width of fabric lies on the stream bottom. The bag should be placed on what will be the outside of the isolation area.
- Pull the fabric up, and place a metal t-post immediately behind the fabric, on the inside of the isolation area; attach the silt fence to the post with three diagonal nylon ties.
- Continue placing fabric as described above until the entire work area has been isolated, staking the fabric at least every 6 ft.

Inspection and Maintenance

- Immediately repair any gaps, holes or scour.
- Remove and properly dispose of sediment buildup.
- Remove BMP upon completion of construction activity. Recycle or reuse if applicable.
- Revegetate areas disturbed by BMP removal if needed.

Turbidity Curtain Isolation Technique

Definition and Purpose

A turbidity curtain is a fabric barrier used to isolate the near shore work area. The barriers are intended to confine the suspended sediment. The curtain is a floating barrier, and thus does not prevent water from entering the isolated area; rather, it prevents suspended sediment from getting out.

Appropriate Applications

Turbidity curtains should be used where sediment discharge to a stream is unavoidable. They are used when construction activities adjoin quiescent waters, such as lakes, ponds, and slow flowing rivers. The curtains are designed to deflect and contain sediment within a limited area and provide sufficient retention time so that the sediment particles will fall out of suspension.

Limitations

- Turbidity curtains should not be used in flowing water; they are best suited for use in ponds, lakes, and very slow-moving rivers.
- Turbidity curtains should not be placed across the width of a channel.
- Removing sediment that has been deflected and settled out by the curtain may create a discharge problem through the resuspension of particles and by accidental dumping by the removal equipment.

Design and Installation

- Turbidity curtains should be oriented parallel to the direction of flow.
- The curtain should extend the entire depth of the watercourse in calm-water situations.
- In wave conditions, the curtain should extend to within 1 ft of the bottom of the watercourse, such that the curtain does not stir up sediment by hitting the bottom repeatedly. If it is

desirable for the curtain to reach the bottom in an active-water situation, a pervious filter fabric may be used for the bottom 1 ft.

- The top of the curtain should consist of flexible flotation buoys, and the bottom should be held down by a load line incorporated into the curtain fabric. The fabric should be a brightly colored impervious mesh.
- The curtain should be held in place by anchors placed at least every 100 ft.
- First, place the anchors, then tow the fabric out in a furled condition, and connect to the anchors. The anchors should be connected to the flotation devices, and not to the bottom of the curtain. Once in place, cut the furling lines, and allow the bottom of the curtain to sink.
- Consideration must be given to the probable outcome of the removal procedure. It must be determined if it will create more of a sediment problem through re-suspension of the particles or by accidental dumping of material during removal. It is recommended that the soil particles trapped by the turbidity curtain only be removed if there has been a significant change in the original contours of the affected area in the watercourse.
- Particles should always be allowed to settle for a minimum of 6 to 12 hours prior to their removal or prior to removal of the turbidity curtain.

Maintenance and Inspection:

- The curtain should be inspected for holes or other problems, and any repairs needed should be made promptly.
- Allow sediment to settle for 6 to 12 hours prior to removal of sediment or curtain. This means that after removing sediment, wait an additional 6 to 12 hours before removing the curtain.
- To remove, install furling lines along the curtain, detach from anchors, and tow out of the water.

K-rail River Isolation

Definition and Purpose

This temporary sediment control or stream isolation method uses K-rails to form the sediment deposition area, or to isolate the in-stream or near-bank construction area.

Barriers are placed end-to-end in a pre-designed configuration and gravel-filled bags are used at the toe of the barrier and at their abutting ends to seal and prevent movement of sediment beneath or through the barrier walls.

Appropriate Applications

The K-rail isolation can be used in streams with higher water velocities than many other isolation techniques.

- This technique is also useful at the toe of embankments, and cut or fill slopes.

Limitations

- The K-rail method should not be used to dewater a project site, as the barrier is not watertight.

Design and Installation

- To create a floor for the K-rail, move large rocks and obstructions. Place washed gravel and gravel-filled bags to create a level surface for K-rails to sit. Washed gravel should always be used.
- Place the bottom two K-rails adjacent to each other, and parallel to the direction of flow; fill the center portion with gravel bags. Then place the third K-rail on top of the bottom two. There should be sufficient gravel bags between the bottom K-rails such that the top rail is supported by the gravel. Place plastic sheeting around the K-rails, and secure at the bottom with gravel bags.
- Further support can be added by pinning and cabling the K-rails together. Also, large riprap and boulders can be used to support either side of the K-rail, especially where there is strong current.

Inspection and Maintenance:

- The barrier should be inspected and any leaks, holes, or other problems should be addressed immediately.
- Sediment should be allowed to settle for at least 6 to 12 hours prior to removal of sediment, and for 6 to 12 hours prior to removal of the barrier.

Stream Diversions

The selection of which stream diversion technique to use will depend upon the type of work involved, physical characteristics of the site, and the volume of water flowing through the project.

Advantages of a Pumped Diversion

- Downstream sediment transport can be nearly eliminated.
- Dewatering of the work area is possible.
- Pipes can be moved around to allow construction operations.
- The dams can serve as temporary access to the site.
- Increased flows can be managed by adding more pumping capacity.

Disadvantages of a Pumped Diversion

- Flow volume is limited by pump capacity.
- A pumped diversion requires 24 hour monitoring of pumps.
- Sudden rain could overtop dams.
- Erosion at the outlet.

- Minor in-stream disturbance is required to install and remove dams.

Advantages of Excavated Channels and Flumes

- Excavated channels isolate work from water flow and allow dewatering.
- Excavated channels can handle larger flows than pumps.

Disadvantages of Excavated Channels and Flumes

- Bypass channel or flume must be sized to handle flows, including possible floods.
- Channels must be protected from erosion.
- Flow diversion and re-direction with small dams involves in-stream disturbance and mobilization of sediment.

Design and Installation

- Installation guidelines will vary based on existing site conditions and type of diversion used.
- Pump capacity must be sufficient for design flow.
- A standby pump is required in case a primary pump fails.
- Dam materials used to create dams upstream and downstream of diversion should be erosion resistant; materials such as steel plate, sheet pile, sandbags, continuous berms, inflatable water bladders, etc., would be acceptable.

When constructing a diversion channel, begin excavation of the channel at the proposed downstream end, and work upstream. Once the watercourse to be diverted is reached and the excavated channel is stable, breach the upstream end and allow water to flow down the new channel. Once flow has been established in the diversion channel, install the diversion weir in the main channel; this will force all water to be diverted from the main channel.

Inspection and Maintenance

- Pumped diversions require 24 hour monitoring of pumps.
- Inspect embankments and diversion channels for damage to the linings, accumulating debris, sediment buildup, and adequacy of the slope protection. Remove debris and repair linings and slope protection as required. Remove holes, gaps, or scour.
- Upon completion of work, the diversion or isolation structure should be removed and flow should be redirected through the new culvert or back into the original stream channel. Recycle or reuse if applicable.
- Revegetate areas disturbed by BMP removal if needed.

Costs

Costs of clear water diversion vary considerably and can be very high.

Inspection and Maintenance

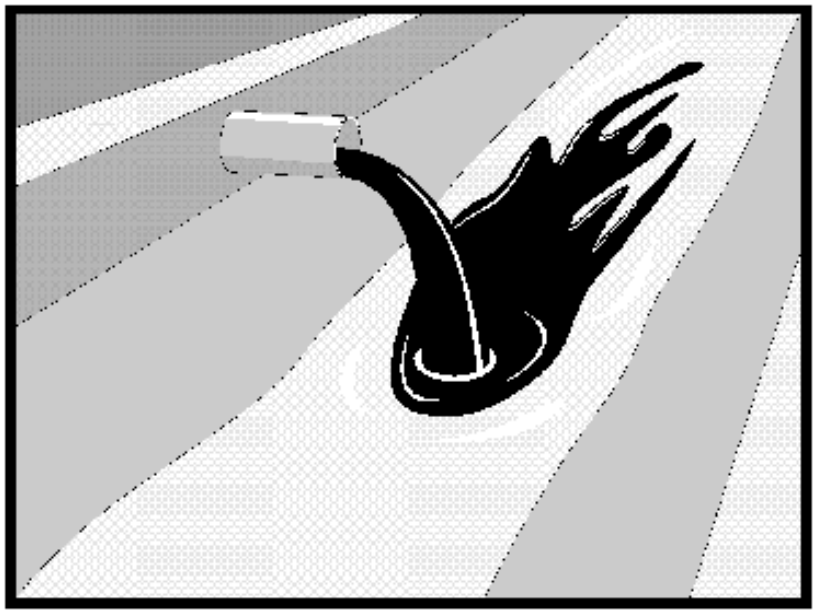
- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Refer to BMP-specific inspection and maintenance requirements.

References

California Bank and Shore Rock Slope Protection Design – Practitioners Guide and Field Evaluations of Riprap Methods, Caltrans Study No. F90TL03, October, 2000.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Illicit Connection / Discharge NS-6



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Procedures and practices designed for construction contractors to recognize illicit connections or illegally dumped or discharged materials on a construction site and report incidents.

Suitable Applications

This best management practice (BMP) applies to all construction projects. Illicit connection/discharge and reporting is applicable anytime an illicit connection or discharge is discovered or illegally dumped material is found on the construction site.

Limitations

Illicit connections and illegal discharges or dumping, for the purposes of this BMP, refer to discharges and dumping caused by parties other than the contractor. If pre-existing hazardous materials or wastes are known to exist onsite, they should be identified in the SWPPP and handled as set forth in the SWPPP.

Implementation

Planning

- Review the SWPPP. Pre-existing areas of contamination should be identified and documented in the SWPPP.
- Inspect site before beginning the job for evidence of illicit connections, illegal dumping or discharges. Document any pre-existing conditions and notify the owner.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Inspect site regularly during project execution for evidence of illicit connections, illegal dumping or discharges.
- Observe site perimeter for evidence for potential of illicitly discharged or illegally dumped material, which may enter the job site.

Identification of Illicit Connections and Illegal Dumping or Discharges

- **General –** unlabeled and unidentifiable material should be treated as hazardous.
- **Solids** - Look for debris, or rubbish piles. Solid waste dumping often occurs on roadways with light traffic loads or in areas not easily visible from the traveled way.
- **Liquids** - signs of illegal liquid dumping or discharge can include:
  - Visible signs of staining or unusual colors to the pavement or surrounding adjacent soils
  - Pungent odors coming from the drainage systems
  - Discoloration or oily substances in the water or stains and residues detained within ditches, channels or drain boxes
  - Abnormal water flow during the dry weather season
- **Urban Areas** - Evidence of illicit connections or illegal discharges is typically detected at storm drain outfall locations or at manholes. Signs of an illicit connection or illegal discharge can include:
  - Abnormal water flow during the dry weather season
  - Unusual flows in sub drain systems used for dewatering
  - Pungent odors coming from the drainage systems
  - Discoloration or oily substances in the water or stains and residues detained within ditches, channels or drain boxes
  - Excessive sediment deposits, particularly adjacent to or near active offsite construction projects
- **Rural Areas** - Illicit connections or illegal discharges involving irrigation drainage ditches are detected by visual inspections. Signs of an illicit discharge can include:
  - Abnormal water flow during the non-irrigation season
  - Non-standard junction structures
  - Broken concrete or other disturbances at or near junction structures

Reporting

Notify the owner of any illicit connections and illegal dumping or discharge incidents at the time of discovery. For illicit connections or discharges to the storm drain system, notify the local stormwater management agency. For illegal dumping, notify the local law enforcement agency.

Cleanup and Removal

The responsibility for cleanup and removal of illicit or illegal dumping or discharges will vary by location. Contact the local stormwater management agency for further information.

Costs

Costs to look for and report illicit connections and illegal discharges and dumping are low. The best way to avoid costs associated with illicit connections and illegal discharges and dumping is to keep the project perimeters secure to prevent access to the site, to observe the site for vehicles that should not be there, and to document any waste or hazardous materials that exist onsite before taking possession of the site.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect the site regularly to check for any illegal dumping or discharge.
- Prohibit employees and subcontractors from disposing of non-job related debris or materials at the construction site.
- Notify the owner of any illicit connections and illegal dumping or discharge incidents at the time of discovery.

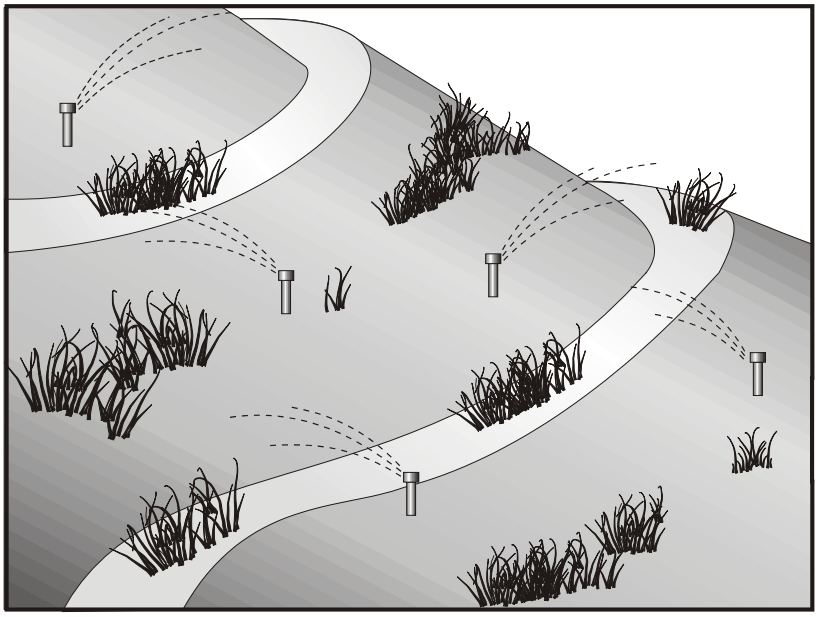
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Potable Water / Irrigation NS-7



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	
Metals	☑
Bacteria	
Oil and Grease	
Organics	☑

Potential Alternatives

None

Description and Purpose

Potable Water/Irrigation consists of practices and procedures to manage the discharge of potential pollutants generated during discharges from irrigation water lines, landscape irrigation, lawn or garden watering, planned and unplanned discharges from potable water sources, water line flushing, and hydrant flushing.

Suitable Applications

Implement this BMP whenever potable water or irrigation water discharges occur at or enter a construction site.

Limitations

None identified.

Implementation

- Direct water from offsite sources around or through a construction site, where feasible, in a way that minimizes contact with the construction site.
- Discharges from water line flushing should be reused for landscaping purposes where feasible.
- Shut off the water source to broken lines, sprinklers, or valves as soon as possible to prevent excess water flow.
- Protect downstream stormwater drainage systems and watercourses from water pumped or bailed from trenches excavated to repair water lines.

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Inspect irrigated areas within the construction limits for excess watering. Adjust watering times and schedules to ensure that the appropriate amount of water is being used and to minimize runoff. Consider factors such as soil structure, grade, time of year, and type of plant material in determining the proper amounts of water for a specific area.

Costs

Cost to manage potable water and irrigation are low and generally considered to be a normal part of related activities.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events..
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Repair broken water lines as soon as possible.
- Inspect irrigated areas regularly for signs of erosion and/or discharge.

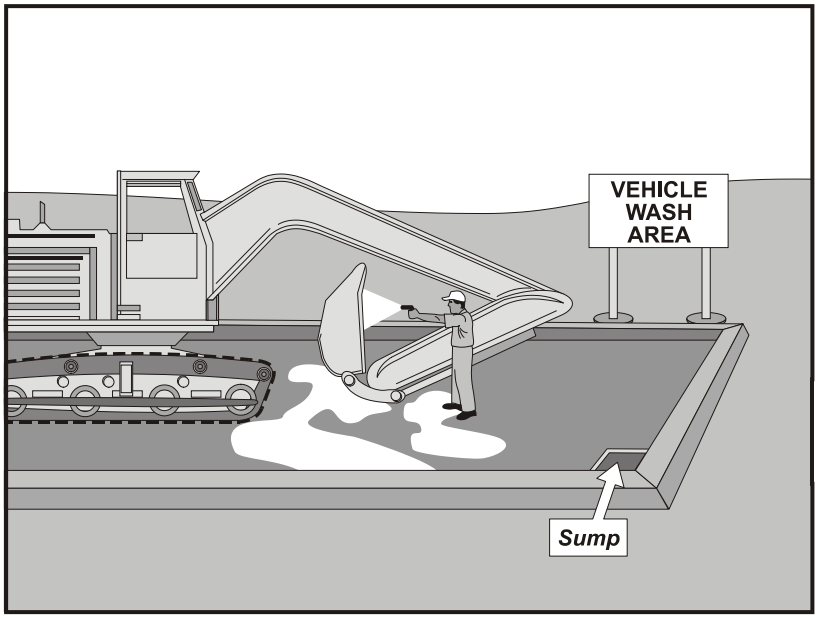
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Vehicle and Equipment Cleaning NS-8



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	
Metals	
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Vehicle and equipment cleaning procedures and practices eliminate or reduce the discharge of pollutants to stormwater from vehicle and equipment cleaning operations. Procedures and practices include but are not limited to: using offsite facilities; washing in designated, contained areas only; eliminating discharges to the storm drain by infiltrating the wash water; and training employees and subcontractors in proper cleaning procedures.

Suitable Applications

These procedures are suitable on all construction sites where vehicle and equipment cleaning is performed.

Limitations

Even phosphate-free, biodegradable soaps have been shown to be toxic to fish before the soap degrades. Sending vehicles/equipment offsite should be done in conjunction with TC-1, Stabilized Construction Entrance/Exit.

Implementation

Other options to washing equipment onsite include contracting with either an offsite or mobile commercial washing business. These businesses may be better equipped to handle and dispose of the wash waters properly. Performing this work offsite can also be economical by eliminating the need for a separate washing operation onsite.

If washing operations are to take place onsite, then:

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Use phosphate-free, biodegradable soaps.
- Educate employees and subcontractors on pollution prevention measures.
- Do not permit steam cleaning onsite. Steam cleaning can generate significant pollutant concentrates.
- Cleaning of vehicles and equipment with soap, solvents or steam should not occur on the project site unless resulting wastes are fully contained and disposed of. Resulting wastes should not be discharged or buried, and must be captured and recycled or disposed according to the requirements of WM-10, Liquid Waste Management or WM-6, Hazardous Waste Management, depending on the waste characteristics. Minimize use of solvents. Use of diesel for vehicle and equipment cleaning is prohibited.
- All vehicles and equipment that regularly enter and leave the construction site must be cleaned offsite.
- When vehicle and equipment washing and cleaning must occur onsite, and the operation cannot be located within a structure or building equipped with appropriate disposal facilities, the outside cleaning area should have the following characteristics:
  - Located away from storm drain inlets, drainage facilities, or watercourses
  - Paved with concrete or asphalt and bermed to contain wash waters and to prevent runon and runoff
  - Configured with a sump to allow collection and disposal of wash water
  - No discharge of wash waters to storm drains or watercourses
  - Used only when necessary
- When cleaning vehicles and equipment with water:
  - Use as little water as possible. High-pressure sprayers may use less water than a hose and should be considered
  - Use positive shutoff valve to minimize water usage
  - Facility wash racks should discharge to a sanitary sewer, recycle system or other approved discharge system and must not discharge to the storm drainage system, watercourses, or to groundwater

Costs

Cleaning vehicles and equipment at an offsite facility may reduce overall costs for vehicle and equipment cleaning by eliminating the need to provide similar services onsite. When onsite cleaning is needed, the cost to establish appropriate facilities is relatively low on larger, long-duration projects, and moderate to high on small, short-duration projects.

Inspection and Maintenance

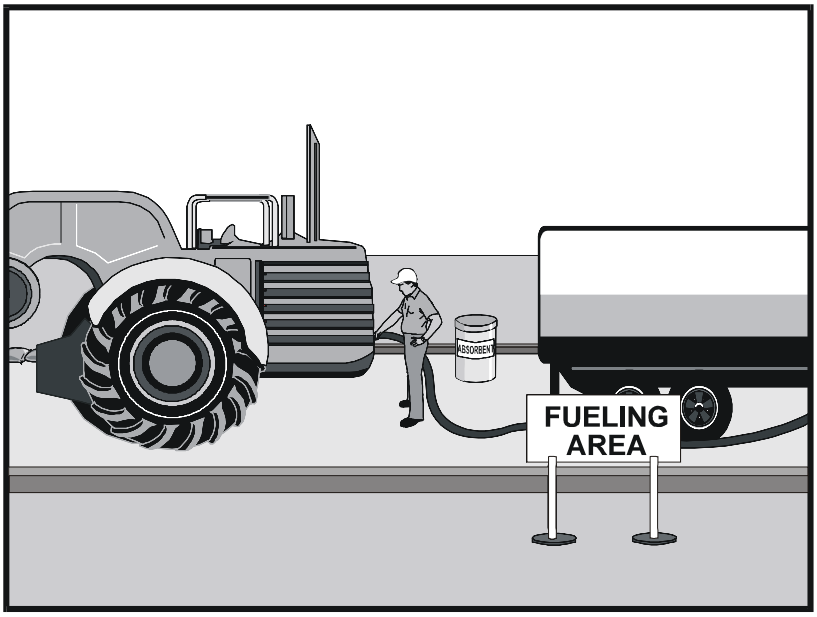
- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspection and maintenance is minimal, although some berm repair may be necessary.
- Monitor employees and subcontractors throughout the duration of the construction project to ensure appropriate practices are being implemented.
- Inspect sump regularly and remove liquids and sediment as needed.
- Prohibit employees and subcontractors from washing personal vehicles and equipment on the construction site.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Swisher, R.D. Surfactant Biodegradation, Marcel Decker Corporation, 1987.

Vehicle and Equipment Fueling NS-9



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Vehicle equipment fueling procedures and practices are designed to prevent fuel spills and leaks, and reduce or eliminate contamination of stormwater. This can be accomplished by using offsite facilities, fueling in designated areas only, enclosing or covering stored fuel, implementing spill controls, and training employees and subcontractors in proper fueling procedures.

Suitable Applications

These procedures are suitable on all construction sites where vehicle and equipment fueling takes place.

Limitations

Onsite vehicle and equipment fueling should only be used where it is impractical to send vehicles and equipment offsite for fueling. Sending vehicles and equipment offsite should be done in conjunction with TC-1, Stabilized Construction Entrance/ Exit.

Implementation

- Use offsite fueling stations as much as possible. These businesses are better equipped to handle fuel and spills properly. Performing this work offsite can also be economical by eliminating the need for a separate fueling area at a site.
- Discourage "topping-off" of fuel tanks.

- Absorbent spill cleanup materials and spill kits should be available in fueling areas and on fueling trucks, and should be disposed of properly after use.
- Drip pans or absorbent pads should be used during vehicle and equipment fueling, unless the fueling is performed over an impermeable surface in a dedicated fueling area.
- Use absorbent materials on small spills. Do not hose down or bury the spill. Remove the adsorbent materials promptly and dispose of properly.
- Avoid mobile fueling of mobile construction equipment around the site; rather, transport the equipment to designated fueling areas. With the exception of tracked equipment such as bulldozers and large excavators, most vehicles should be able to travel to a designated area with little lost time.
- Train employees and subcontractors in proper fueling and cleanup procedures.
- When fueling must take place onsite, designate an area away from drainage courses to be used. Fueling areas should be identified in the SWPPP.
- Dedicated fueling areas should be protected from stormwater runon and runoff, and should be located at least 50 ft away from downstream drainage facilities and watercourses. Fueling must be performed on level-grade areas.
- Protect fueling areas with berms and dikes to prevent runon, runoff, and to contain spills.
- Nozzles used in vehicle and equipment fueling should be equipped with an automatic shutoff to control drips. Fueling operations should not be left unattended.
- Use vapor recovery nozzles to help control drips as well as air pollution where required by Air Quality Management Districts (AQMD).
- Federal, state, and local requirements should be observed for any stationary above ground storage tanks.

Costs

- All of the above measures are low cost except for the capital costs of above ground tanks that meet all local environmental, zoning, and fire codes.

Inspection and Maintenance

- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Vehicles and equipment should be inspected each day of use for leaks. Leaks should be repaired immediately or problem vehicles or equipment should be removed from the project site.
- Keep ample supplies of spill cleanup materials onsite.

- Immediately clean up spills and properly dispose of contaminated soil and cleanup materials.

References

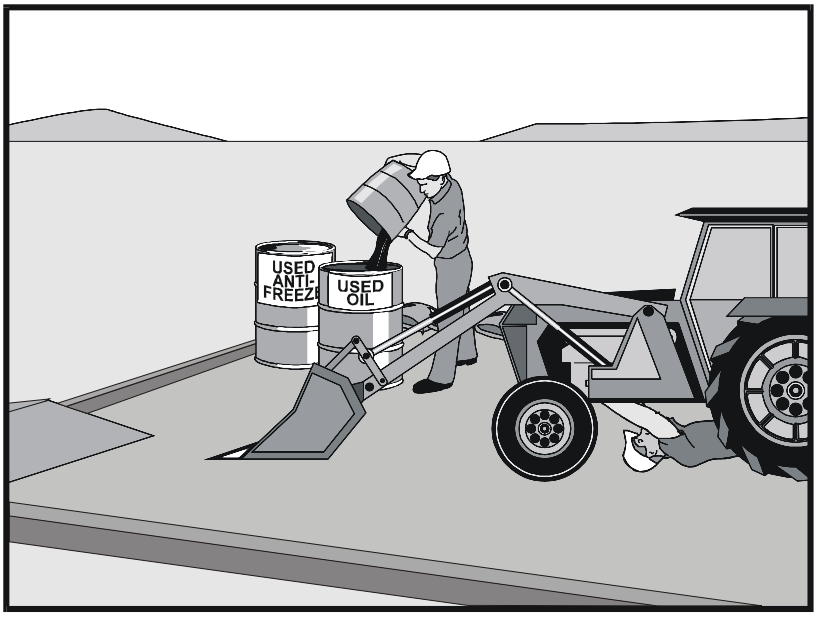
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Vehicle & Equipment Maintenance NS-10



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	
Nutrients	☑
Trash	☑
Metals	
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Prevent or reduce the contamination of stormwater resulting from vehicle and equipment maintenance by running a "dry and clean site". The best option would be to perform maintenance activities at an offsite facility. If this option is not available then work should be performed in designated areas only, while providing cover for materials stored outside, checking for leaks and spills, and containing and cleaning up spills immediately. Employees and subcontractors must be trained in proper procedures.

Suitable Applications

These procedures are suitable on all construction projects where an onsite yard area is necessary for storage and maintenance of heavy equipment and vehicles.

Limitations

Onsite vehicle and equipment maintenance should only be used where it is impractical to send vehicles and equipment offsite for maintenance and repair. Sending vehicles/equipment offsite should be done in conjunction with TC-1, Stabilized Construction Entrance/Exit.

Outdoor vehicle or equipment maintenance is a potentially significant source of stormwater pollution. Activities that can contaminate stormwater include engine repair and service, changing or replacement of fluids, and outdoor equipment storage and parking (engine fluid leaks). For further information on vehicle or equipment servicing, see NS-8,

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Vehicle and Equipment Cleaning, and NS-9, Vehicle and Equipment Fueling.

Implementation

- Use offsite repair shops as much as possible. These businesses are better equipped to handle vehicle fluids and spills properly. Performing this work offsite can also be economical by eliminating the need for a separate maintenance area.
- If maintenance must occur onsite, use designated areas, located away from drainage courses. Dedicated maintenance areas should be protected from stormwater runon and runoff, and should be located at least 50 ft from downstream drainage facilities and watercourses.
- Drip pans or absorbent pads should be used during vehicle and equipment maintenance work that involves fluids, unless the maintenance work is performed over an impermeable surface in a dedicated maintenance area.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- All fueling trucks and fueling areas are required to have spill kits and/or use other spill protection devices.
- Use adsorbent materials on small spills. Remove the absorbent materials promptly and dispose of properly.
- Inspect onsite vehicles and equipment daily at startup for leaks, and repair immediately.
- Keep vehicles and equipment clean; do not allow excessive build-up of oil and grease.
- Segregate and recycle wastes, such as greases, used oil or oil filters, antifreeze, cleaning solutions, automotive batteries, hydraulic and transmission fluids. Provide secondary containment and covers for these materials if stored onsite.
- Train employees and subcontractors in proper maintenance and spill cleanup procedures.
- Drip pans or plastic sheeting should be placed under all vehicles and equipment placed on docks, barges, or other structures over water bodies when the vehicle or equipment is planned to be idle for more than 1 hour.
- For long-term projects, consider using portable tents or covers over maintenance areas if maintenance cannot be performed offsite.
- Consider use of new, alternative greases and lubricants, such as adhesive greases, for chassis lubrication and fifth-wheel lubrication.
- Properly dispose of used oils, fluids, lubricants, and spill cleanup materials.
- Do not place used oil in a dumpster or pour into a storm drain or watercourse.
- Properly dispose of or recycle used batteries.
- Do not bury used tires.

- Repair leaks of fluids and oil immediately.

Listed below is further information if you must perform vehicle or equipment maintenance onsite.

Safer Alternative Products

- Consider products that are less toxic or hazardous than regular products. These products are often sold under an "environmentally friendly" label.
- Consider use of grease substitutes for lubrication of truck fifth-wheels. Follow manufacturers label for details on specific uses.
- Consider use of plastic friction plates on truck fifth-wheels in lieu of grease. Follow manufacturers label for details on specific uses.

Waste Reduction

Parts are often cleaned using solvents such as trichloroethylene, trichloroethane, or methylene chloride. Many of these cleaners are listed in California Toxic Rule as priority pollutants. These materials are harmful and must not contaminate stormwater. They must be disposed of as a hazardous waste. Reducing the number of solvents makes recycling easier and reduces hazardous waste management costs. Often, one solvent can perform a job as well as two different solvents. Also, if possible, eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous materials. For example, replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check the list of active ingredients to see whether it contains chlorinated solvents. The "chlor" term indicates that the solvent is chlorinated. Also, try substituting a wire brush for solvents to clean parts.

Recycling and Disposal

Separating wastes allows for easier recycling and may reduce disposal costs. Keep hazardous wastes separate, do not mix used oil solvents, and keep chlorinated solvents (like,-trichloroethane) separate from non-chlorinated solvents (like kerosene and mineral spirits). Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around. Provide cover and secondary containment until these materials can be removed from the site.

Oil filters can be recycled. Ask your oil supplier or recycler about recycling oil filters.

Do not dispose of extra paints and coatings by dumping liquid onto the ground or throwing it into dumpsters. Allow coatings to dry or harden before disposal into covered dumpsters.

Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Costs

All of the above are low cost measures. Higher costs are incurred to setup and maintain onsite maintenance areas.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Keep ample supplies of spill cleanup materials onsite.
- Maintain waste fluid containers in leak proof condition.
- Vehicles and equipment should be inspected on each day of use. Leaks should be repaired immediately or the problem vehicle(s) or equipment should be removed from the project site.
- Inspect equipment for damaged hoses and leaky gaskets routinely. Repair or replace as needed.

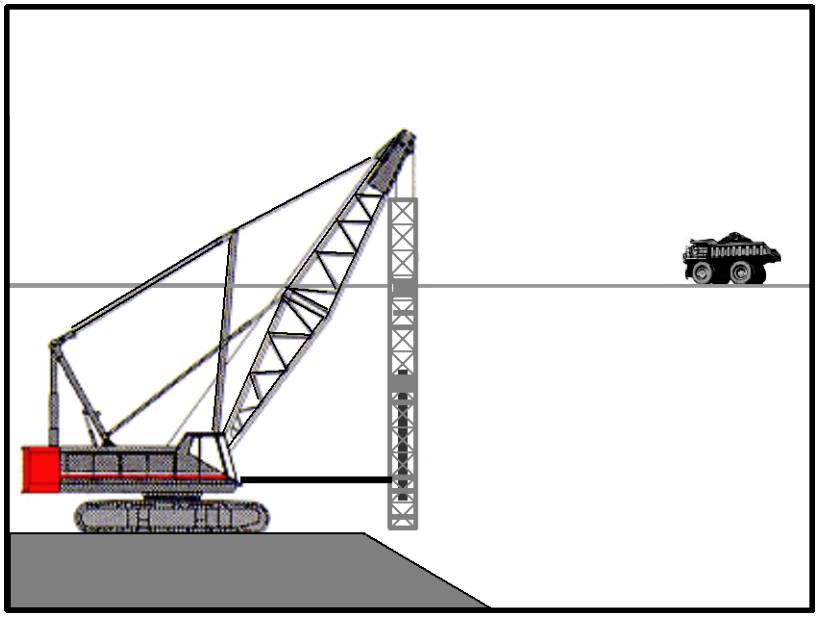
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Pile Driving Operations NS-11



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Objective**
☒ **Secondary Objective**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

The construction and retrofit of bridges and retaining walls often include driving piles for foundation support and shoring operations. Driven piles are typically constructed of precast concrete, steel, or timber. Driven sheet piles are also used for shoring and cofferdam construction. Proper control and use of equipment, materials, and waste products from pile driving operations will reduce or eliminate the discharge of potential pollutants to the storm drain system, watercourses, and waters of the United States.

Suitable Applications

These procedures apply to all construction sites near or adjacent to a watercourse or groundwater where permanent and temporary pile driving (impact and vibratory) takes place, including operations using pile shells as well as construction of cast-in-steel-shell and cast-in-drilled-hole piles.

Limitations

None identified.

Implementation

- Use drip pans or absorbent pads during vehicle and equipment operation, maintenance, cleaning, fueling, and storage. Refer to NS-8, Vehicle and Equipment Cleaning, NS-9, Vehicle and Equipment Fueling, and NS-10, Vehicle and Equipment Maintenance.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Have spill kits and cleanup materials available at all locations of pile driving. Refer to WM-4, Spill Prevention and Control.
- Equipment that is stored or in use in streambeds, or on docks, barges, or other structures over water bodies should be kept leak free.
- Park equipment over plastic sheeting or equivalent where possible. Plastic is not a substitute for drip pans or absorbent pads. The storage or use of equipment in streambeds or other bodies of water must comply with all applicable permits.
- Implement other BMPs as applicable, such as NS-2, Dewatering Operations, WM-5, Solid Waste Management, WM-6, Hazardous Waste Management, and WM-10, Liquid Waste Management.
- When not in use, store pile-driving equipment away from concentrated flows of stormwater, drainage courses, and inlets. Protect hammers and other hydraulic attachments from runon and runoff by placing them on plywood and covering them with plastic or a comparable material prior to the onset of rain.
- Use less hazardous products, e.g., vegetable oil, when practicable.

Costs

All of the above measures can be low cost.

Inspection and Maintenance

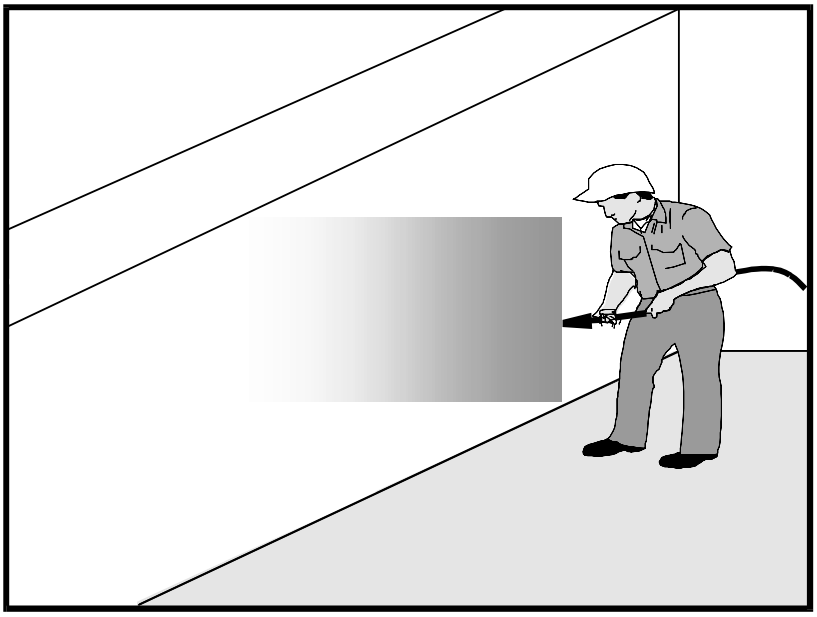
- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspect equipment every day at startup and repair equipment as needed (i.e., worn or damaged hoses, fittings, and gaskets). Recheck equipment at shift changes or at the end of the day and scheduled repairs as needed.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Concrete Curing NS-12



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	☑

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Concrete curing is used in the construction of structures such as bridges, retaining walls, pump houses, large slabs, and structured foundations. Concrete curing includes the use of both chemical and water methods.

Concrete and its associated curing materials have basic chemical properties that can raise the pH of water to levels outside of the permitted range. Discharges of stormwater and non-stormwater exposed to concrete during curing may have a high pH and may contain chemicals, metals, and fines. The General Permit incorporates Numeric Action Levels (NAL) for pH (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements).

Proper procedures and care should be taken when managing concrete curing materials to prevent them from coming into contact with stormwater flows, which could result in a high pH discharge.

Suitable Applications

Suitable applications include all projects where Portland Cement Concrete (PCC) and concrete curing chemicals are placed where they can be exposed to rainfall, runoff from other areas, or where runoff from the PCC will leave the site.

Limitations

- Runoff contact with concrete waste can raise pH levels in the water to environmentally harmful levels and trigger permit violations.

Implementation

Chemical Curing

- Avoid over spray of curing compounds.
- Minimize the drift by applying the curing compound close to the concrete surface. Apply an amount of compound that covers the surface, but does not allow any runoff of the compound.
- Use proper storage and handling techniques for concrete curing compounds. Refer to WM-1, Material Delivery and Storage.
- Protect drain inlets prior to the application of curing compounds.
- Refer to WM-4, Spill Prevention and Control.

Water Curing for Bridge Decks, Retaining Walls, and other Structures

- Direct cure water away from inlets and watercourses to collection areas for evaporation or other means of removal in accordance with all applicable permits. See WM-8 Concrete Waste Management.
- Collect cure water at the top of slopes and transport to a concrete waste management area in a non-erosive manner. See EC-9 Earth Dikes and Drainage Swales, EC-10, Velocity Dissipation Devices, and EC-11, Slope Drains.
- Utilize wet blankets or a similar method that maintains moisture while minimizing the use and possible discharge of water.

Education

- Educate employees, subcontractors, and suppliers on proper concrete curing techniques to prevent contact with discharge as described herein.
- Arrange for the QSP or the appropriately trained contractor's superintendent or representative to oversee and enforce concrete curing procedures.

Costs

All of the above measures are generally low cost.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.

- Sample non-stormwater discharges and stormwater runoff that contacts uncured and partially cured concrete as required by the General Permit.
- Ensure that employees and subcontractors implement appropriate measures for storage, handling, and use of curing compounds.
- Inspect cure containers and spraying equipment for leaks.

References

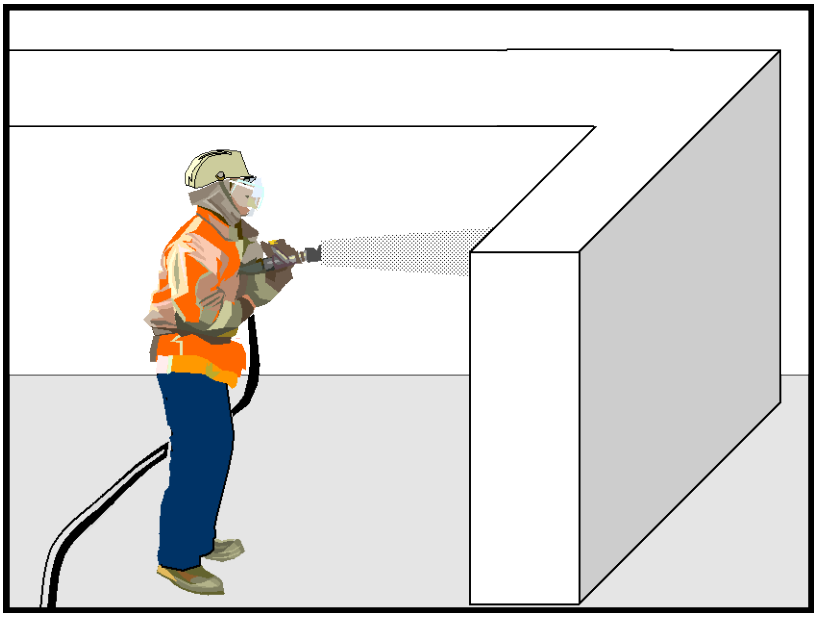
Blue Print for a Clean Bay-Construction-Related Industries: Best Management Practices for Stormwater Pollution Prevention; Santa Clara Valley Non Point Source Pollution Control Program, 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Concrete Finishing NS-13



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	☑
Bacteria	
Oil and Grease	
Organics	☑

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Concrete finishing methods are used for bridge deck rehabilitation, paint removal, curing compound removal, and final surface finish appearances. Methods include sand blasting, shot blasting, grinding, or high pressure water blasting. Stormwater and non-stormwater exposed to concrete finishing by-products may have a high pH and may contain chemicals, metals, and fines. Proper procedures and implementation of appropriate BMPs can minimize the impact that concrete-finishing methods may have on stormwater and non-stormwater discharges.

The General Permit incorporates Numeric Action Levels (NAL) for pH (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements).

Concrete and its associated curing materials have basic chemical properties that can raise pH levels outside of the permitted range. Additional care should be taken when managing these materials to prevent them from coming into contact with stormwater flows, which could lead to exceedances of the General Permit requirements.

Suitable Applications

These procedures apply to all construction locations where concrete finishing operations are performed.

Limitations

- Runoff contact with concrete waste can raise pH levels in the water to environmentally harmful levels and trigger permit violations.

Implementation

- Collect and properly dispose of water from high-pressure water blasting operations.
- Collect contaminated water from blasting operations at the top of slopes. Transport or dispose of contaminated water while using BMPs such as those for erosion control. Refer to EC-9, Earth Dikes and Drainage Swales, EC-10, Velocity Dissipation Devices, and EC-11, Slope Drains.
- Direct water from blasting operations away from inlets and watercourses to collection areas for infiltration or other means of removal (dewatering). Refer to NS-2 Dewatering Operations.
- Protect inlets during sandblasting operations. Refer to SE-10, Storm Drain Inlet Protection.
- Refer to WM-8, Concrete Waste Management for disposal of concrete debris.
- Minimize the drift of dust and blast material as much as possible by keeping the blasting nozzle close to the surface.
- When blast residue contains a potentially hazardous waste, refer to WM-6, Hazardous Waste Management.

Education

- Educate employees, subcontractors, and suppliers on proper concrete finishing techniques to prevent contact with discharge as described herein.
- Arrange for the QSP or the appropriately trained contractor's superintendent or representative to oversee and enforce concrete finishing procedures.

Costs

These measures are generally of low cost.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Sample non-stormwater discharges and stormwater runoff that contacts concrete dust and debris as required by the General Permit.

- Sweep or vacuum up debris from sandblasting at the end of each shift.
- At the end of each work shift, remove and contain liquid and solid waste from containment structures, if any, and from the general work area.
- Inspect containment structures for damage prior to use and prior to onset of forecasted rain.

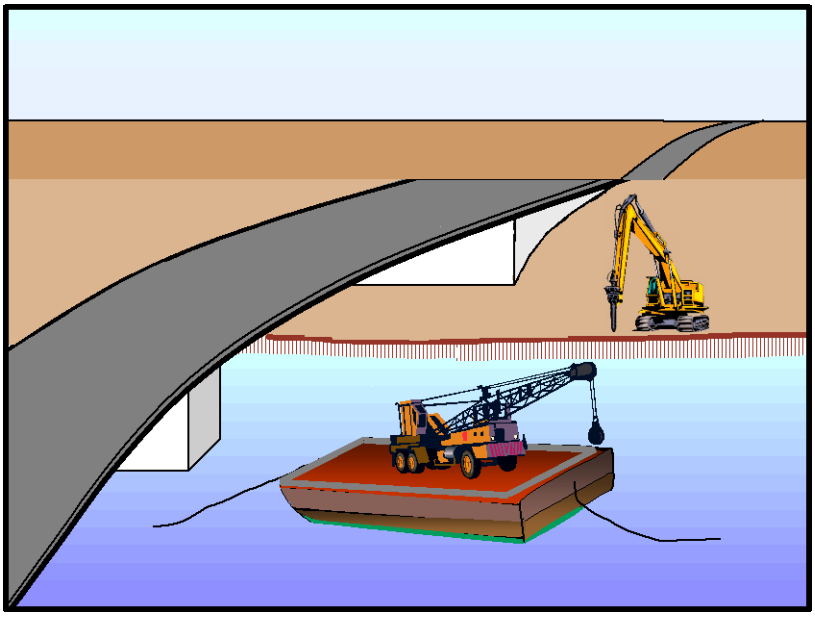
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Material Over Water NS-14



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	☑

Legend:
☑ **Primary Objective**
☒ **Secondary Objective**

Targeted Constituents	
Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Procedures for the proper use, storage, and disposal of materials and equipment on barges, boats, temporary construction pads, or similar locations that minimize or eliminate the discharge of potential pollutants to a watercourse.

Suitable Applications

Applies where materials and equipment are used on barges, boats, docks, and other platforms over or adjacent to a watercourse including waters of the United States. These procedures should be implemented for construction materials and wastes (solid and liquid), soil or dredging materials, or any other materials that may cause or contribute to exceedances of water quality standards.

Limitations

Dredge and fill activities are regulated by the US Army Corps of Engineers and Regional Boards under Section 404/401 of the Clean Water Act.

Implementation

- Refer to WM-1, Material Delivery and Storage and WM-4, Spill Prevention and Control.
- Use drip pans and absorbent materials for equipment and vehicles and ensure that an adequate supply of spill clean up materials is available.
- Drip pans should be placed under all vehicles and equipment placed on docks, barges, or other structures over

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

water bodies when the vehicle or equipment is expected to be idle for more than 1 hour.

- Maintain equipment in accordance with NS-10, Vehicle and Equipment Maintenance. If a leaking line cannot be repaired, remove equipment from over the water.
- Provide watertight curbs or toe boards to contain spills and prevent materials, tools, and debris from leaving the barge, platform, dock, etc.
- Secure all materials to prevent discharges to receiving waters via wind.
- Identify types of spill control measures to be employed, including the storage of such materials and equipment. Ensure that staff is trained regarding the use of the materials, deployment and access of control measures, and reporting measures.
- In case of spills, contact the local Regional Board as soon as possible but within 48 hours.
- Refer to WM-5, Solid Waste Management (non-hazardous) and WM-6, Hazardous Waste Management. Ensure the timely and proper removal of accumulated wastes
- Comply with all necessary permits required for construction within or near the watercourse, such as Regional Water Quality Control Board, U.S. Army Corps of Engineers, Department of Fish and Game or and other local permitting.
- Discharges to waterways should be reported to the Regional Water Quality Control Board immediately upon discovery. A written discharge notification must follow within 7 days. Follow the spill reporting procedures contained in SWPPP.

Costs

These measures are generally of low to moderate cost. Exceptions are areas for temporary storage of materials, engine fluids, or wastewater pump out.

Inspection and Maintenance

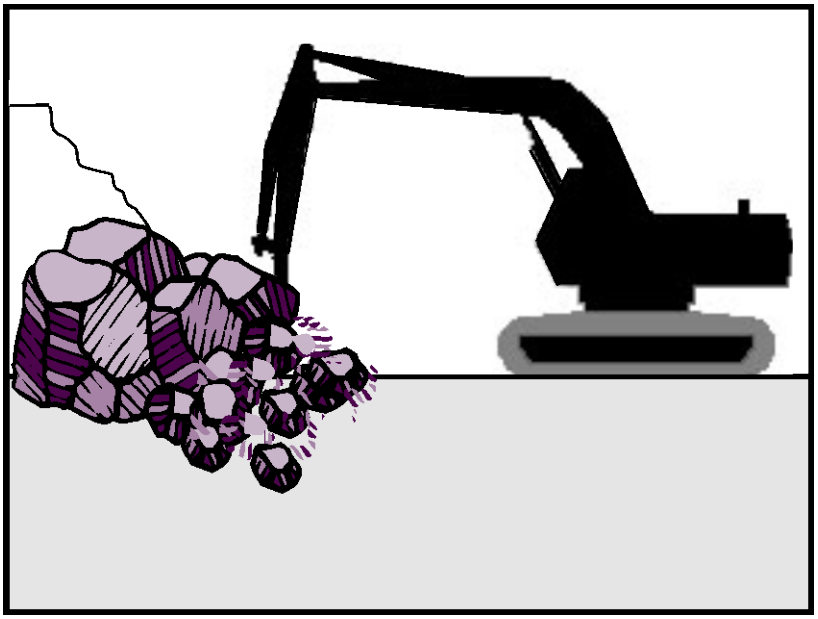
- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.
- Ensure that employees and subcontractors implement the appropriate measures for storage and use of materials and equipment.
- Inspect and maintain all associated BMPs and perimeter controls to ensure continuous protection of the water courses, including waters of the United States.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Demolition Adjacent to Water NS-15



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Objective**
☒ **Secondary Objective**

Targeted Constituents	
Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Procedures to protect water bodies from debris and wastes associated with structure demolition or removal over or adjacent to watercourses.

Suitable Applications

Full bridge demolition and removal, partial bridge removal (barrier rail, edge of deck) associated with bridge widening projects, concrete channel removal, or any other structure removal that could potentially affect water quality.

Limitations

None identified.

Implementation

- Refer to NS-5, Clear Water Diversion, to direct water away from work areas.
- Use attachments on construction equipment such as backhoes to catch debris from small demolition operations.
- Use covers or platforms to collect debris.
- Platforms and covers are to be approved by the owner.
- Stockpile accumulated debris and waste generated during demolition away from watercourses and in accordance with WM-3, Stockpile Management.
- Ensure safe passage of wildlife, as necessary.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION®

- Discharges to waterways shall be reported to the Regional Water Quality Control Board immediately upon discovery. A written discharge notification must follow within 7 days. Follow the spill reporting procedures in the SWPPP.

- For structures containing hazardous materials, i.e., lead paint or asbestos, refer to BMP WM-6, Hazardous Waste Management. For demolition work involving soil excavation around lead-painted structures, refer to WM-7, Contaminated Soil Management.

Costs

Cost may vary according to the combination of practices implemented.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.

- Any debris-catching devices shall be emptied regularly. Collected debris shall be removed and stored away from the watercourse and protected from runon and runoff.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Temporary Batch Plants NS-16



Objectives

EC	Erosion Control	
SE	Sediment Control	
TR	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

Description and Purpose

The construction of roads, bridges, retaining walls, and other large structures in remote areas, often requires temporary batch plant facilities to manufacture Portland Cement Concrete (PCC) or asphalt cement (AC). Temporary batch plant facilities typically consist of silos containing fly ash, lime, and cement; heated tanks of liquid asphalt; sand and gravel material storage areas; mixing equipment; above ground storage tanks containing concrete additives and water; and designated areas for sand and gravel truck unloading, concrete truck loading, and concrete truck washout. Proper control and use of equipment, materials, and waste products from temporary batch plant facilities will reduce the discharge of potential pollutants to the storm drain system or watercourses, reduce air emissions, and mitigate noise impacts.

Suitable Applications

These procedures typically apply to construction sites where temporary batch plant facilities are used.

Limitations

The General Permit for discharges of stormwater associated with industrial activities may be applicable to temporary batch plants.

Specific permit requirements or mitigation measures such as Air Resources Board (ARB), Air Quality Management District (AQMD), Air Pollution Control District (APCD), Regional Water Quality Control Board (RWQCB), county ordinances and city

ordinances may require alternative mitigation measures for temporary batch plants.

Implementation

Planning

Implementation steps are as follows:

- Temporary batch plants may be subject to the General Industrial NPDES permit. To comply with the permit, a Notice of Intent (NOI) must be submitted to the State Water Resource Control Board.
- Proper planning, design, and construction of temporary batch plants should be implemented to minimize potential water quality, air pollution, and noise impacts associated with temporary batch plants.
- BMPs and a Sampling and Analysis Plan (SAP) must be included in the project Stormwater Pollution Prevention Plan (SWPPP). BMPs must be implemented, inspected, and maintained.
- Temporary batch plants should be managed to comply with AQMD Statewide Registration Program and/or local AQMD Portable Equipment Registration requirements.
- Construct temporary batch plants down-wind of existing developments whenever possible.
- Placement of access roads should be planned to mitigate water and air quality impacts.

Layout and Design

- Temporary batch plants should be properly located and designed to mitigate water quality impacts to receiving water bodies. Batch plants should be located away from watercourses, drainage courses, and drain inlets. Batch plants should be located to minimize the potential for stormwater runon onto the site.
- Temporary batch plant facilities (including associated stationary equipment and stockpiles) should be located at least 300 ft from any recreational area, school, residence, or other structure not associated with the construction project.
- Construct continuous interior AC or PCC berms around batch plant equipment (mixing equipment, silos, concrete drop points, conveyor belts, admixture tanks, etc.) to facilitate proper containment and cleanup of releases. Rollover or flip top curb or dikes should be placed at ingress and egress points.
- Direct runoff from the paved or unpaved portion of the batch plant into a sump and pipe to a lined washout area or dewatering tank.
- Direct stormwater and non-stormwater runoff from unpaved portions of batch plant facility to catchment ponds or tanks.
- Construct and remove concrete washout facilities in accordance with WM-8, Concrete Waste Management.

- Layout of a typical batch plant and associated BMP is located at the end of this BMP fact sheet.

Operational Procedures

- Washout of concrete trucks should be conducted in a designated area in accordance with WM-8, Concrete Waste Management.
- Do not dispose of concrete into drain inlets, the stormwater drainage system, or watercourses.
- Equipment washing should occur in a designated area in accordance with WM-8, Concrete Waste Management. Washing equipment, tools, or vehicles to remove PCC shall be conducted in accordance with NS-7, Potable Water/Irrigation, and NS-8, Vehicle and Equipment Cleaning.
- All dry material transfer points should be ducted through a fabric or cartridge type filter unless there are no visible emissions from the transfer point.
- Equip all bulk storage silos, including auxiliary bulk storage trailers, with fabric or cartridge type filter(s).
- Maintain silo vent filters in proper operating condition.
- Equip silos and auxiliary bulk storage trailers with dust-tight service hatches.
- Fabric dust collection system should be capable of controlling 99 percent of the particulate matter.
- Fabric dust collectors (except for vent filters) should be equipped with an operational pressure differential gauge to measure the pressure drop across the filters.
- All transfer points should be equipped with a wet suppression system to control fugitive particulate emissions unless there are no visible emissions.
- All conveyors should be covered, unless the material being transferred results in no visible emissions.
- There should be no visible emissions beyond the property line, while the equipment is being operated.
- Collect dust emissions from the loading of open-bodied trucks at the drip point of dry batch plants, or dust emissions from the drum feed for central mix plants.
- Equip silos and auxiliary bulk storage trailers with a visible and/or audible warning mechanism to warn operators that the silo or trailer is full.
- All open-bodied vehicles transporting material should be loaded with a final layer of wet sand and the truck shall be covered with a tarp to reduce emissions.

NS-16 Temporary Batch Plants

Tracking Control

- Plant roads (batch truck and material delivery truck roads) and areas between stockpiles and conveyor hoppers should be stabilized (TR-2, Stabilized Construction Roadway), watered (WE-1, Wind Erosion Control), treated with dust-suppressant chemicals, or paved with a cohesive hard surface that can be repeatedly swept, maintained intact, and cleaned as necessary to control dust emissions.

- Trucks should not track PCC from plants onto public roads. Use appropriate practices from TR-1, Stabilized Construction Entrance/Exit to prevent tracking.

Materials Storage

- WM-1, Material Delivery and Storage, should be implemented at all batch plants using concrete components or compounds. An effective strategy is to cover and contain materials.

- WM-2, Material Use should be conducted in a way to minimize or eliminate the discharge of materials to storm drain system or watercourse.

- Ensure that finer materials are not dispersed into the air during operations, such as unloading of cement delivery trucks.

- Stockpiles should be covered and enclosed with perimeter sediment barriers per WM-3, Stockpile Management. Uncovered stockpiles should be sprinkled with water and/or dust-suppressant chemicals as necessary to control dust emissions, unless the stockpiled material results in no visible emissions. An operable stockpile watering system should be onsite at all times.

- Store bagged and boxed materials on pallets and cover on non-working days prior to rain.

- Minimize stockpiles of demolished PCC by recycling them in a timely manner.

- Provide secondary containment for liquid materials (WM-1). Containment should provide sufficient volume to contain precipitation from a 25-year storm plus 10% of the aggregate volume of all containers or plus 100% of the largest container, whichever is greater.

- Handle solid and liquid waste in accordance with WM-5, Solid Waste Management, WM-10, Liquid Waste Management, and WM-8, Concrete Waste Management.

- Maintain adequate supplies of spill cleanup materials and train staff to respond to spills per WM-4, Spill Prevention and Control.

- Immediately clean up spilled cement and fly ash and contain or dampen so that dust or emissions from wind erosion or vehicle traffic are minimized.

Equipment Maintenance

- Equipment should be maintained to prevent fluid leaks and spills per NS-9, Vehicle and Equipment Fueling, and NS-10, Vehicle and Equipment Maintenance.

- Maintain adequate supplies of spill cleanup materials and train staff to respond to spills per WM-4, Spill Prevention and Control.

- Incorporate other BMPs such as WM-5, Solid Waste Management, WM-6, Hazardous Waste Management, and WM-10, Liquid Waste Management.

Costs

Costs will vary depending on the size of the facility and combination of BMPs implemented.

Inspection and Maintenance

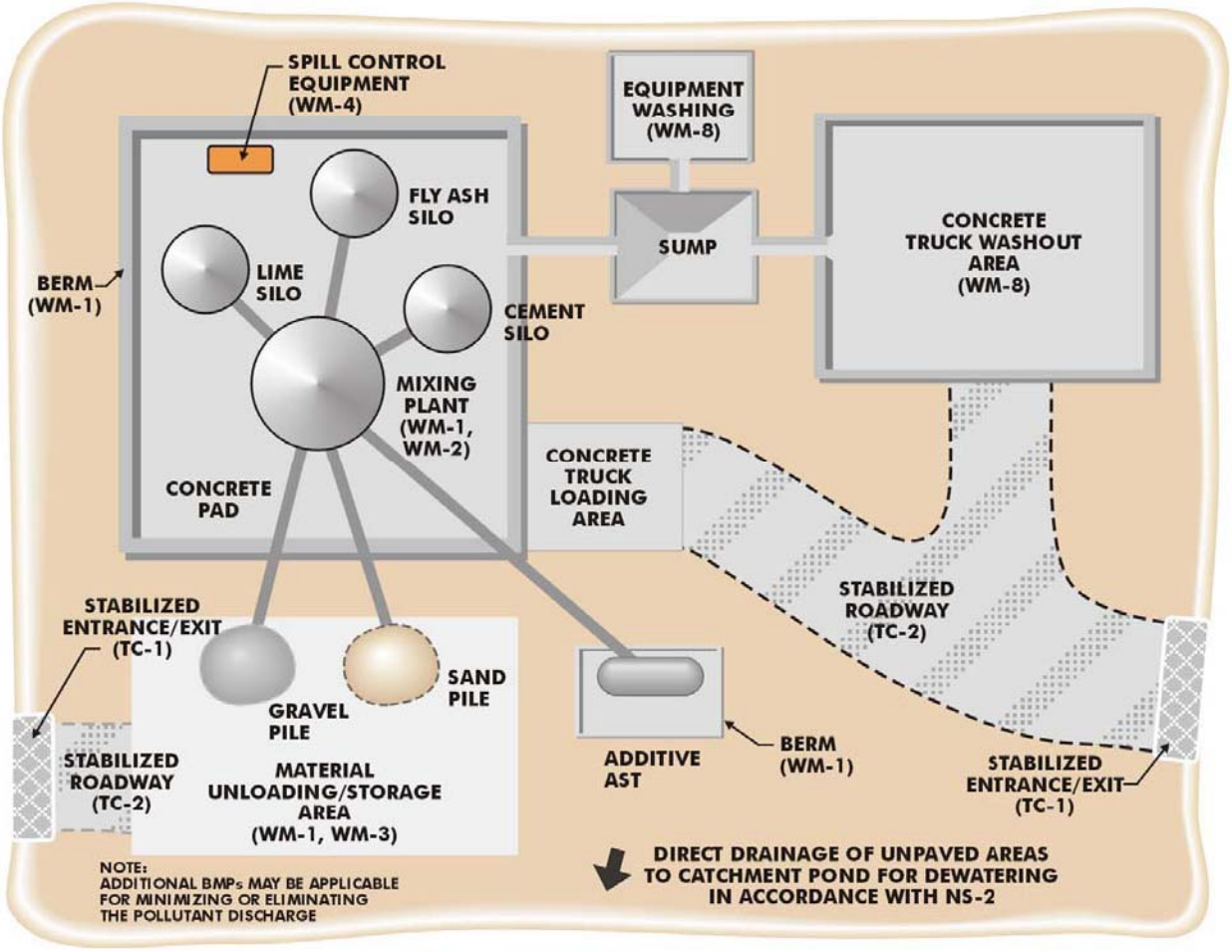
- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.
- Inspect and repair equipment (for damaged hoses, fittings, and gaskets).
- Inspect and maintain Stabilized Construction Entrance/Exit (TR-1) as needed.
- Inspect and maintain stabilized haul roads as needed.
- Inspect and maintain materials and waste storage areas as needed.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

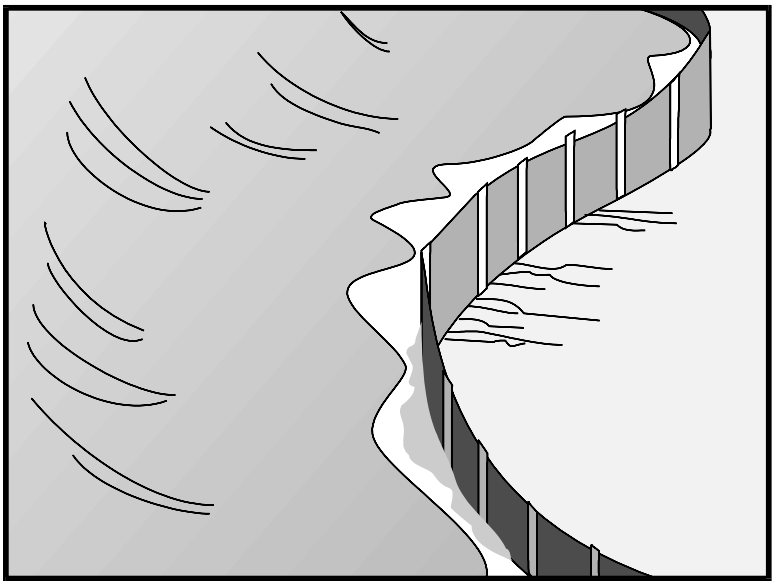
Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

NS-16 Temporary Batch Plants



Typical Temporary Batch

Silt Fence SE-1



Categories

EC	Erosion Control	
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Description and Purpose

A silt fence is made of a woven geotextile that has been entrenched, attached to supporting poles, and sometimes backed by a plastic or wire mesh for support. The silt fence detains water, promoting sedimentation of coarse sediment behind the fence. Silt fence does not retain soil fine particles like clays or silts.

Suitable Applications

Silt fences are suitable for perimeter control, placed below areas where sheet flows discharge from the site. They could also be used as interior controls below disturbed areas where runoff may occur in the form of sheet and rill erosion and around inlets within disturbed areas (SE-10). Silt fences should not be used in locations where the flow is concentrated. Silt fences should always be used in combination with erosion controls. Suitable applications include:

- At perimeter of a project.
- Below the toe or down slope of exposed and erodible slopes.
- Along streams and channels.
- Around temporary spoil areas and stockpiles.
- Around inlets.
- Below other small cleared areas.

Targeted Constituents

Sediment (coarse sediment)	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm SE-12 Manufactured Linear Sediment Controls

SE-13 Compost Socks and Berms

SE-14 Biofilter Bags

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Limitations

- Do not use in streams, channels, drain inlets, or anywhere flow is concentrated.
- Do not use in locations where ponded water may cause a flooding hazard.
- Do not use silt fence to divert water flows or place across any contour line.
- Improperly installed fences are subject to failure from undercutting, overtopping, or collapsing.
- Must be trenched and keyed in.
- Not intended for use as a substitute for Fiber Rolls (SE-5), when fiber rolls are being used as a slope interruption device.
- Do not use on slopes subject to creeping, slumping, or landslides.

Implementation

General

A silt fence is a temporary sediment barrier consisting of woven geotextile stretched across and attached to supporting posts, trenched-in, and, depending upon the strength of fabric used, supported with plastic or wire mesh fence. Silt fences trap coarse sediment by intercepting and detaining sediment-laden runoff from disturbed areas in order to promote sedimentation behind the fence.

The following layout and installation guidance can improve performance and should be followed:

- Silt fence should be used in combination with erosion controls up-slope in order to provide the most effective sediment control.
- Silt fence alone is not effective at reducing turbidity. (Barrett and Malina, 2004)
- Designers should consider diverting sediment laden water to a temporary sediment basin or trap. (EPA, 2012)
- Use principally in areas where sheet flow occurs.
- Install along a level contour, so water does not pond more than 1.5 ft at any point along the silt fence.
- Provide sufficient room for runoff to pond behind the fence and to allow sediment removal equipment to pass between the silt fence and toes of slopes or other obstructions. About 1200 ft^2 of ponding area should be provided for every acre draining to the fence.
- Efficiency of silt fences is primarily dependent on the detention time of the runoff behind the control. (Barrett and Malina, 2004)
- The drainage area above any fence should not exceed a quarter of an acre. (Rule of Thumb-100-feet of silt fence per 10,000 square feet of disturbed area.) (EPA 2012)

- The maximum length of slope draining to any point along the silt fence should be 100 ft per foot of silt fence.
- Turn the ends of the filter fence uphill to prevent stormwater from flowing around the fence.
- Leave an undisturbed or stabilized area immediately down slope from the fence where feasible.
- Silt fences should remain in place until the disturbed area draining to the silt fence is permanently stabilized, after which, the silt fence fabric and posts should be removed and properly disposed.
- J-Hooks, which have ends turning up the slope to break up long runs of fence and provide multiple storage areas that work like mini-retention areas, may be used to increase the effectiveness of silt fence.
- Be aware of local regulations regarding the type and installation requirements of silt fence, which may differ from those presented in this fact sheet.

Design and Layout

In areas where high winds are anticipated the fence should be supported by a plastic or wire mesh. The geotextile fabric of the silt fence should contain ultraviolet inhibitors and stabilizers to provide longevity equivalent to the project life or replacement schedule.

- Layout in accordance with the attached figures.
- For slopes that contain a high number of rocks or large dirt clods that tend to dislodge, it may be necessary to protect silt fence from rocks (e.g., rockfall netting) ensure the integrity of the silt fence installation.

Standard vs. Heavy Duty Silt Fence

Standard Silt Fence

- Generally applicable in cases where the area draining to fence produces moderate sediment loads.

Heavy Duty Silt Fence

- Heavy duty silt fence usually has 1 or more of the following characteristics, not possessed by standard silt fence.
  - Fabric is reinforced with wire backing or additional support.
  - Posts are spaced closer than pre-manufactured, standard silt fence products.
- Use is generally limited to areas affected by high winds.
- Area draining to fence produces moderate sediment loads.

Materials

Standard Silt Fence

- Silt fence material should be woven geotextile with a minimum width of 36 in. The fabric should conform to the requirements in ASTM designation D6461.
- Wooden stakes should be commercial quality lumber of the size and shape shown on the plans. Each stake should be free from decay, splits or cracks longer than the

thickness of the stake or other defects that would weaken the stakes and cause the stakes to be structurally unsuitable.

- Staples used to fasten the fence fabric to the stakes should be not less than 1.75 in. long and should be fabricated from 15 gauge or heavier wire. The wire used to fasten the tops of the stakes together when joining two sections of fence should be 9 gauge or heavier wire. Galvanizing of the fastening wire will not be required.

Heavy-Duty Silt Fence

- Some silt fence has a wire backing to provide additional support, and there are products that may use prefabricated plastic holders for the silt fence and use metal posts instead of wood stakes.

Installation Guidelines – Traditional Method

Silt fences are to be constructed on a level contour. Sufficient area should exist behind the fence for ponding to occur without flooding or overtopping the fence.

- A trench should be excavated approximately 6 in. wide and 6 in. deep along the line of the proposed silt fence (trenches should not be excavated wider or deeper than necessary for proper silt fence installation).
- Bottom of the silt fence should be keyed-in a minimum of 12 in.
- Posts should be spaced a maximum of 6 ft apart and driven securely into the ground a minimum of 18 in. or 12 in. below the bottom of the trench.
- When standard strength geotextile is used, a plastic or wire mesh support fence should be fastened securely to the upslope side of posts using heavy–duty wire staples at least 1 in. long. The mesh should extend into the trench.
- When extra-strength geotextile and closer post spacing are used, the mesh support fence may be eliminated.
- Woven geotextile should be purchased in a long roll, then cut to the length of the barrier. When joints are necessary, geotextile should be spliced together only at a support post, with a minimum 6 in. overlap and both ends securely fastened to the post.
- The trench should be backfilled with native material and compacted.
- Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/3 the height of the barrier; in no case should the reach exceed 500 ft.
- Cross barriers should be a minimum of 1/3 and a maximum of ½ the height of the linear barrier.
- See typical installation details at the end of this fact sheet.

Installation Guidelines - Static Slicing Method

- Static Slicing is defined as insertion of a narrow blade pulled behind a tractor, similar to a plow blade, at least 10 inches into the soil while at the same time pulling silt geotextile fabric into the ground through the opening created by the blade to the depth of the blade. Once the geotextile is installed, the soil is compacted using tractor tires.
- This method will not work with pre-fabricated, wire backed silt fence.
- Benefits:
    - Ease of installation (most often done with a 2 person crew).
    - Minimal soil disturbance.
    - Better level of compaction along fence, less susceptible to undercutting
    - Uniform installation.
- Limitations:
    - Does not work in shallow or rocky soils.
    - Complete removal of geotextile material after use is difficult.
    - Be cautious when digging near potential underground utilities.

Costs

- It should be noted that costs vary greatly across regions due to available supplies and labor costs.
- Average annual cost for installation using the traditional silt fence installation method (assumes 6 month useful life) is $7 per linear foot based on vendor research. Range of cost is $3.50 - $9.10 per linear foot.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Repair undercut silt fences.
- Repair or replace split, torn, slumping, or weathered fabric. The lifespan of silt fence fabric is generally 5 to 8 months.
- Silt fences that are damaged and become unsuitable for the intended purpose should be removed from the site of work, disposed, and replaced with new silt fence barriers.
- Sediment that accumulates in the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches 1/3 of the barrier height.
- Silt fences should be left in place until the upgradient area is permanently stabilized. Until then, the silt fence should be inspected and maintained regularly.

- Remove silt fence when upgradient areas are stabilized. Fill and compact post holes and anchor trench, remove sediment accumulation, grade fence alignment to blend with adjacent ground, and stabilize disturbed area.

References

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Monitoring Data on Effectiveness of Sediment Control Techniques, Proceedings of World Water and Environmental Resources Congress, Barrett M. and Malina J. 2004.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group-Working Paper, USEPA, April 1992.

Sedimentation and Erosion Control Practices, and Inventory of Current Practices (Draft), USEPA, 1990.

Southeastern Wisconsin Regional Planning Commission (SWRPC). Costs of Urban Nonpoint Source Water Pollution Control Measures. Technical Report No. 31. Southeastern Wisconsin Regional Planning Commission, Waukesha, WI. 1991.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management Manual for The Puget Sound Basin, Washington State Department of Ecology, Public Review Draft, 1991.

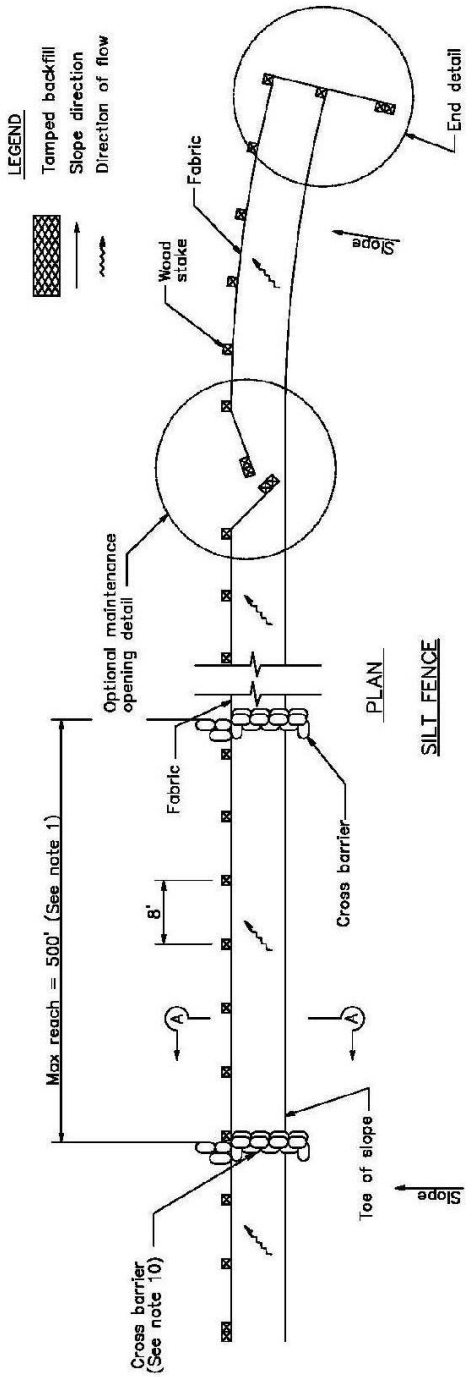
U.S. Environmental Protection Agency (USEPA). Stormwater Best Management Practices: Silt Fences. U.S. Environmental Protection Agency, Office of Water, Washington, DC, 2012.

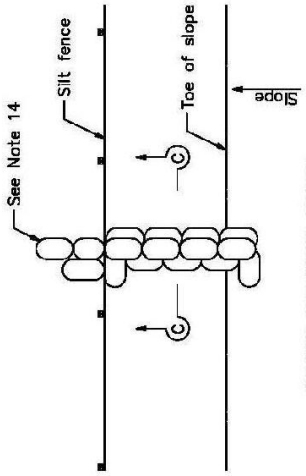
U.S. Environmental Protection Agency (USEPA). Stormwater Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices. U.S. Environmental Protection Agency, Office of Water, Washington, DC, 1992.

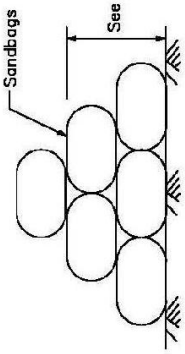
Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Soil Stabilization BMP Research for Erosion and Sediment Controls: Cost Survey Technical Memorandum, State of California Department of Transportation (Caltrans), July 2007.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

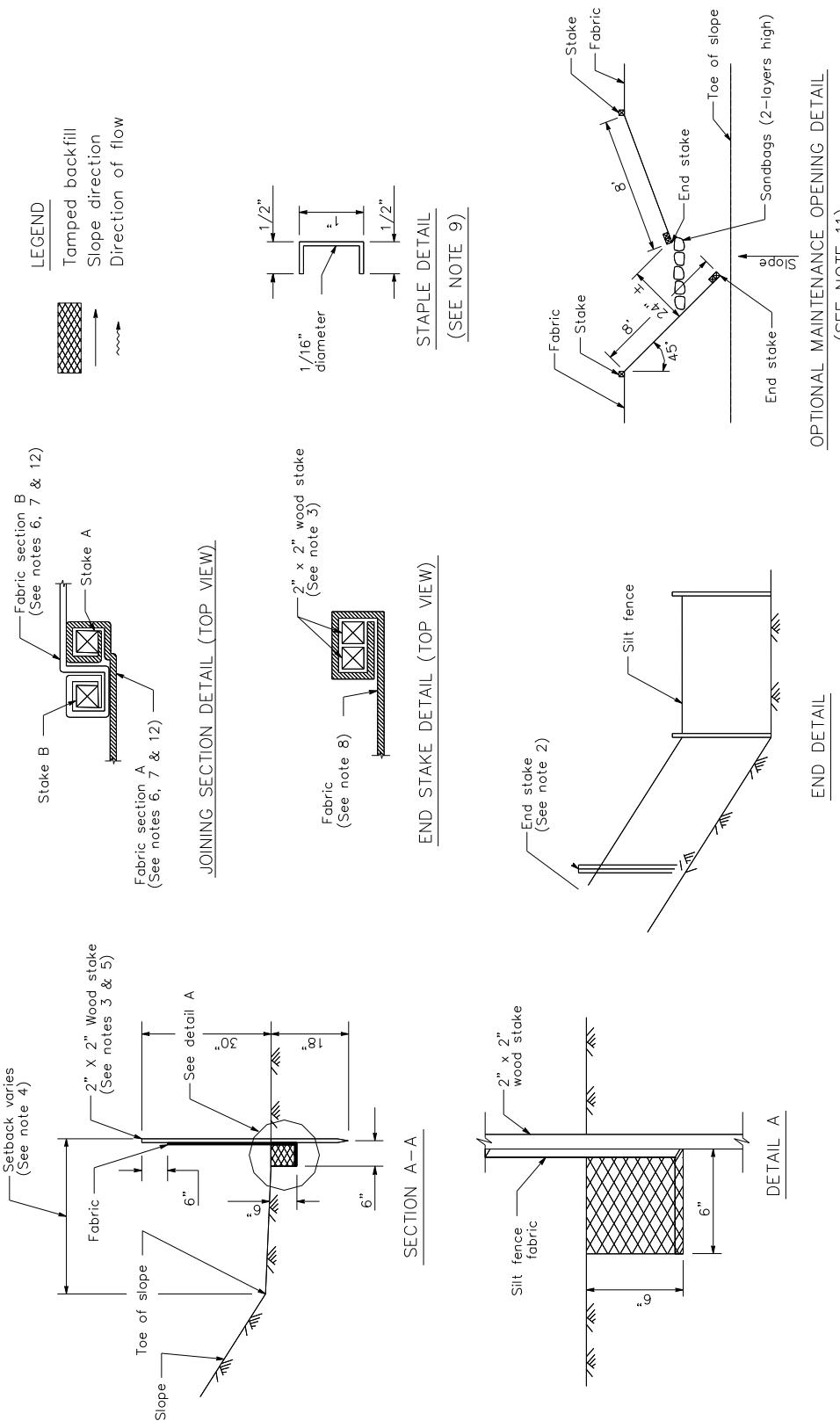


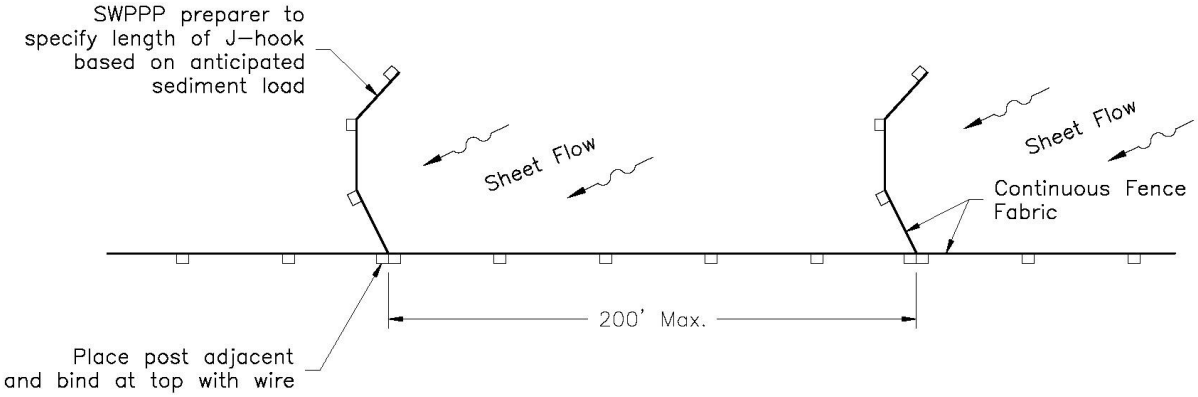




NOTES

1. Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/3 the height of the linear barrier, in no case shall the reach length exceed 500'.
2. The last 8'–0" of fence shall be turned up slope.
3. Stake dimensions are nominal.
4. Dimension may vary to fit field condition.
5. Stakes shall be spaced at 8'–0" maximum and shall be positioned on downstream side of fence.
6. Stakes to overlap and fence fabric to fold around each stake one full turn. Secure fabric to stake with 4 staples.
7. Stakes shall be driven tightly together to prevent potential flow–through of sediment at joint. The tops of the stakes shall be secured with wire.
8. For end stake, fence fabric shall be folded around two stakes one full turn and secured with 4 staples.
9. Minimum 4 staples per stake. Dimensions shown are typical.
10. Cross barriers shall be a minimum of 1/3 and a maximum of 1/2 the height of the linear barrier.
11. Maintenance openings shall be constructed in a manner to ensure sediment remains behind silt fence.
12. Joining sections shall not be placed at sump locations.
13. Sandbag rows and layers shall be offset to eliminate gaps.
14. Add 3–4 bags to cross barrier on downgradient side of silt fence as needed to prevent bypass or undermining and as allowable based on site limits of disturbance.

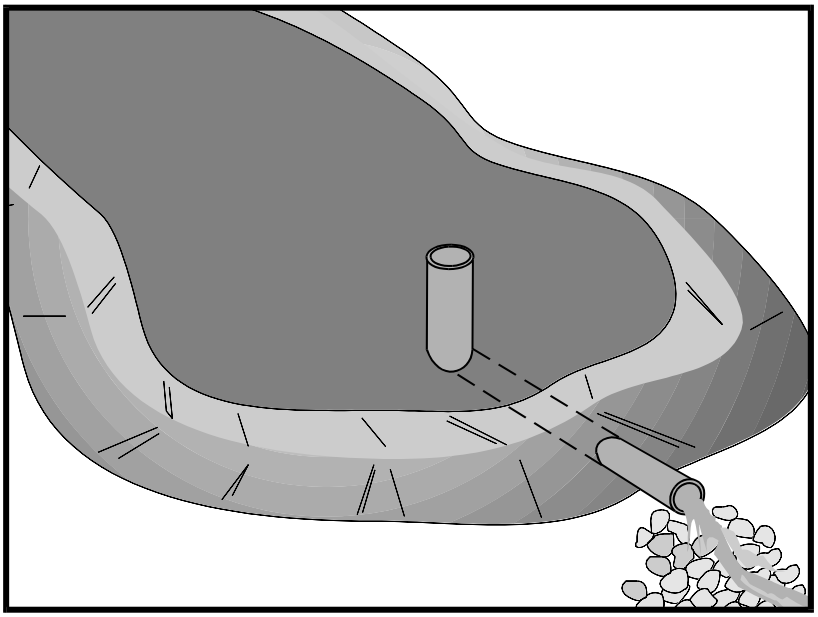

LEGEND
Tamped backfill
Slope direction
Direction of flow
1/2"
1"
1/2"
1/16" diameter
STAPLE DETAIL
(SEE NOTE 9)
Stake
Fabric
Toe of slope
8'
End stake
Sandbags (2-layers high)
Slope
4'
2'
8'
45°
Fabric
Stake
End stake
OPTIONAL MAINTENANCE OPENING DETAIL
(SEE NOTE 11)
Fabric section B
(See notes 6, 7 & 12)
Stake A
Stake B
Fabric section A
(See notes 6, 7 & 12)
JOINING SECTION DETAIL (TOP VIEW)
2" x 2" wood stake
(See note 3)
Fabric
(See note 8)
END STAKE DETAIL (TOP VIEW)
Silt fence
End stake
(See note 2)
END DETAIL
Setback varies
(See note 4)
2" X 2" Wood stake
(See notes 3 & 5)
See detail A
30"
18"
Fabric
6"
6"
6"
Toe of slope
Slope
SECTION A-A
2" x 2"
wood stake
Silt fence
fabric
6"
6"
DETAIL A


SWPPP preparer to specify length of J–hook based on anticipated sediment load
Sheet Flow
Sheet Flow
Continuous Fence Fabric
200' Max.
Place post adjacent and bind at top with wire

Plan

J–HOOK

Sediment Basin SE-2



Categories

EC	Erosion Control	
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☑
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-3 Sediment Trap (for smaller areas)

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

A sediment basin is a temporary basin formed by excavation or by constructing an embankment so that sediment-laden runoff is temporarily detained under quiescent conditions, allowing sediment to settle out before the runoff is released.

Sediment basin design guidance presented in this fact sheet is intended to provide options, methods, and techniques to optimize temporary sediment basin performance and basin sediment removal. Basin design guidance provided in this fact sheet is not intended to guarantee basin effluent compliance with numeric discharge limits (numeric action levels or numeric effluent limits for turbidity). Compliance with discharge limits requires a thoughtful approach to comprehensive BMP planning, implementation, and maintenance. Therefore, optimally designed and maintained sediment basins should be used in conjunction with a comprehensive system of BMPs that includes:

- Diverting runoff from undisturbed areas away from the basin
- Erosion control practices to minimize disturbed areas on-site and to provide temporary stabilization and interim sediment controls (e.g., stockpile perimeter control, check dams, perimeter controls around individual lots) to reduce the basin's influent sediment concentration.

At some sites, sediment basin design enhancements may be required to adequately remove sediment. Traditional

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION®

(a.k.a. "physical") enhancements such as alternative outlet configurations or flow deflection baffles increase detention time and other techniques such as outlet skimmers preferentially drain flows with lower sediment concentrations. These "physical" enhancement techniques are described in this fact sheet. To further enhance sediment removal particularly at sites with fine soils or turbidity sensitive receiving waters, some projects may need to consider implementing Active Treatment Systems (ATS) whereby coagulants and flocculants are used to enhance settling and removal of suspended sediments. Guidance on implementing ATS is provided in SE-11.

Suitable Applications

Sediment basins may be suitable for use on larger projects with sufficient space for constructing the basin. Sediment basins should be considered for use:

- Where sediment-laden water may enter the drainage system or watercourses
- On construction projects with disturbed areas during the rainy season
- At the outlet of disturbed watersheds between 5 acres and 75 acres and evaluated on a site by site basis
- Where post construction detention basins are required
- In association with dikes, temporary channels, and pipes used to convey runoff from disturbed areas

Limitations

Sediment basins must be installed only within the property limits and where failure of the structure will not result in loss of life, damage to homes or buildings, or interruption of use or service of public roads or utilities. In addition, sediment basins are attractive to children and can be very dangerous. Local ordinances regarding health and safety must be adhered to. If fencing of the basin is required, the type of fence and its location should be shown in the SWPPP and in the construction specifications.

- As a general guideline, sediment basins are suitable for drainage areas of 5 acres or more, but not appropriate for drainage areas greater than 75 acres. However, the tributary area should be evaluated on a site by site basis.
- Sediment basins may become an "attractive nuisance" and care must be taken to adhere to all safety practices. If safety is a concern, basin may require protective fencing.
- Sediment basins designed according to this fact sheet are only effective in removing sediment down to about the silt size fraction. Sediment-laden runoff with smaller size fractions (fine silt and clay) may not be adequately treated unless chemical (or other appropriate method) treatment is used in addition to the sediment basin.
- Basins with a height of 25 ft or more or an impounding capacity of 50 ac-ft or more must obtain approval from California Department of Water Resources Division of Safety of Dams (http://www.water.ca.gov/damsafety/).

- Water that stands in sediment basins longer than 96 hours may become a source of mosquitoes (and midges), particularly along perimeter edges, in shallow zones, in scour or below-grade pools, around inlet pipes, along low-flow channels, and among protected habitats created by emergent or floating vegetation (e.g. cattails, water hyacinth), algal mats, riprap, etc.
- Basins require large surface areas to permit settling of sediment. Size may be limited by the available area.

Implementation

General

A sediment basin is a controlled stormwater release structure formed by excavation or by construction of an embankment of compacted soil across a drainage way, or other suitable location. It is intended to trap sediment before it leaves the construction site. The basin is a temporary measure expected to be used during active construction in most cases and is to be maintained until the site area is permanently protected against erosion or a permanent detention basin is constructed.

Sediment basins are suitable for nearly all types of construction projects. Whenever possible, construct the sediment basins before clearing and grading work begins. Basins should be located at the stormwater outlet from the site but not in any natural or undisturbed stream. A typical application would include temporary dikes, pipes, and/or channels to convey runoff to the basin inlet.

Many development projects in California are required by local ordinances to provide a stormwater detention basin for post-construction flood control, desilting, or stormwater pollution control. A temporary sediment basin may be constructed by rough grading the post-construction control basins early in the project.

Sediment basins if properly designed and maintained can trap a significant amount of the sediment that flows into them. However, traditional basins do not remove all inflowing sediment. Therefore, they should be used in conjunction with erosion control practices such as temporary seeding, mulching, diversion dikes, etc., to reduce the amount of sediment flowing into the basin.

Planning

To improve the effectiveness of the basin, it should be located to intercept runoff from the largest possible amount of disturbed area. Locations best suited for a sediment basin are generally in lower elevation areas of the site (or basin tributary area) where site drainage would not require significant diversion or other means to direct water to the basin but outside jurisdictional waterways. However, as necessary, drainage into the basin can be improved by the use of earth dikes and drainage swales (see BMP EC-9). . The basin should not be located where its failure would result in the loss of life or interruption of the use or service of public utilities or roads.

Construct before clearing and grading work begins when feasible.

- Do not locate the basin in a jurisdictional stream.

- Basin sites should be located where failure of the structure will not cause loss of life, damage to homes or buildings, or interruption of use or service of public roads or utilities.
- Basins with a height of 25 ft or more or an impounding capacity of 50 ac-ft must obtain approval from the Division of Dam Safety. Local dam safety requirements may be more stringent.
- Limit the contributing area to the sediment basin to only the runoff from the disturbed soil areas. Use temporary concentrated flow conveyance controls to divert runoff from undisturbed areas away from the sediment basin.
- The basin should be located: (1) by excavating a suitable area or where a low embankment can be constructed across a swale, (2) where post-construction (permanent) detention basins will be constructed, and (3) where the basins can be maintained on a year-round basis to provide access for maintenance, including sediment removal and sediment stockpiling in a protected area, and to maintain the basin to provide the required capacity.

Design

When designing a sediment basin, designers should evaluate the site constraints that could affect the efficiency of the BMP. Some of these constraints include: the relationship between basin capacity, anticipated sediment load, and freeboard, available footprint for the basin, maintenance frequency and access, and hydraulic capacity and efficiency of the temporary outlet infrastructure. Sediment basins should be designed to maximize sediment removal and to consider sediment load retained by the basin as it affects basin performance.

Three Basin Design Options (Part A) are presented below along with a Typical Sediment/Detention Basin Design Methodology (Part B). Regardless of the design option that is selected, designers also need to evaluate the sediment basin capacity with respect to sediment accumulation (See "*Step 3. Evaluate the Capacity of the Sediment Basin"),* and should incorporate approaches identified in "*Step 4. Other Design Considerations*" to enhance basin performance.

A) Basin Design Options:

Option 1:

Design sediment basin(s) using the standard equation:

$$A_s = \frac{1.2Q}{V_s} \qquad \text{(Eq. 1)}$$

Where:

A_s = Minimum surface area for trapping soil particles of a certain size

V_s = Settling velocity of the design particle size chosen (V_s = 0.00028 ft/s for a design particle size of 0.01 mm at 68°F)

1.2 = Factor of safety recommended by USEPA to account for the reduction in basin efficiency caused due to turbulence and other non ideal conditions.

$Q = CIA$ (Eq.2)

Where

Q = Peak basin influent flow rate measured in cubic feet per second (ft^3/s)

C = Runoff coefficient (unitless)

I = Peak rainfall intensity for the 10-year, 6-hour rain event (in/hr)

A = Area draining into the sediment basin in acres

The design particle size should be the smallest soil grain size determined by wet sieve analysis, or the fine silt sized (0.01 mm [or 0.0004 in.]) particle, and the Vs used should be 100 percent of the calculated settling velocity.

This sizing basin method is dependent on the outlet structure design or the total basin length with an appropriate outlet. If the designer chooses to utilize the outlet structure to control the flow duration in the basin, the basin length (distance between the inlet and the outlet) should be a minimum of twice the basin width; the depth should not be less than 3 ft nor greater than 5 ft for safety reasons and for maximum efficiency (2 ft of sediment storage, 2 ft of capacity). If the designer chooses to utilize the basin length (with appropriate basin outlet) to control the flow duration in the basin, the basin length (distance between the inlet and the outlet) should be a specifically designed to capture 100% of the design particle size; the depth should not be less than 3 ft nor greater than 5 ft for safety reasons and for maximum efficiency (2 ft of sediment storage, 2 ft of capacity).

Basin design guidance provided herein assumes standard water properties (e.g., estimated average water temperature, kinematic viscosity, etc.) as a basis of the design. Designers can use an alternative design (Option 3) with site specific water properties as long as the design is as protective as Option 1.

The design guidance uses the peak influent flow rate to size sediment basins. Designers can use an alternative design (Option 3) with site specific average flow rates as long as the design is as protective as Option 1.

The basin should be located on the site where it can be maintained on a year-round basis and should be maintained on a schedule to retain the 2 ft of capacity.

Option 2:

Design pursuant to local ordinance for sediment basin design and maintenance, provided that the design efficiency is as protective or more protective of water quality than Option 1.

Option 3:

The use of an equivalent surface area design or equation provided that the design efficiency is as protective or more protective of water quality than Option 1.

B) Typical Sediment/Detention Basin Design Methodology:

Design of a sediment basin requires the designer to have an understanding of the site constraints, knowledge of the local soil (e.g., particle size distribution of potentially contributing soils), drainage area of the basin, and local hydrology. Designers should not assume that a sediment basin for location A is applicable to location B. Therefore, designers can use this factsheet as guidance but will need to apply professional judgment and knowledge of the site to design an effective and efficient sediment basin. The following provides a general overview of typical design methodologies:

Step 1. Hydrologic Design

- Evaluate the site constraints and assess the drainage area for the sediment basin. Designers should consider on- and off-site flows as well as changes in the drainage area associated with site construction/disturbance. To minimize additional construction during the course of the project, the designer should consider identifying the maximum drainage area when calculating the basin dimensions.

- If a local hydrology manual is not available it is recommended to follow standard rational method procedures to estimate the flow rate. The references section of this factsheet provides a reference to standard hydrology textbooks that can provide standard methodologies. If local rainfall depths are not available, values can be obtained from standard precipitation frequency maps from NOAA (downloaded from http://www.wrcc.dri.edu/pcpnfreq.html).

Step 2. Hydraulic Design

- Calculate the surface area required for the sediment basin using Equation 1. In which the flow rate is estimated for a 10-yr 6-hr event using rational method procedure listed in local hydrology manual and Vs is estimated using Stokes Law presented in Equation 3.

$$V_s = 2.81d^2 \qquad \text{(Eq.3)}$$

Where

V_s = Settling velocity in feet per second at 68˚F

d = diameter of sediment particle in millimeters (smallest soil grain size determined by wet sieve analysis or fine silt (0.01 mm [or 0.0004 in.])

- In general the basin outlet design requires an iterative trial and error approach that considered the maximum water surface elevation, the elevation versus volume (stage-storage) relationship, the elevation verses basin outflow (a.k.a.-discharge) relationship, and the estimated inflow hydrograph. To adequately design the basins to settle sediment, the outlet configuration and associated outflow rates can be estimated by numerous methodologies. The following provides some guidance for design the basin outlet:

  - An outlet should have more than one orifice.

  - An outlet design typically utilizes multiple horizontal rows of orifices (approximately 3 or more) with at least 2 orifices per row (see Figures 1 and 2 at the end of this fact sheet).

- Orifices can vary in shape.
- Select the appropriate orifice diameter and number of perforations per row with the objective of minimizing the number of rows while maximizing the detention time.
- The diameter of each orifice is typically a maximum of 3-4 inches and a minimum of 0.25-0.5 inches.
- If a rectangular orifice is used, it is recommended to have minimum height of 0.5 inches and a maximum height of 6 inches.
- Rows are typically spaced at three times the diameter center to center vertically with a minimum distance of approximately 4 inches on center and a maximum distance of 1 foot on center.
- To estimate the outflow rate, each row is calculated separately based on the flow through a single orifice then multiplied by the number of orifices in the row. This step is repeated for each of the rows. Once all of the orifices are estimated, the total outflow rate versus elevation (stage-discharge curve) is developed to evaluate the detention time within the basin.
- Flow through a single orifice can be estimated using an Equation 4:

$$Q = BC' A(2gH)^{0.5} \qquad \text{(Eq.4)}$$

Where
Q = Outflow rate in ft^3/s
C′ = Orifice coefficient (unitless)
A = Area of the orifice (ft^2)
g = acceleration due to gravity (ft^3/s)
H = Head above the orifice (ft)
B = Anticipated Blockage or clogging factor (unitless), It is dependent on anticipated sediment and debris load, trash rack configuration etc, so the value is dependent on design engineers professional judgment and/or local requirements (B is never greater than 1 and a value of 0.5 is generally used)

- Care must be taken in the selection of orifice coefficient ("C′"); 0.60 is most often recommended and used. However, based on actual tests, Young and Graziano (1989), "Outlet Hydraulics of Extended Detention Facilities for Northern Virginia Planning District Commission", recommends the following:
  - C′ = 0.66 for thin materials; where the thickness is equal to or less than the orifice diameter, or
  - C′ = 0.80 when the material is thicker than the orifice diameter
- If different sizes of orifices are used along the riser then they have to be sized such that not more than 50 percent of the design storm event drains in one-third of the drawdown time (to provide adequate settling time for events smaller than the design storm event)

and the entire volume drains within 96 hours or as regulated by the local vector control agency. If a basin fails to drain within 96 hours, the basin must be pumped dry.

- Because basins are not maintained for infiltration, water loss by infiltration should be disregarded when designing the hydraulic capacity of the outlet structure.

- Floating Outlet Skimmer: The floating skimmer (see Figure 3 at the end of this fact sheet is an alternative outlet configuration (patented) that drains water from upper portion of the water column. This configuration has been used for temporary and permanent basins and can improve basin performance by eliminating bottom orifices which have the potential of discharging solids. Some design considerations for this alternative outlet device includes the addition of a sand filter or perforated under drain at the low point in the basin and near the floating skimmer. These secondary drains allow the basin to fully drain. More detailed guidelines for sizing the skimmer can be downloaded from http://www.fairclothskimmer.com/.

- Hold and Release Valve: An ideal sediment/detention basin would hold all flows to the design storm level for sufficient time to settle solids, and then slowly release the storm water. Implementing a reliable valve system for releasing detention basins is critical to eliminate the potential for flooding in such a system. Some variations of hold and release valves include manual valves, bladder devices or electrically operated valves. When a precipitation event is forecast, the valve would be close for the duration of the storm and appropriate settling time. When the settling duration is met (approximately 24 or 48 hours), the valve would be opened and allow the stormwater to be released at a rate that does not resuspend settled solids and in a non-erosive manner. If this type of system is used the valve should be designed to empty the entire basin within 96 hours or as stipulated by local vector control regulations.

Step 3. Evaluate the Capacity of the Sediment Basin

- Typically, sediment basins do not perform as designed when they are not properly maintained or the sediment yield to the basin is larger than expected. As part of a good sediment basin design, designers should consider maintenance cycles, estimated soil loss and/or sediment yield, and basin sediment storage volume. The two equations below can be used to quantify the amount of soil entering the basin.

- The Revised Universal Soil Loss Equation (RUSLE, Eq.5) can be used to estimate annual soil loss and the Modified Universal Soil Equation (MUSLE, Eq.6) can be used to estimate sediment yield from a single storm event.

$$A = R \times K \times LS \times C \times P \qquad \text{(Eq.5)}$$

$$Y = 95 \times q_p^{0.56} \times K \times LS \times C \times P \qquad \text{(Eq.6)}$$

Where:

A = annual soil loss, tons/acre-year

R = rainfall erosion index, in 100 ft.tons/acre.in/hr

K = soil erodibility factor, tons/acre per unit of R

LS = slope length and steepness factor (unitless)

C = vegetative cover factor (unitless)

P = erosion control practice factor (unitless)

Y = single storm sediment yield in tons

Q = runoff volume in acre-feet

q_p = peak flow in cfs

- Detailed descriptions and methodologies for estimating the soil loss can be obtained from standard hydrology text books (See References section).
- Determination of the appropriate equation should consider construction duration and local environmental factors (soils, hydrology, etc.). For example, if a basin is planned for a project duration of 1 year and the designer specifies one maintenance cycle, RUSLE could be used to estimate the soil loss and thereby the designer could indicate that the sediment storage volume would be half of the soil loss value estimated. As an example for use of MUSLE, a project may have a short construction duration thereby requiring fewer maintenance cycles and a reduced sediment storage volume. MUSLE would be used to estimate the anticipated soil loss based on a specific storm event to evaluate the sediment storage volume and appropriate maintenance frequency.
- The soil loss estimates are an essential step in the design and it is essential that the designer provide construction contractors with enough information to understand maintenance frequency and/or depths within the basin that would trigger maintenance. Providing maintenance methods, frequency and specification should be included in design bid documents such as the SWPPP Site Map.
- Once the designer has quantified the amount of soil entering the basin, the depth required for sediment storage can be determined by dividing the estimated sediment loss by the surface area of the basin.

Step 4. Other Design Considerations

- Consider designing the volume of the settling zone for the total storm volume associated with the 2-year event or other appropriate design storms specified by the local agency. This volume can be used as a guide for sizing the basin without iterative routing calculations. The depth of the settling zone can be estimated by dividing the estimated 2-yr storm volume by the surface area of the basin.
- The basin volume consists of two zones:
  - A sediment storage zone at least 1 ft deep.
  - A settling zone at least 2 ft deep.

- The basin depth must be no less than 3 ft (not including freeboard).

- Proper hydraulic design of the outlet is critical to achieving the desired performance of the basin. The outlet should be designed to drain the basin within 24 to 96 hours (also referred to as "drawdown time"). The 24-hour limit is specified to provide adequate settling time; the 96-hour limit is specified to mitigate vector control concerns.

- Confirmation of the basin performance can be evaluated by routing the design storm (10-yr 6-hr, or as directed by local regulations) through the basin based on the basin volume (stage-storage curve) and the outlet design (stage-discharge curve based on the orifice configuration or equivalent outlet design).

- Sediment basins, regardless of size and storage volume, should include features to accommodate overflow or bypass flows that exceed the design storm event.

  - Include an emergency spillway to accommodate flows not carried by the principal spillway. The spillway should consist of an open channel (earthen or vegetated) over undisturbed material (not fill) or constructed of a non-erodible riprap (or equivalent protection) on fill slopes.

  - The spillway control section, which is a level portion of the spillway channel at the highest elevation in the channel, should be a minimum of 20 ft in length.

- Rock, vegetation or appropriate erosion control should be used to protect the basin inlet, outlet, and slopes against erosion.

- The total depth of the sediment basin should include the depth required for sediment storage, depth required for settling zone and freeboard of at least 1 foot or as regulated by local flood control agency for a flood event specified by the local agency.

- The basin alignment should be designed such that the length of the basin is more than twice the width of the basin; the length should be determined by measuring the distance between the inlet and the outlet. If the site topography does not allow for this configuration baffles should be installed so that the ratio is satisfied. If a basin has more than one inflow point, any inflow point that conveys more than 30 percent of the total peak inflow rate has to meet the required length to width ratio.

- An alternative basin sizing method proposed by Fifield (2004) can be consulted to estimate an alternative length to width ratio and basin configuration. These methods can be considered as part of Option 3 which allows for alternative designs that are protective or more protective of water quality.

- Baffles (see Figure 4 at the end of this fact sheet) can be considered at project sites where the existing topography or site constraints limit the length to width ratio. Baffles should be constructed of earthen berms or other structural material within the basin to divert flow in the basin, thus increasing the effective flow length from the basin inlet to the outlet riser. Baffles also reduce the change of short circuiting and allows for settling throughout the basin.

- Baffles are typically constructed from the invert of the basin to the crest of the emergency spillway (i.e., design event flows are meant to flow around the baffles and flows greater than the design event would flow over the baffles to the emergency spillway).
- Use of other materials for construction of basin baffles (such as silt fence) may not be appropriate based on the material specifications and will require frequent maintenance (maintain after every storm event). Maintenance may not be feasible when required due to flooded conditions resulting from frequent (i.e., back to back) storm events. Use of alternative baffle materials should not deviate from the intended purpose of the material, as described by the manufacturer.
- Sediment basins are best used in conjunction with erosion controls.
- Basins with an impounding levee greater than 4.5 ft tall, measured from the lowest point to the impounding area to the highest point of the levee, and basins capable of impounding more than 35,000 ft^3, should be designed by a Registered Civil Engineer. The design should include maintenance requirements, including sediment and vegetation removal, to ensure continuous function of the basin outlet and bypass structures.
- A forebay, constructed upstream of the basin, may be provided to remove debris and larger particles.
- The outflow from the sediment basin should be provided with velocity dissipation devices (see BMP EC-10) to prevent erosion and scouring of the embankment and channel.
- The principal outlet should consist of a corrugated metal, high density polyethylene (HDPE), or reinforced concrete riser pipe with dewatering holes and an anti-vortex device and trash rack attached to the top of the riser, to prevent floating debris from flowing out of the basin or obstructing the system. This principal structure should be designed to accommodate the inflow design storm.
- A rock pile or rock-filled gabions can serve as alternatives to the debris screen, although the designer should be aware of the potential for extra maintenance involved should the pore spaces in the rock pile clog.
- The outlet structure should be placed on a firm, smooth foundation with the base securely anchored with concrete or other means to prevent floatation.
- Attach riser pipe (watertight connection) to a horizontal pipe (barrel). Provide anti-seep collars on the barrel.
- Cleanout level should be clearly marked on the riser pipe.

Installation

- Securely anchor and install an anti-seep collar on the outlet pipe/riser and provide an emergency spillway for passing major floods (see local flood control agency).
- Areas under embankments must be cleared and stripped of vegetation.

- Chain link fencing should be provided around each sediment basin to prevent unauthorized entry to the basin or if safety is a concern.

Costs

The cost of a sediment basin is highly variable and is dependent of the site configuration. To decrease basin construction costs, designers should consider using existing site features such as berms or depressed area to site the sediment basin. Designers should also consider potential savings associated with designing the basin to minimize the number of maintenance cycles and siting the basin in a location where a permanent BMP (e.g., extended detention basin) is required for the project site.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level and as required by local requirements. It is recommended that at a minimum, basins be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Examine basin banks for seepage and structural soundness.
- Check inlet and outlet structures and spillway for any damage or obstructions. Repair damage and remove obstructions as needed.
- Check inlet and outlet area for erosion and stabilize if required.
- Check fencing for damage and repair as needed.
- Sediment that accumulates in the basin must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when sediment accumulation reaches one-half the designated sediment storage volume. Sediment removed during maintenance should be managed properly. The sediment should be appropriately evaluated and used or disposed of accordingly. Options include: incorporating sediment into earthwork on the site (only if there is no risk that sediment is contaminated); or off-site export/disposal at an appropriate location (e.g., sediment characterization and disposal to an appropriate landfill).
- Remove standing water from basin within 96 hours after accumulation.
- If the basin does not drain adequately (e.g., due to storms that are more frequent or larger than the design storm or other unforeseen site conditions), dewatering should be conducted in accordance with appropriate dewatering BMPs (see NS-2) and in accordance with local permits as applicable.
- To minimize vector production:
  - Remove accumulation of live and dead floating vegetation in basins during every inspection.
  - Remove excessive emergent and perimeter vegetation as needed or as advised by local or state vector control agencies.

References

A Current Assessment of Urban Best Management Practices: Techniques for Reducing Nonpoint Source Pollution in the Coastal Zones, Metropolitan Washington Council of Governments, March 1992.

Draft-Sedimentation and Erosion Control, an Inventory of Current Practices, USEPA. April 1990.

U.S. Environmental Protection Agency (USEPA). Erosion and Sediment Control, Surface Mining in the Eastern U.S., U.S. Environmental Protection Agency, Office of Water, Washington, DC,Washington, D.C., 1976.

Fifield, J.S. Designing for Effective Sediment and Erosion Control on Construction Sites. Forester Press, Santa Barbara, CA. 2004.

Goldman S.J., Jackson K. and Bursztynsky T.A. Erosion and Sediment Control Handbook. McGraw-Hill Book Company, 1986.

U.S. Environmental Protection Agency (USEPA). Guidance Specifying Management Measures for Nonpoint Pollution in Coastal Waters. EPA 840-B-9-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC, 1993.

Guidelines for the Design and Construction of Small Embankment Dams, Division of Safety of Dams, California Department of Water Resources, March 1986.

Haan C.T., Barfield B.J. and Hayes J.C. Design Hydrology and Sedimentology for Small Catchments. Academic Press. 1994.

Inlet/Outlet Alternatives for Extended Detention Basins. State of California Department of Transportation (Caltrans), 2001.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

McLean, J., 2000. Mosquitoes in Constructed Wetlands: A Management Bugaboo? In T.R. Schueler and H.K. Holland [eds.], The Practice of Watershed Protection. pp. 29-33. Center for Watershed Protection, Ellicott City, MD, 2000.

Metzger, M.E., D. F. Messer, C. L. Beitia, C. M. Myers, and V. L. Kramer. The Dark Side of Stormwater Runoff Management: Disease Vectors Associated with Structural BMPs, 2002.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Water, Work Group-Working Paper, USEPA, April 1992.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Water Quality Management Plan for the Lake Tahoe Region, Volume II Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Young, G.K. and Graziano, F., Outlet Hydraulics of Extended Detention Facilities for Northern Virginia Planning District Commission, 1989.

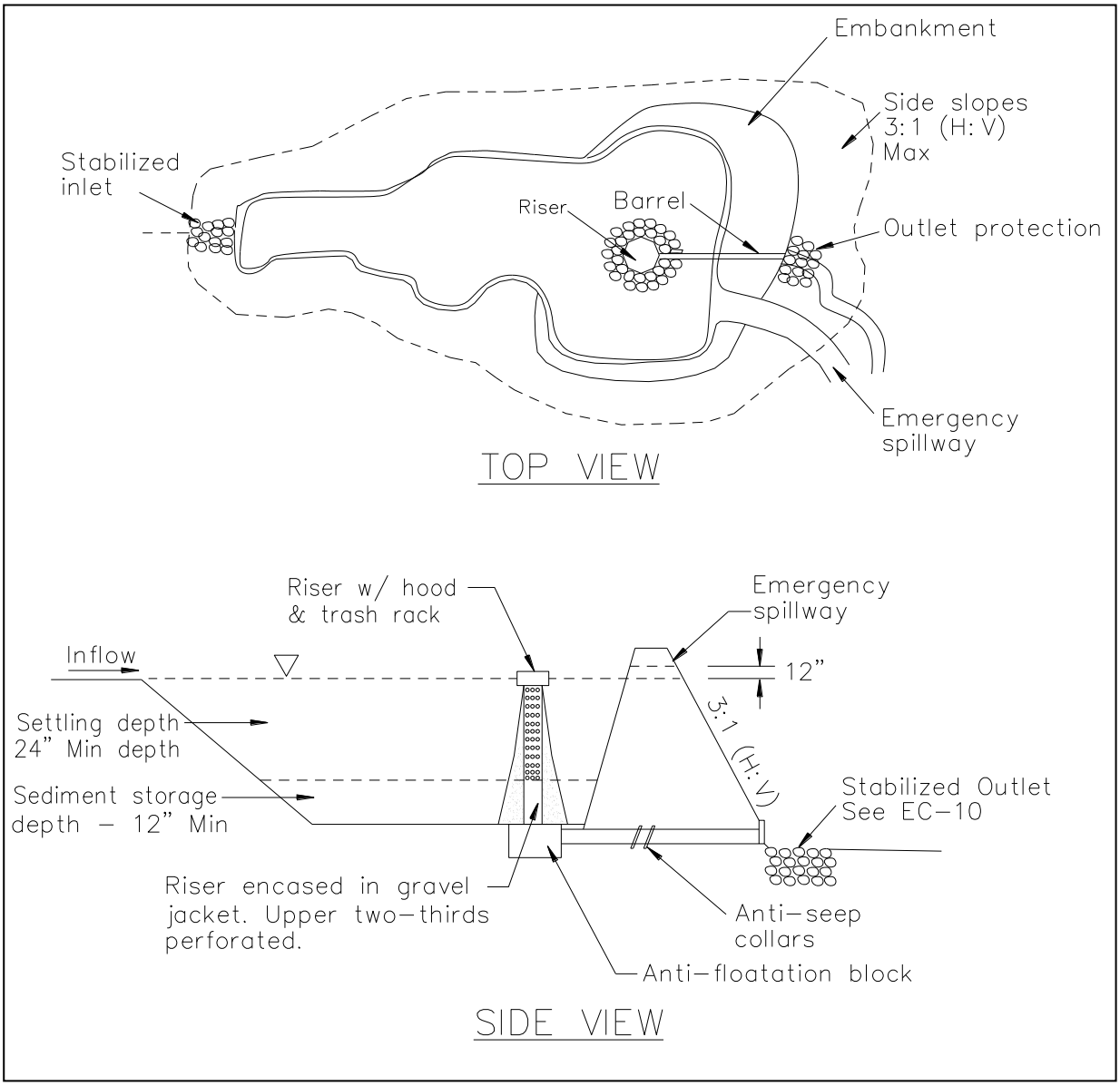


FIGURE 1: TYPICAL TEMPORARY SEDIMENT BASIN
MULTIPLE ORIFICE DESIGN
NOT TO SCALE

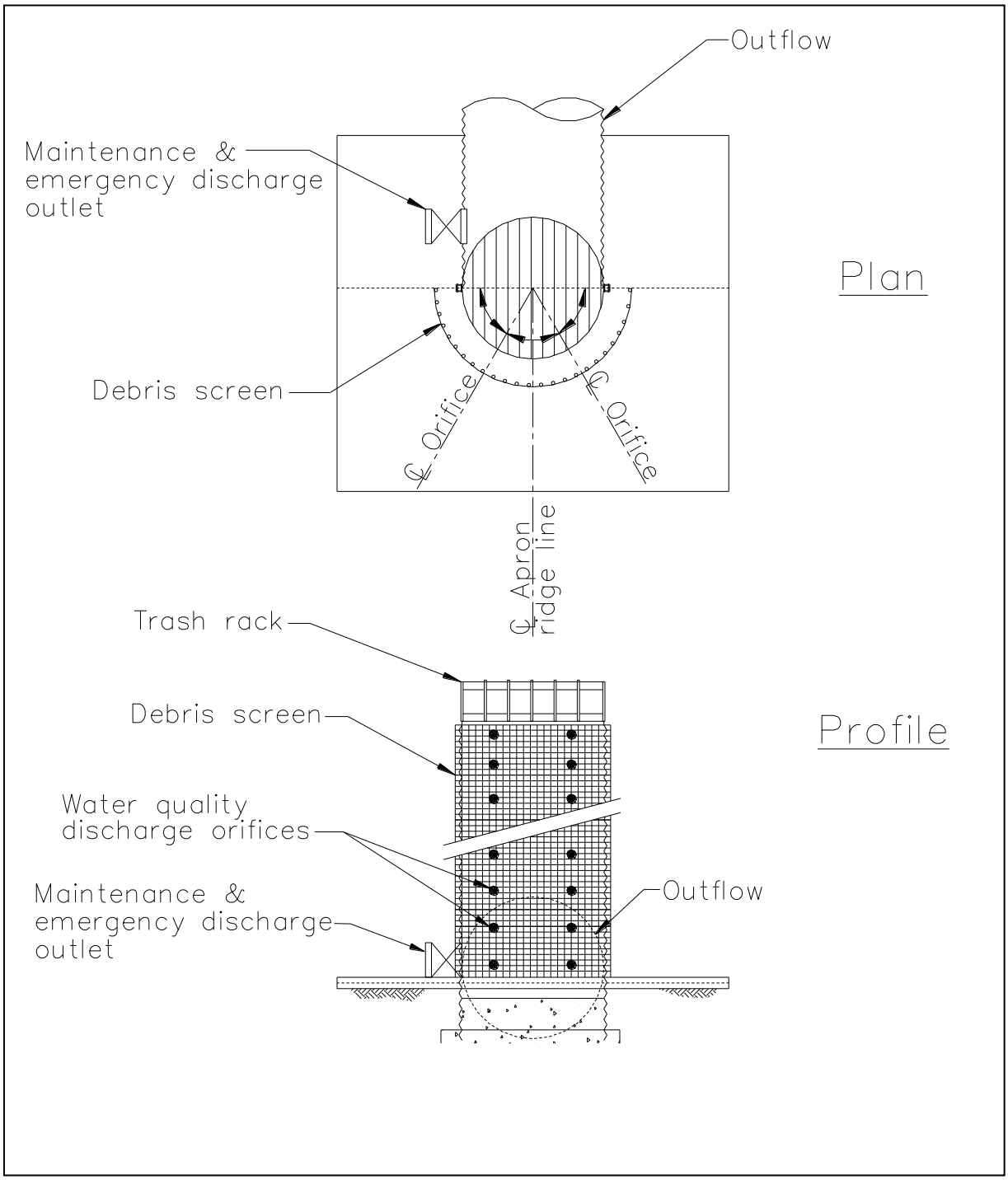


FIGURE 2: MULTIPLE ORIFICE OUTLET RISER
NOT TO SCALE

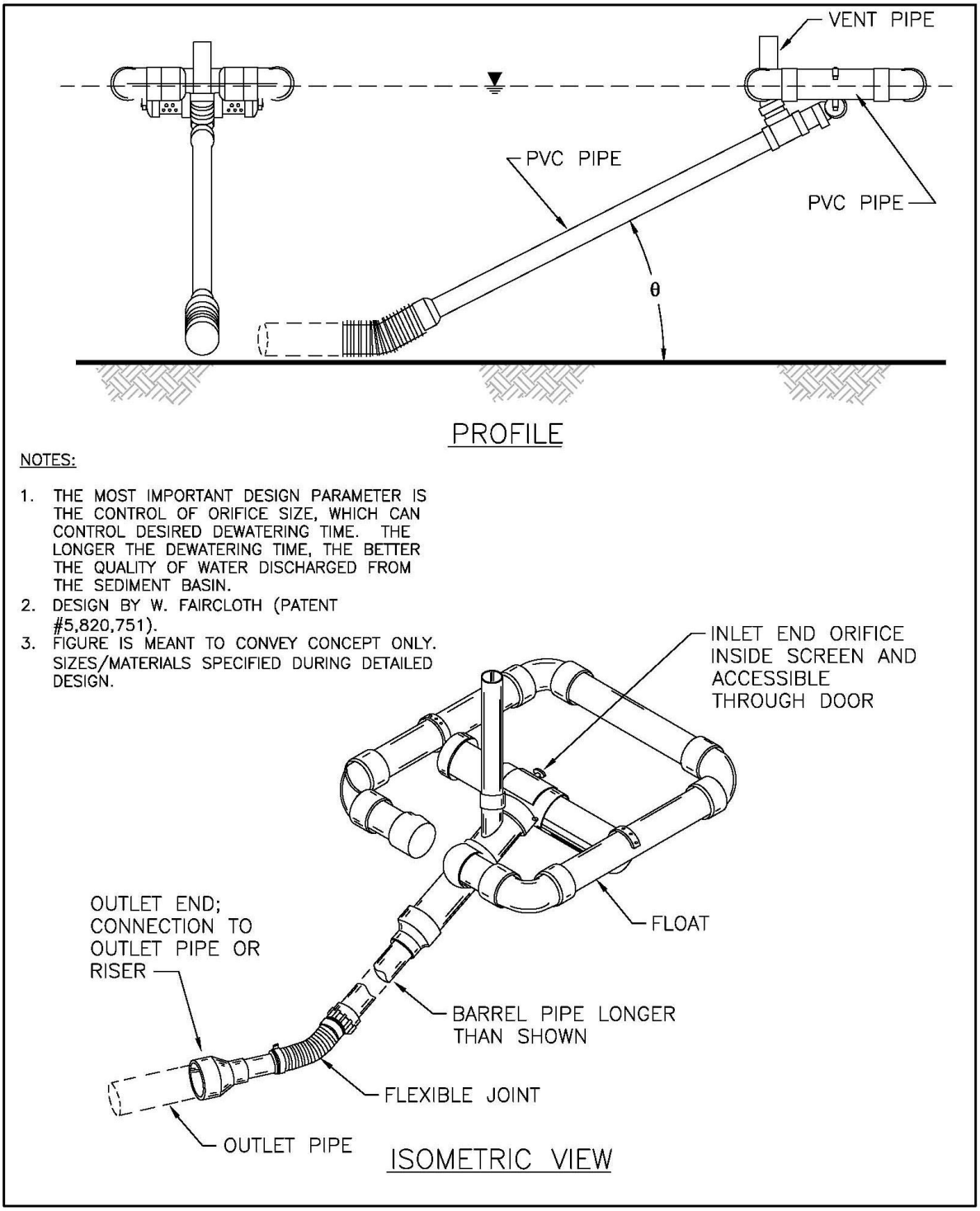


FIGURE 3: TYPICAL SKIMMER
NOT TO SCALE

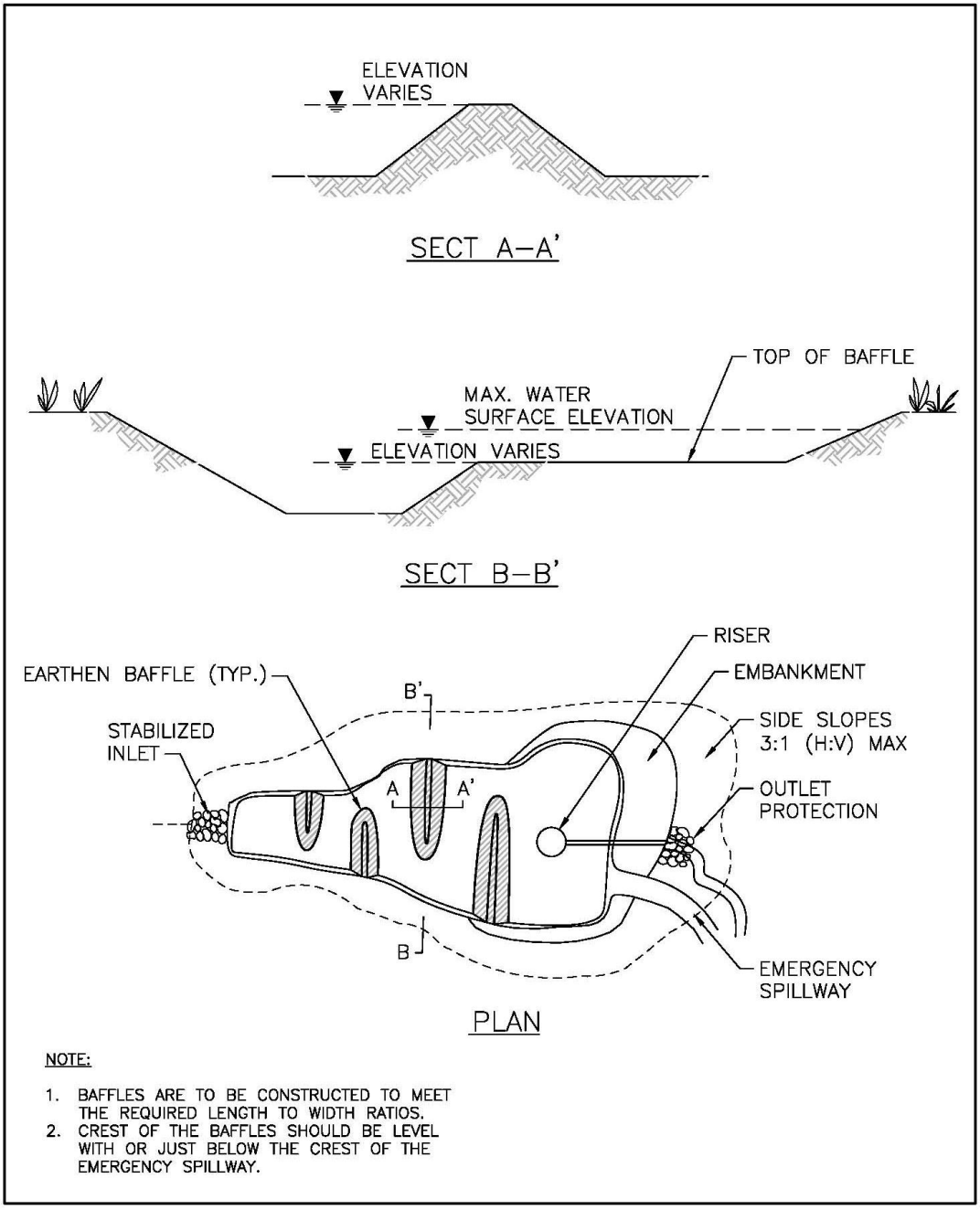
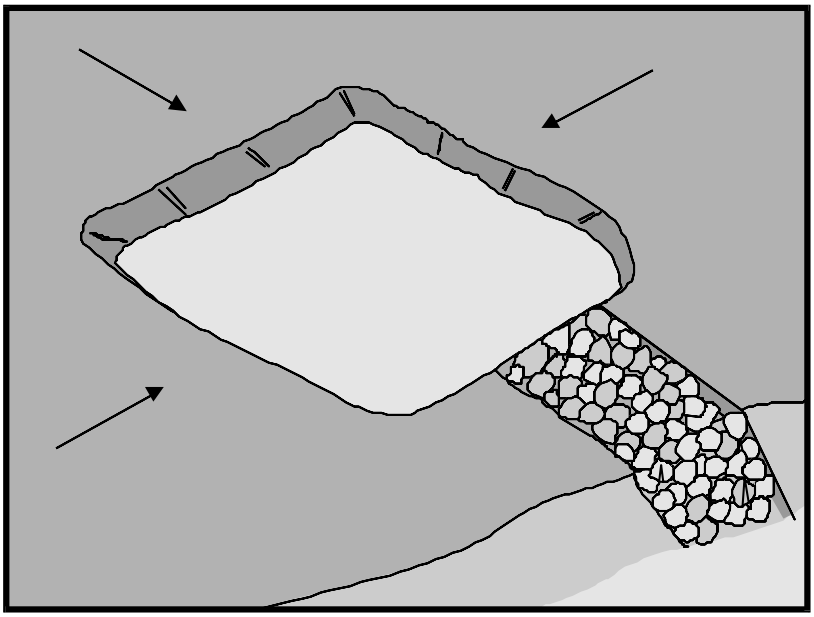


FIGURE 4: TYPICAL TEMPORARY SEDIMENT BASIN WITH BAFFLES
NOT TO SCALE

Sediment Trap SE-3



Description and Purpose

A sediment trap is a containment area where sediment-laden runoff is temporarily detained under quiescent conditions, allowing sediment to settle out or before the runoff is discharged by gravity flow. Sediment traps are formed by excavating or constructing an earthen embankment across a waterway or low drainage area.

Trap design guidance provided in this fact sheet is not intended to guarantee compliance with numeric discharge limits (numeric action levels or numeric effluent limits for turbidity). Compliance with discharge limits requires a thoughtful approach to comprehensive BMP planning, implementation, and maintenance. Therefore, optimally designed and maintained sediment traps should be used in conjunction with a comprehensive system of BMPs.

Suitable Applications

Sediment traps should be considered for use:

- At the perimeter of the site at locations where sediment-laden runoff is discharged offsite.
- At multiple locations within the project site where sediment control is needed.
- Around or upslope from storm drain inlet protection measures.
- Sediment traps may be used on construction projects where the drainage area is less than 5 acres. Traps would be

Categories

EC	Erosion Control	
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☑
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-2 Sediment Basin (for larger areas)

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

placed where sediment-laden stormwater may enter a storm drain or watercourse. SE-2, Sediment Basins, must be used for drainage areas greater than 5 acres.

- As a supplemental control, sediment traps provide additional protection for a water body or for reducing sediment before it enters a drainage system.

Limitations

- Requires large surface areas to permit infiltration and settling of sediment.
- Not appropriate for drainage areas greater than 5 acres.
- Only removes large and medium sized particles and requires upstream erosion control.
- Attractive and dangerous to children, requiring protective fencing.
- Conducive to vector production.
- Should not be located in live streams.

Implementation

Design

A sediment trap is a small temporary ponding area, usually with a gravel outlet, formed by excavation or by construction of an earthen embankment. Its purpose is to collect and store sediment from sites cleared or graded during construction. It is intended for use on small drainage areas with no unusual drainage features and projected for a quick build-out time. It should help in removing coarse sediment from runoff. The trap is a temporary measure with a design life of approximately six months to one year and is to be maintained until the site area is permanently protected against erosion by vegetation and/or structures.

Sediment traps should be used only for small drainage areas. If the contributing drainage area is greater than 5 acres, refer to SE-2, Sediment Basins, or subdivide the catchment area into smaller drainage basins.

Sediment usually must be removed from the trap after each rainfall event. The SWPPP should detail how this sediment is to be disposed, such as in fill areas onsite, or removal to an approved offsite dump. Sediment traps used as perimeter controls should be installed before any land disturbance takes place in the drainage area.

Sediment traps are usually small enough that a failure of the structure would not result in a loss of life, damage to home or buildings, or interruption in the use of public roads or utilities. However, sediment traps are attractive to children and can be dangerous. The following recommendations should be implemented to reduce risks:

- Install continuous fencing around the sediment trap or pond. Consult local ordinances regarding requirements for maintaining health and safety.
- Restrict basin side slopes to 3:1 or flatter.

Sediment trap size depends on the type of soil, size of the drainage area, and desired sediment removal efficiency (see SE-2, Sediment Basin). As a rule of thumb, the larger the basin volume

the greater the sediment removal efficiency. Sizing criteria are typically established under the local grading ordinance or equivalent. The runoff volume from a 2-year storm is a common design criteria for a sediment trap. The sizing criteria below assume that this runoff volume is 0.042 acre-ft/acre (0.5 in. of runoff). While the climatic, topographic, and soil type extremes make it difficult to establish a statewide standard, the following criteria should trap moderate to high amounts of sediment in most areas of California:

- Locate sediment traps as near as practical to areas producing the sediment.
- Trap should be situated according to the following criteria: (1) by excavating a suitable area or where a low embankment can be constructed across a swale, (2) where failure would not cause loss of life or property damage, and (3) to provide access for maintenance, including sediment removal and sediment stockpiling in a protected area.
- Trap should be sized to accommodate a settling zone and sediment storage zone with recommended minimum volumes of 67 yd^3/acre and 33 yd^3/acre of contributing drainage area, respectively, based on 0.5 in. of runoff volume over a 24-hour period. In many cases, the size of an individual trap is limited by available space. Multiple traps or additional volume may be required to accommodate specific rainfall, soil, and site conditions.
- Traps with an impounding levee greater than 4.5 ft tall, measured from the lowest point to the impounding area to the highest point of the levee, and traps capable of impounding more than 35,000 ft^3, should be designed by a Registered Civil Engineer. The design should include maintenance requirements, including sediment and vegetation removal, to ensure continuous function of the trap outlet and bypass structures.
- The outlet pipe or open spillway must be designed to convey anticipated peak flows.
- Use rock or vegetation to protect the trap outlets against erosion.
- Fencing should be provided to prevent unauthorized entry.

Installation

Sediment traps can be constructed by excavating a depression in the ground or creating an impoundment with a small embankment. Sediment traps should be installed outside the area being graded and should be built prior to the start of the grading activities or removal of vegetation. To minimize the area disturbed by them, sediment traps should be installed in natural depressions or in small swales or drainage ways. The following steps must be followed during installation:

- The area under the embankment must be cleared, grubbed, and stripped of any vegetation and root mat. The pool area should be cleared.
- The fill material for the embankment must be free of roots or other woody vegetation as well as oversized stones, rocks, organic material, or other objectionable material. The embankment may be compacted by traversing with equipment while it is being constructed.
- All cut-and-fill slopes should be 3:1 or flatter.
- When a riser is used, all pipe joints must be watertight.

- When a riser is used, at least the top two-thirds of the riser should be perforated with 0.5 in. diameter holes spaced 8 in. vertically and 10 to 12 in. horizontally. See SE-2, Sediment Basin.
- When an earth or stone outlet is used, the outlet crest elevation should be at least 1 ft below the top of the embankment.
- When crushed stone outlet is used, the crushed stone used in the outlet should meet AASHTO M43, size No. 2 or 24, or its equivalent such as MSHA No. 2. Gravel meeting the above gradation may be used if crushed stone is not available.

Costs

Average annual cost per installation and maintenance (18 month useful life) is $0.73 per ft^3 ($1,300 per drainage acre). Maintenance costs are approximately 20% of installation costs.

Inspection and Maintenance

- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect outlet area for erosion and stabilize if required.
- Inspect trap banks for seepage and structural soundness, repair as needed.
- Inspect outlet structure and spillway for any damage or obstructions. Repair damage and remove obstructions as needed.
- Inspect fencing for damage and repair as needed.
- Inspect the sediment trap for area of standing water during every visit. Corrective measures should be taken if the BMP does not dewater completely in 96 hours or less to prevent vector production.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the trap capacity. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed of at an appropriate location.
- Remove vegetation from the sediment trap when first detected to prevent pools of standing water and subsequent vector production.
- BMPs that require dewatering shall be continuously attended while dewatering takes place. Dewatering BMPs per NS-2 shall be implemented at all times during dewatering activities.

References

Brown, W., and T. Schueler. The Economics of Stormwater BMPs in the Mid-Atlantic Region. Prepared for Chesapeake Research Consortium, Edgewater, MD, by the Center for Watershed Protection, Ellicott City, MD, 1997.

Draft – Sedimentation and Erosion Control, an Inventory of Current Practices, USEPA, April 1990.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Metzger, M.E., D.F. Messer, C.L. Beitia, C.M. Myers, and V.L. Kramer, The Dark Side of Stormwater Runoff Management: Disease Vectors Associated with Structural BMPs, 2002.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

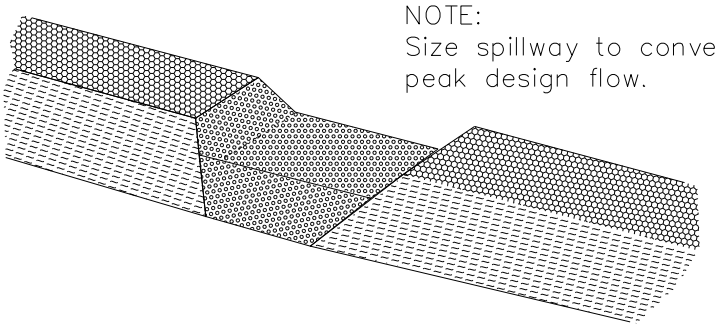
Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group-Working Paper, USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

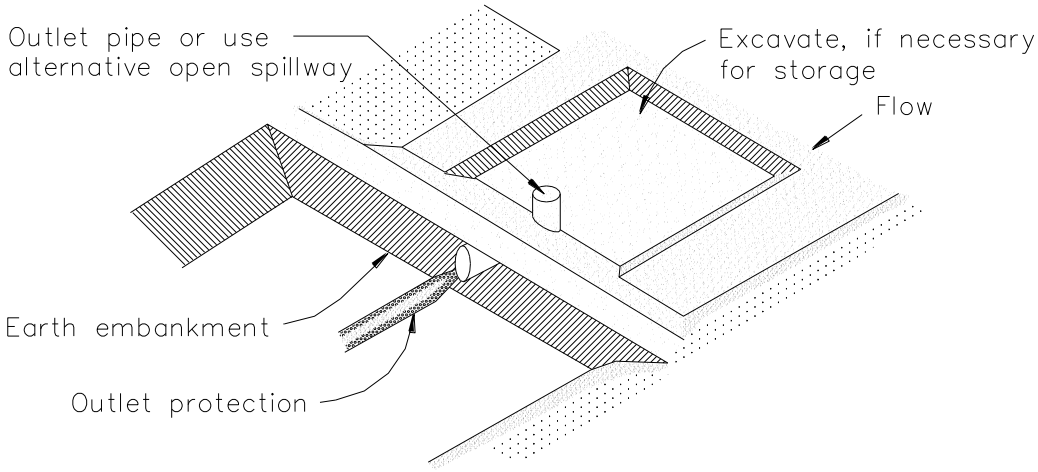
Stormwater Management Manual for The Puget Sound Basin, Washington State Department of Ecology, Public Review Draft, 1991.

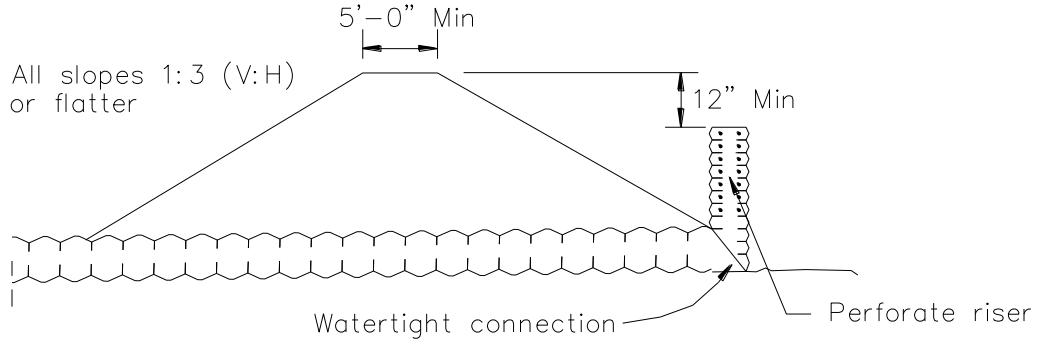
U.S. Environmental Protection Agency (USEPA). Guidance Specifying Management Measures for Nonpoint Pollution in Coastal Waters. EPA 840-B-9-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC, 1993.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



TYPICAL OPEN SPILLWAY

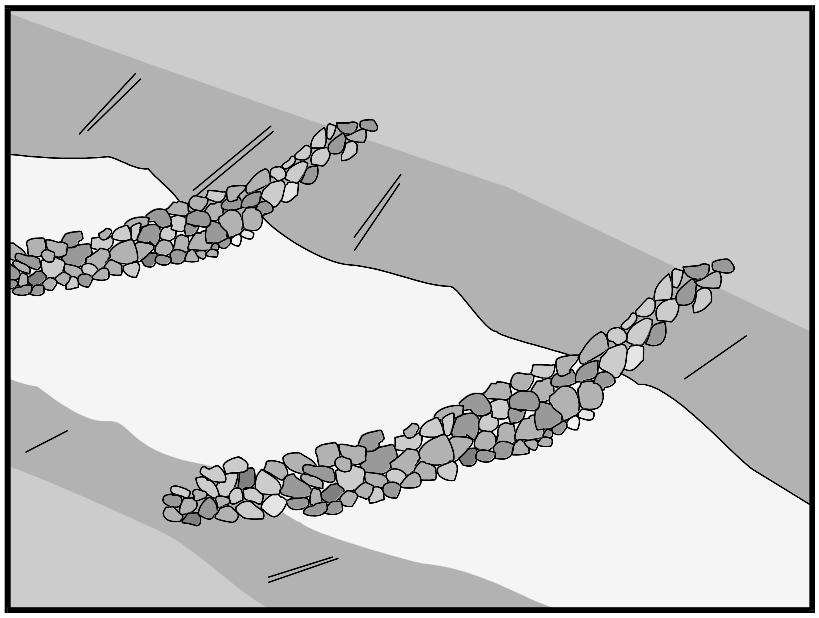




EMBANKMENT SECTION THRU RISER

TYPICAL SEDIMENT TRAP
NOT TO SCALE

Check Dams SE-4



Description and Purpose

A check dam is a small barrier constructed of rock, gravel bags, sandbags, fiber rolls, or other proprietary products, placed across a constructed swale or drainage ditch. Check dams reduce the effective slope of the channel, thereby reducing scour and channel erosion by reducing flow velocity and increasing residence time within the channel, allowing sediment to settle.

Suitable Applications

Check dams may be appropriate in the following situations:

- To promote sedimentation behind the dam.
- To prevent erosion by reducing the velocity of channel flow in small intermittent channels and temporary swales.
- In small open channels that drain 10 acres or less.
- In steep channels where stormwater runoff velocities exceed 5 ft/s.
- During the establishment of grass linings in drainage ditches or channels.
- In temporary ditches where the short length of service does not warrant establishment of erosion-resistant linings.
- To act as a grade control structure.

Categories

EC	Erosion Control	☒
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-12 Manufactured Linear Sediment Controls

SE-14 Biofilter Bags

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Limitations

- Not to be used in live streams or in channels with extended base flows.
- Not appropriate in channels that drain areas greater than 10 acres.
- Not appropriate in channels that are already grass-lined unless erosion potential or sediment-laden flow is expected, as installation may damage vegetation.
- Require extensive maintenance following high velocity flows.
- Promotes sediment trapping which can be re-suspended during subsequent storms or removal of the check dam.
- Do not construct check dams with straw bales or silt fence.
- Water suitable for mosquito production may stand behind check dams, particularly if subjected to daily non-stormwater discharges.

Implementation

General

Check dams reduce the effective slope and create small pools in swales and ditches that drain 10 acres or less. Using check dams to reduce channel slope reduces the velocity of stormwater flows, thus reducing erosion of the swale or ditch and promoting sedimentation. Thus, check dams are dual-purpose and serve an important role as erosion controls as well as as sediment controls. Note that use of 1-2 isolated check dams for sedimentation will likely result in little net removal of sediment because of the small detention time and probable scour during longer storms. Using a series of check dams will generally increase their effectiveness. A sediment trap (SE-3) may be placed immediately upstream of the check dam to increase sediment removal efficiency.

Design and Layout

Check dams work by decreasing the effective slope in ditches and swales. An important consequence of the reduced slope is a reduction in capacity of the ditch or swale. This reduction in capacity should be considered when using this BMP, as reduced capacity can result in overtopping of the ditch or swale and resultant consequences. In some cases, such as a "permanent" ditch or swale being constructed early and used as a "temporary" conveyance for construction flows, the ditch or swale may have sufficient capacity such that the temporary reduction in capacity due to check dams is acceptable. When check dams reduce capacities beyond acceptable limits, either:

- Don't use check dams. Consider alternative BMPs, or.
- Increase the size of the ditch or swale to restore capacity.

Maximum slope and velocity reduction is achieved when the toe of the upstream dam is at the same elevation as the top of the downstream dam (see "Spacing Between Check Dams" detail at the end of this fact sheet). The center section of the dam should be lower than the edge sections (at least 6 inches), acting as a spillway, so that the check dam will direct flows to the center of

the ditch or swale (see "Typical Rock Check Dam" detail at the end of this fact sheet). Bypass or side-cutting can occur if a sufficient spillway is not provided in the center of the dam.

Check dams are usually constructed of rock, gravel bags, sandbags, and fiber rolls. A number of products can also be used as check dams (e.g. HDPE check dams, temporary silt dikes (SE-12)), and some of these products can be removed and reused. Check dams can also be constructed of logs or lumber, and have the advantage of a longer lifespan when compared to gravel bags, sandbags, and fiber rolls. Check dams should not be constructed from straw bales or silt fences, since concentrated flows quickly wash out these materials.

Rock check dams are usually constructed of 8 to 12 in. rock. The rock is placed either by hand or mechanically, but never just dumped into the channel. The dam should completely span the ditch or swale to prevent washout. The rock used should be large enough to stay in place given the expected design flow through the channel. It is recommended that abutments be extended 18 in. into the channel bank. Rock can be graded such that smaller diameter rock (e.g. 2-4 in) is located on the upstream side of larger rock (holding the smaller rock in place); increasing residence time.

Log check dams are usually constructed of 4 to 6 in. diameter logs, installed vertically. The logs should be embedded into the soil at least 18 in. Logs can be bolted or wired to vertical support logs that have been driven or buried into the soil.

See fiber rolls, SE-5, for installation of fiber roll check dams.

Gravel bag and sand bag check dams are constructed by stacking bags across the ditch or swale, shaped as shown in the drawings at the end of this fact sheet (see "Gravel Bag Check Dam" detail at the end of this fact sheet).

Manufactured products, such as temporary silt dikes (SE-12), should be installed in accordance with the manufacturer's instructions. Installation typically requires anchoring or trenching of products, as well as regular maintenance to remove accumulated sediment and debris.

If grass is planted to stabilize the ditch or swale, the check dam should be removed when the grass has matured (unless the slope of the swales is greater than 4%).

The following guidance should be followed for the design and layout of check dams:

- Install the first check dam approximately 16 ft from the outfall device and at regular intervals based on slope gradient and soil type.
- Check dams should be placed at a distance and height to allow small pools to form between each check dam.
- For multiple check dam installation, backwater from a downstream check dam should reach the toes of the upstream check dam.
- A sediment trap provided immediately upstream of the check dam will help capture sediment. Due to the potential for this sediment to be resuspended in subsequent storms, the sediment trap should be cleaned following each storm event.

- High flows (typically a 2-year storm or larger) should safely flow over the check dam without an increase in upstream flooding or damage to the check dam.
- Where grass is used to line ditches, check dams should be removed when grass has matured sufficiently to protect the ditch or swale.

Materials

- Rock used for check dams should typically be 8-12 in rock and be sufficiently sized to stay in place given expected design flows in the channel. Smaller diameter rock (e.g. 2 to 4 in) can be placed on the upstream side of larger rock to increase residence time.
- Gravel bags used for check dams should conform to the requirements of SE-6, Gravel Bag Berms.
- Sandbags used for check dams should conform to SE-8, Sandbag Barrier.
- Fiber rolls used for check dams should conform to SE-5, Fiber Rolls.
- Temporary silt dikes used for check dams should conform to SE-12, Temporary Silt Dikes.

Installation

- Rock should be placed individually by hand or by mechanical methods (no dumping of rock) to achieve complete ditch or swale coverage.
- Tightly abut bags and stack according to detail shown in the figure at the end of this section (pyramid approach). Gravel bags and sandbags should not be stacked any higher than 3 ft.
- Upper rows or gravel and sand bags shall overlap joints in lower rows.
- Fiber rolls should be trenched in, backfilled, and firmly staked in place.
- Install along a level contour.
- HDPE check dams, temporary silt dikes, and other manufactured products should be used and installed per manufacturer specifications.

Costs

Cost consists of labor costs if materials are readily available (such as gravel on-site). If material must be imported, costs will increase. For other material and installation costs, see SE-5, SE-6, SE-8, SE-12, and SE-14.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Replace missing rock, bags, rolls, etc. Replace bags or rolls that have degraded or have become damaged.

- If the check dam is used as a sediment capture device, sediment that accumulates behind the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height.
- If the check dam is used as a grade control structure, sediment removal is not required as long as the system continues to control the grade.
- Inspect areas behind check dams for pools of standing water, especially if subjected to daily non-stormwater discharges.
- Remove accumulated sediment prior to permanent seeding or soil stabilization.
- Remove check dam and accumulated sediment when check dams are no longer needed.

References

Draft – Sedimentation and Erosion Control, and Inventory of Current Practices, USEPA, April 1990.

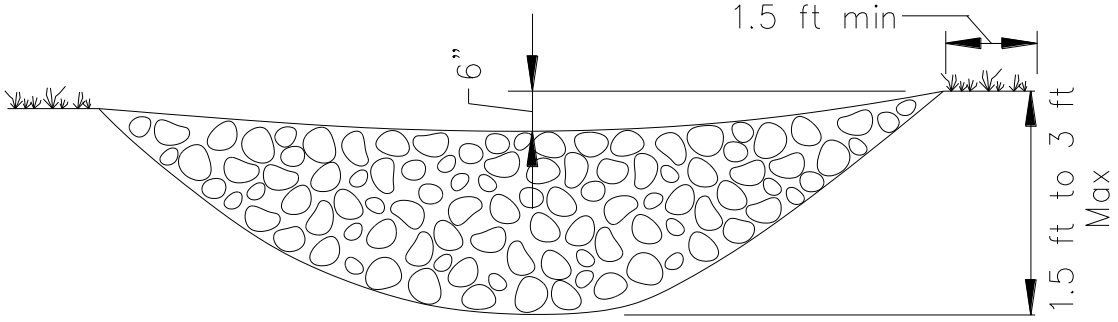
Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

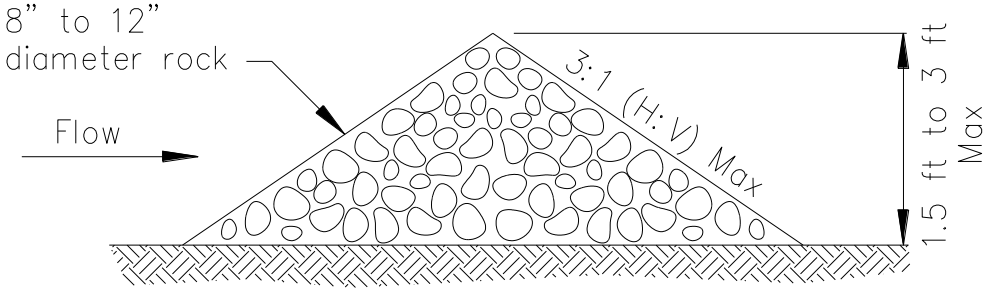
Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Metzger, M.E. 2004. Managing mosquitoes in stormwater treatment devices. University of California Division of Agriculture and Natural Resources, Publication 8125. On-line: http://anrcatalog.ucdavis.edu/pdf/8125.pdf

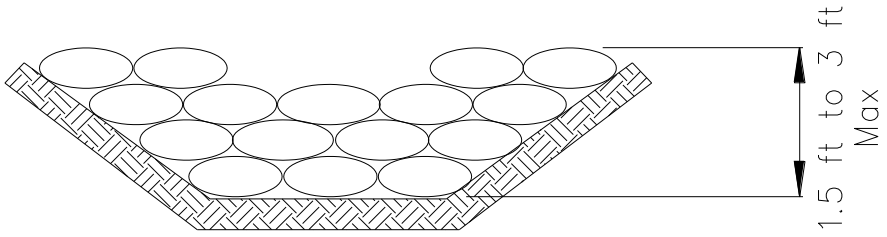


ELEVATION

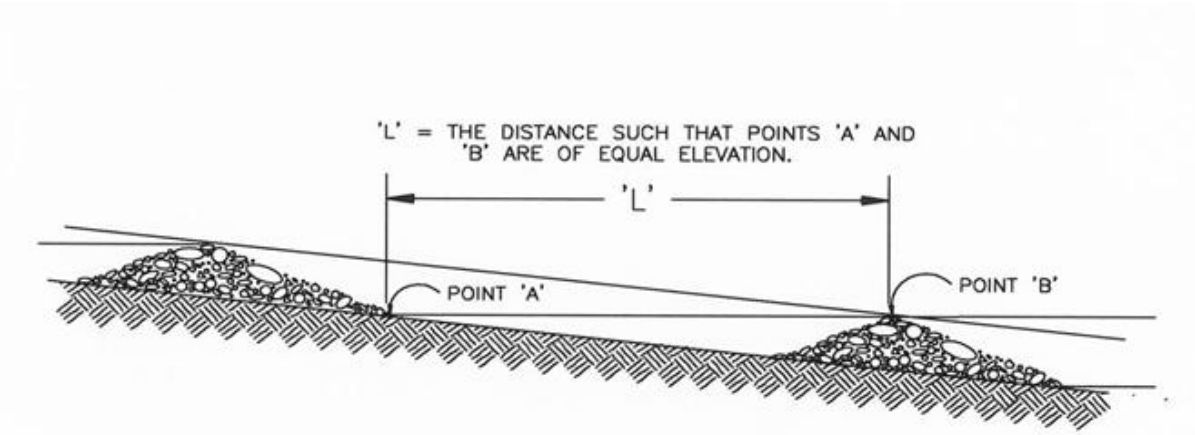


TYPICAL ROCK CHECK DAM SECTION

ROCK CHECK DAM
NOT TO SCALE

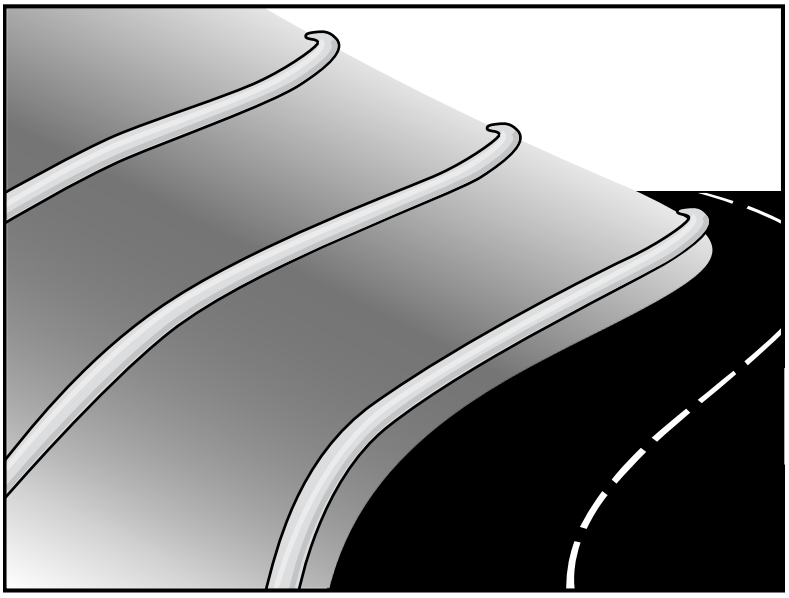


GRAVEL BAG CHECK DAM ELEVATION
NOT TO SCALE



SPACING BETWEEN CHECK DAMS

Fiber Rolls SE-5



Description and Purpose

A fiber roll consists of straw, coir, or other biodegradable materials bound into a tight tubular roll wrapped by netting, which can be photodegradable or natural. Additionally, gravel core fiber rolls are available, which contain an imbedded ballast material such as gravel or sand for additional weight when staking the rolls are not feasible (such as use as inlet protection). When fiber rolls are placed at the toe and on the face of slopes along the contours, they intercept runoff, reduce its flow velocity, release the runoff as sheet flow, and provide removal of sediment from the runoff (through sedimentation). By interrupting the length of a slope, fiber rolls can also reduce sheet and rill erosion until vegetation is established.

Suitable Applications

Fiber rolls may be suitable:

- Along the toe, top, face, and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow.
- At the end of a downward slope where it transitions to a steeper slope.
- Along the perimeter of a project.
- As check dams in unlined ditches with minimal grade.
- Down-slope of exposed soil areas.
- At operational storm drains as a form of inlet protection.

Categories

EC	Erosion Control	☒
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-12 Manufactured Linear Sediment Controls

SE-14 Biofilter Bags

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Around temporary stockpiles.

Limitations

- Fiber rolls are not effective unless trenched in and staked.
- Not intended for use in high flow situations.
- Difficult to move once saturated.
- If not properly staked and trenched in, fiber rolls could be transported by high flows.
- Fiber rolls have a very limited sediment capture zone.
- Fiber rolls should not be used on slopes subject to creep, slumping, or landslide.
- Rolls typically function for 12-24 months depending upon local conditions.

Implementation

Fiber Roll Materials

- Fiber rolls should be prefabricated.
- Fiber rolls may come manufactured containing polyacrylamide (PAM), a flocculating agent within the roll. Fiber rolls impregnated with PAM provide additional sediment removal capabilities and should be used in areas with fine, clayey or silty soils to provide additional sediment removal capabilities. Monitoring may be required for these installations.
- Fiber rolls are made from weed free rice straw, flax, or a similar agricultural material bound into a tight tubular roll by netting.
- Typical fiber rolls vary in diameter from 9 in. to 20 in. Larger diameter rolls are available as well.

Installation

- Locate fiber rolls on level contours spaced as follows:
  - Slope inclination of 4:1 (H:V) or flatter: Fiber rolls should be placed at a maximum interval of 20 ft.
  - Slope inclination between 4:1 and 2:1 (H:V): Fiber Rolls should be placed at a maximum interval of 15 ft. (a closer spacing is more effective).
  - Slope inclination 2:1 (H:V) or greater: Fiber Rolls should be placed at a maximum interval of 10 ft. (a closer spacing is more effective).
- Prepare the slope before beginning installation.
- Dig small trenches across the slope on the contour. The trench depth should be ¼ to 1/3 of the thickness of the roll, and the width should equal the roll diameter, in order to provide area to backfill the trench.

- It is critical that rolls are installed perpendicular to water movement, and parallel to the slope contour.
- Start building trenches and installing rolls from the bottom of the slope and work up.
- It is recommended that pilot holes be driven through the fiber roll. Use a straight bar to drive holes through the roll and into the soil for the wooden stakes.
- Turn the ends of the fiber roll up slope to prevent runoff from going around the roll.
- Stake fiber rolls into the trench.
  - Drive stakes at the end of each fiber roll and spaced 4 ft maximum on center.
  - Use wood stakes with a nominal classification of 0.75 by 0.75 in. and minimum length of 24 in.
- If more than one fiber roll is placed in a row, the rolls should be overlapped, not abutted.
- See typical fiber roll installation details at the end of this fact sheet.

Removal

- Fiber rolls can be left in place or removed depending on the type of fiber roll and application (temporary vs. permanent installation). Typically, fiber rolls encased with plastic netting are used for a temporary application because the netting does not biodegrade. Fiber rolls used in a permanent application are typically encased with a biodegradeable material and are left in place. Removal of a fiber roll used in a permanent application can result in greater disturbance.
- Temporary installations should only be removed when up gradient areas are stabilized per General Permit requirements, and/or pollutant sources no longer present a hazard. But, they should also be removed before vegetation becomes too mature so that the removal process does not disturb more soil and vegetation than is necessary.

Costs

Material costs for regular fiber rolls range from $20 - $30 per 25 ft roll.

Material costs for PAM impregnated fiber rolls range between 7.00-$9.00 per linear foot, based upon vendor research.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Repair or replace split, torn, unraveling, or slumping fiber rolls.
- If the fiber roll is used as a sediment capture device, or as an erosion control device to maintain sheet flows, sediment that accumulates in the BMP should be periodically removed

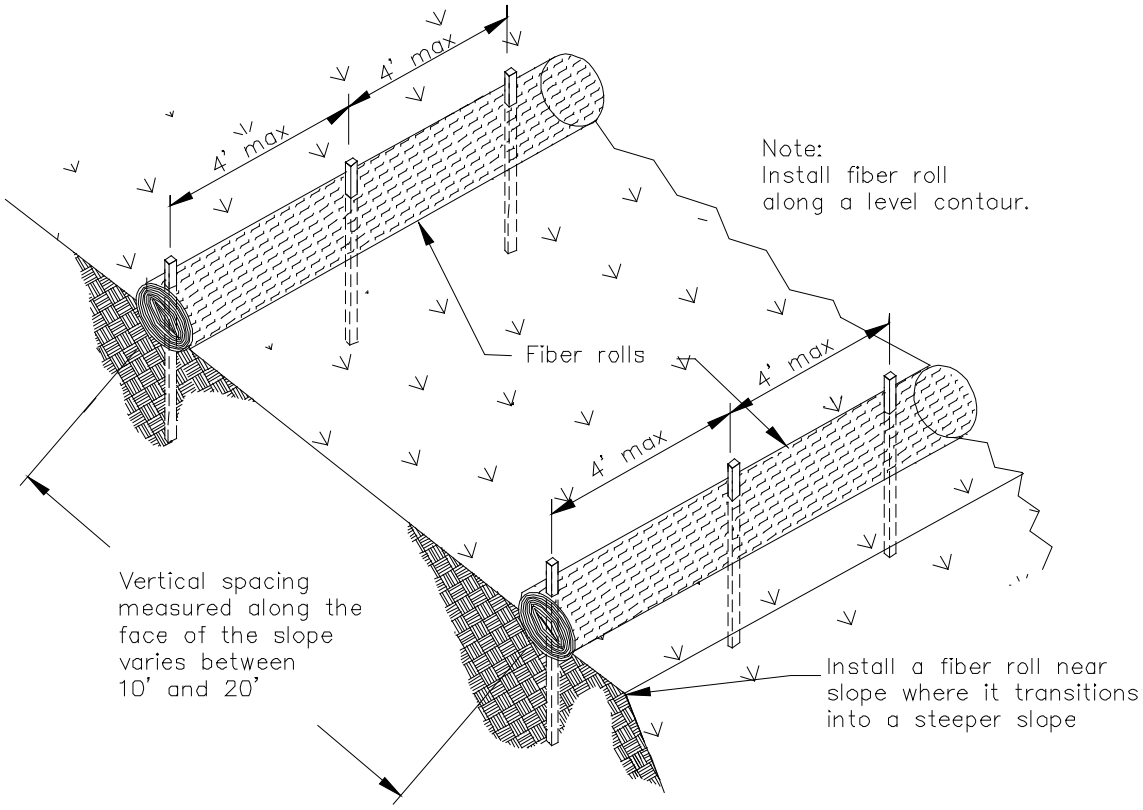
in order to maintain BMP effectiveness. Sediment should be removed when sediment accumulation reaches one-third the designated sediment storage depth.

- If fiber rolls are used for erosion control, such as in a check dam, sediment removal should not be required as long as the system continues to control the grade. Sediment control BMPs will likely be required in conjunction with this type of application.
- Repair any rills or gullies promptly.

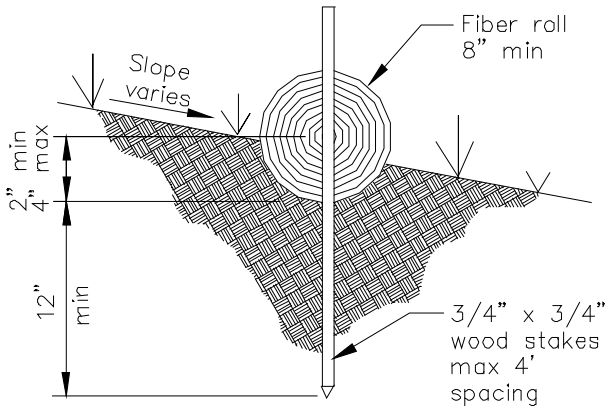
References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

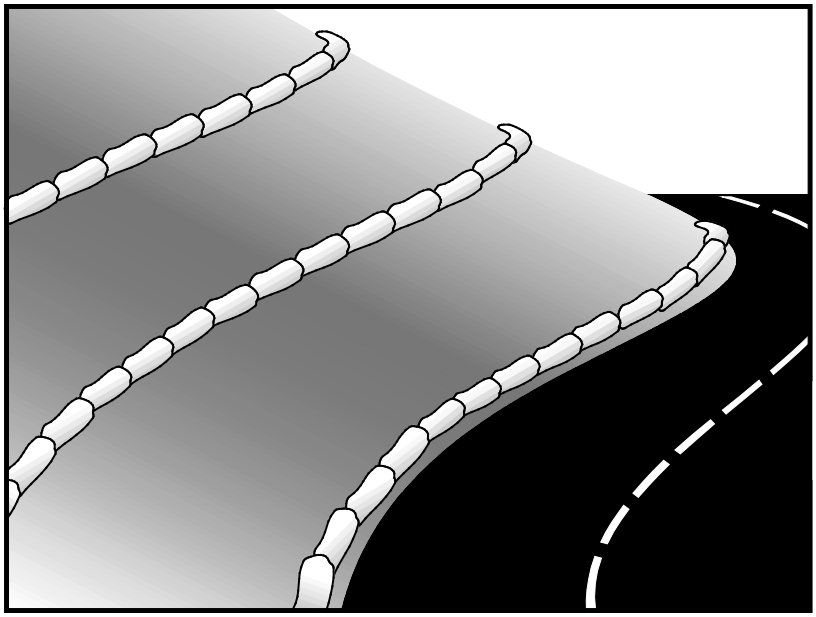


TYPICAL FIBER ROLL INSTALLATION
N.T.S.



ENTRENCHMENT DETAIL
N.T.S.

Gravel Bag Berm SE-6



Description and Purpose

A gravel bag berm is a series of gravel-filled bags placed on a level contour to intercept sheet flows. Gravel bags pond sheet flow runoff, allowing sediment to settle out, and release runoff slowly as sheet flow, preventing erosion.

Suitable Applications

Gravel bag berms may be suitable:

- As a linear sediment control measure:
  - Below the toe of slopes and erodible slopes
  - As sediment traps at culvert/pipe outlets
  - Below other small cleared areas
  - Along the perimeter of a site
  - Down slope of exposed soil areas
  - Around temporary stockpiles and spoil areas
  - Parallel to a roadway to keep sediment off paved areas
  - Along streams and channels
- As a linear erosion control measure:
  - Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow.

Categories

EC	Erosion Control	☒
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Roll

SE-8 Sandbag Barrier

SE-12 Temporary Silt Dike

SE-14 Biofilter Bags

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- At the top of slopes to divert runoff away from disturbed slopes.
- As chevrons (small check dams) across mildly sloped construction roads. For use check dam use in channels, see SE-4, Check Dams.

Limitations

- Gravel berms may be difficult to remove.
- Removal problems limit their usefulness in landscaped areas.
- Gravel bag berm may not be appropriate for drainage areas greater than 5 acres.
- Runoff will pond upstream of the berm, possibly causing flooding if sufficient space does not exist.
- Degraded gravel bags may rupture when removed, spilling contents.
- Installation can be labor intensive.
- Durability of gravel bags is somewhat limited and bags may need to be replaced when installation is required for longer than 6 months.
- Easily damaged by construction equipment.
- When used to detain concentrated flows, maintenance requirements increase.

Implementation

General

A gravel bag berm consists of a row of open graded gravel-filled bags placed on a level contour. When appropriately placed, a gravel bag berm intercepts and slows sheet flow runoff, causing temporary ponding. The temporary ponding allows sediment to settle. The open graded gravel in the bags is porous, which allows the ponded runoff to flow slowly through the bags, releasing the runoff as sheet flows. Gravel bag berms also interrupt the slope length and thereby reduce erosion by reducing the tendency of sheet flows to concentrate into rivulets, which erode rills, and ultimately gullies, into disturbed, sloped soils. Gravel bag berms are similar to sand bag barriers, but are more porous. Generally, gravel bag berms should be used in conjunction with temporary soil stabilization controls up slope to provide effective erosion and sediment control.

Design and Layout

- Locate gravel bag berms on level contours.
- When used for slope interruption, the following slope/sheet flow length combinations apply:
  - Slope inclination of 4:1 (H:V) or flatter: Gravel bags should be placed at a maximum interval of 20 ft, with the first row near the slope toe.
  - Slope inclination between 4:1 and 2:1 (H:V): Gravel bags should be placed at a maximum interval of 15 ft. (a closer spacing is more effective), with the first row near the slope toe.

Slope inclination 2:1 (H:V) or greater: Gravel bags should be placed at a maximum interval of 10 ft. (a closer spacing is more effective), with the first row near the slope toe.

- Turn the ends of the gravel bag barriers up slope to prevent runoff from going around the berm.
- Allow sufficient space up slope from the gravel bag berm to allow ponding, and to provide room for sediment storage.
- For installation near the toe of the slope, gravel bag barriers should be set back from the slope toe to facilitate cleaning. Where specific site conditions do not allow for a set-back, the gravel bag barrier may be constructed on the toe of the slope. To prevent flows behind the barrier, bags can be placed perpendicular to a berm to serve as cross barriers.
- Drainage area should not exceed 5 acres.
- In Non-Traffic Areas:
  - Height = 18 in. maximum
  - Top width = 24 in. minimum for three or more layer construction
  - Top width = 12 in. minimum for one or two layer construction
  - Side slopes = 2:1 (H:V) or flatter
- In Construction Traffic Areas:
  - Height = 12 in. maximum
  - Top width = 24 in. minimum for three or more layer construction.
  - Top width = 12 in. minimum for one or two layer construction.
  - Side slopes = 2:1 (H:V) or flatter.
- Butt ends of bags tightly.
- On multiple row, or multiple layer construction, overlap butt joints of adjacent row and row beneath.
- Use a pyramid approach when stacking bags.

Materials

- ***Bag Material:*** Bags should be woven polypropylene, polyethylene or polyamide fabric or burlap, minimum unit weight of 4 ounces/yd^2, Mullen burst strength exceeding 300 lb/in^2 in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70% in conformance with the requirements in ASTM designation D4355.

- ***Bag Size:*** Each gravel-filled bag should have a length of 18 in., width of 12 in., thickness of 3 in., and mass of approximately 33 lbs. Bag dimensions are nominal, and may vary based on locally available materials.

- ***Fill Material:*** Fill material should be 0.5 to 1 in. crushed rock, clean and free from clay, organic matter, and other deleterious material, or other suitable open graded, non-cohesive, porous gravel.

Costs

Material costs for gravel bags are average and are dependent upon material availability. $2.50-3.00 per filled gravel bag is standard based upon vendor research.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Gravel bags exposed to sunlight will need to be replaced every two to three months due to degrading of the bags.

- Reshape or replace gravel bags as needed.

- Repair washouts or other damage as needed.

- Sediment that accumulates in the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height.

- Remove gravel bag berms when no longer needed and recycle gravel fill whenever possible and properly dispose of bag material. Remove sediment accumulation and clean, re-grade, and stabilize the area.

References

Handbook of Steel Drainage and Highway Construction, American Iron and Steel Institute, 1983.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Pollution Plan Handbook, First Edition, State of California, Department of Transportation Division of New Technology, Materials and Research, October 1992.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Street Sweeping and Vacuuming SE-7



Description and Purpose

Street sweeping and vacuuming includes use of self-propelled and walk-behind equipment to remove sediment from streets and roadways, and to clean paved surfaces in preparation for final paving. Sweeping and vacuuming prevents sediment from the project site from entering storm drains or receiving waters.

Suitable Applications

Sweeping and vacuuming are suitable anywhere sediment is tracked from the project site onto public or private paved streets and roads, typically at points of egress. Sweeping and vacuuming are also applicable during preparation of paved surfaces for final paving.

Limitations

Sweeping and vacuuming may not be effective when sediment is wet or when tracked soil is caked (caked soil may need to be scraped loose).

Implementation

- Controlling the number of points where vehicles can leave the site will allow sweeping and vacuuming efforts to be focused, and perhaps save money.
- Inspect potential sediment tracking locations daily.
- Visible sediment tracking should be swept or vacuumed on a daily basis.

Categories

EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☑
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Do not use kick brooms or sweeper attachments. These tend to spread the dirt rather than remove it.
- If not mixed with debris or trash, consider incorporating the removed sediment back into the project

Costs

Rental rates for self-propelled sweepers vary depending on hopper size and duration of rental. Expect rental rates from $58/hour (3 yd^3 hopper) to $88/hour (9 yd^3 hopper), plus operator costs. Hourly production rates vary with the amount of area to be swept and amount of sediment. Match the hopper size to the area and expect sediment load to minimize time spent dumping.

Inspection and Maintenance

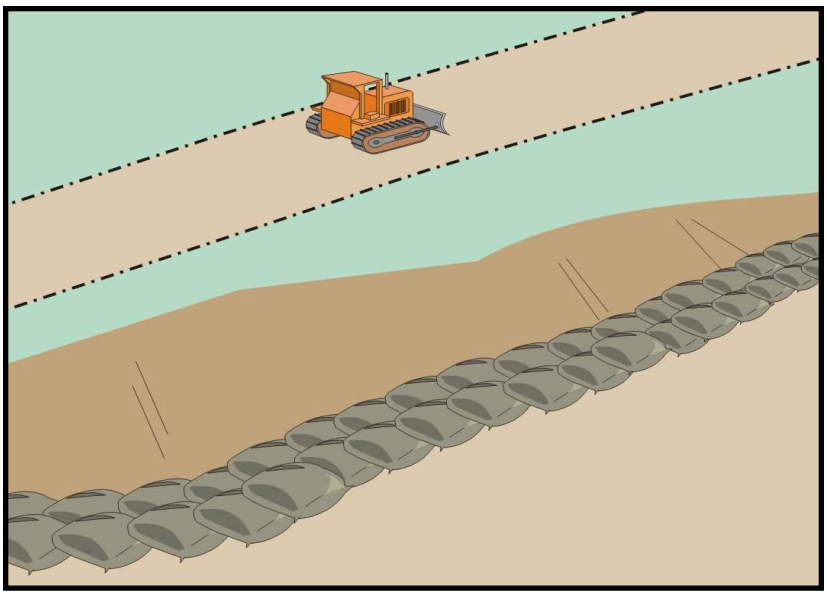
- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- When actively in use, points of ingress and egress must be inspected daily.
- When tracked or spilled sediment is observed outside the construction limits, it must be removed at least daily. More frequent removal, even continuous removal, may be required in some jurisdictions.
- Be careful not to sweep up any unknown substance or any object that may be potentially hazardous.
- Adjust brooms frequently; maximize efficiency of sweeping operations.
- After sweeping is finished, properly dispose of sweeper wastes at an approved dumpsite.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Labor Surcharge and Equipment Rental Rates, State of California Department of Transportation (Caltrans), April 1, 2002 – March 31, 2003.

Sandbag Barrier SE-8



Categories		
EC	Erosion Control	☒
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Description and Purpose

A sandbag barrier is a series of sand-filled bags placed on a level contour to intercept or to divert sheet flows. Sandbag barriers placed on a level contour pond sheet flow runoff, allowing sediment to settle out.

Suitable Applications

Sandbag barriers may be a suitable control measure for the applications described below. It is important to consider that sand bags are less porous than gravel bags and ponding or flooding can occur behind the barrier. Also, sand is easily transported by runoff if bags are damaged or ruptured. The SWPPP Preparer should select the location of a sandbag barrier with respect to the potential for flooding, damage, and the ability to maintain the BMP.

- As a linear sediment control measure:
  - Below the toe of slopes and erodible slopes.
  - As sediment traps at culvert/pipe outlets.
  - Below other small cleared areas.
  - Along the perimeter of a site.
  - Down slope of exposed soil areas.
  - Around temporary stockpiles and spoil areas.
  - Parallel to a roadway to keep sediment off paved areas.
  - Along streams and channels.

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-12 Manufactured Linear Sediment Controls

SE-14 Biofilter Bags

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- As linear erosion control measure:
  - Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow.
  - At the top of slopes to divert runoff away from disturbed slopes.
  - As check dams across mildly sloped construction roads.

Limitations

- It is necessary to limit the drainage area upstream of the barrier to 5 acres.
- Sandbags are not intended to be used as filtration devices.
- Easily damaged by construction equipment.
- Degraded sandbags may rupture when removed, spilling sand.
- Installation can be labor intensive.
- Durability of sandbags is somewhat limited and bags will need to be replaced when there are signs of damage or wear.
- Burlap should not be used for sandbags.

Implementation

General

A sandbag barrier consists of a row of sand-filled bags placed on a level contour. When appropriately placed, a sandbag barrier intercepts and slows sheet flow runoff, causing temporary ponding. The temporary ponding allows sediment to settle. Sand-filled bags have limited porosity, which is further limited as the fine sand tends to quickly plug with sediment, limiting or completely blocking the rate of flow through the barrier. If a porous barrier is desired, consider SE-1, Silt Fence, SE-5, Fiber Rolls, SE-6, Gravel Bag Berms or SE-14, Biofilter Bags. Sandbag barriers also interrupt the slope length and thereby reduce erosion by reducing the tendency of sheet flows to concentrate into rivulets which erode rills, and ultimately gullies, into disturbed, sloped soils. Sandbag barriers are similar to gravel bag berms, but less porous. Generally, sandbag barriers should be used in conjunction with temporary soil stabilization controls up slope to provide effective erosion and sediment control.

Design and Layout

- Locate sandbag barriers on a level contour.
- When used for slope interruption, the following slope/sheet flow length combinations apply:
  - Slope inclination of 4:1 (H:V) or flatter: Sandbags should be placed at a maximum interval of 20 ft, with the first row near the slope toe.
  - Slope inclination between 4:1 and 2:1 (H:V): Sandbags should be placed at a maximum interval of 15 ft. (a closer spacing is more effective), with the first row near the slope toe.

- Slope inclination 2:1 (H:V) or greater: Sandbags should be placed at a maximum interval of 10 ft. (a closer spacing is more effective), with the first row near the slope toe.

- Turn the ends of the sandbag barrier up slope to prevent runoff from going around the barrier.
- Allow sufficient space up slope from the barrier to allow ponding, and to provide room for sediment storage.
- For installation near the toe of the slope, sand bag barriers should be set back from the slope toe to facilitate cleaning. Where specific site conditions do not allow for a set-back, the sand bag barrier may be constructed on the toe of the slope. To prevent flows behind the barrier, bags can be placed perpendicular to a berm to serve as cross barriers.
- Drainage area should not exceed 5 acres.
- Butt ends of bags tightly.
- Overlap butt joints of row beneath with each successive row.
- Use a pyramid approach when stacking bags.
- In non-traffic areas
  - Height = 18 in. maximum
  - Top width = 24 in. minimum for three or more layer construction
  - Side slope = 2:1 (H:V) or flatter
- In construction traffic areas
  - Height = 12 in. maximum
  - Top width = 24 in. minimum for three or more layer construction.
  - Side slopes = 2:1 (H:V) or flatter.
- See typical sandbag barrier installation details at the end of this fact sheet.

Materials

- ***Sandbag Material:*** Sandbag should be woven polypropylene, polyethylene or polyamide fabric, minimum unit weight of 4 ounces/yd^2, Mullen burst strength exceeding 300 lb/in^2 in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70% in conformance with the requirements in ASTM designation D4355. Use of burlap is not an acceptable substitute, as sand can more easily mobilize out of burlap.
- ***Sandbag Size:*** Each sand-filled bag should have a length of 18 in., width of 12 in., thickness of 3 in., and mass of approximately 33 lbs. Bag dimensions are nominal, and may vary based on locally available materials.

- ***Fill Material:*** All sandbag fill material should be non-cohesive, Class 3 (Caltrans Standard Specification, Section 25) or similar permeable material free from clay and deleterious material, such as recycled concrete or asphalt.

Costs

Empty sandbags cost $0.25 - $0.75. Average cost of fill material is $8 per yd^3. Additional labor is required to fill the bags. Pre-filled sandbags are more expensive at $1.50 - $2.00 per bag. These costs are based upon vendor research.

Inspection and Maintenance

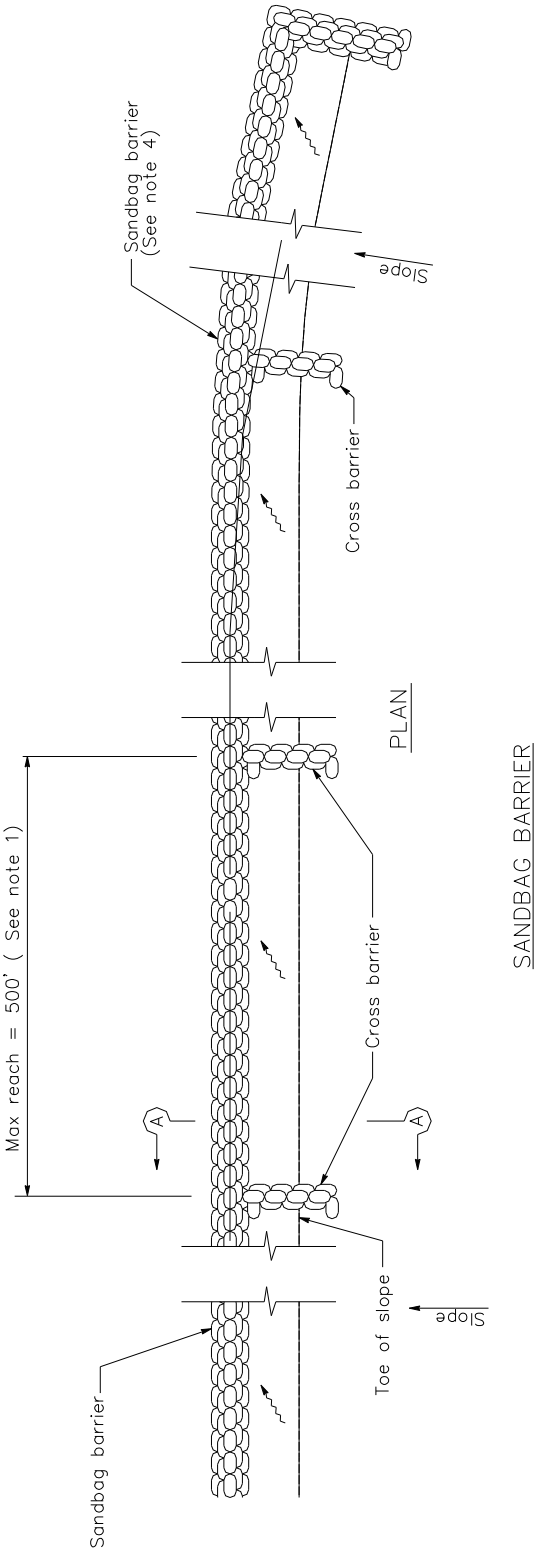
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Sandbags exposed to sunlight will need to be replaced every two to three months due to degradation of the bags.
- Reshape or replace sandbags as needed.
- Repair washouts or other damage as needed.
- Sediment that accumulates behind the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height.
- Remove sandbags when no longer needed and recycle sand fill whenever possible and properly dispose of bag material. Remove sediment accumulation, and clean, re-grade, and stabilize the area.

References

Standard Specifications for Construction of Local Streets and Roads, California Department of Transportation (Caltrans), July 2002.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

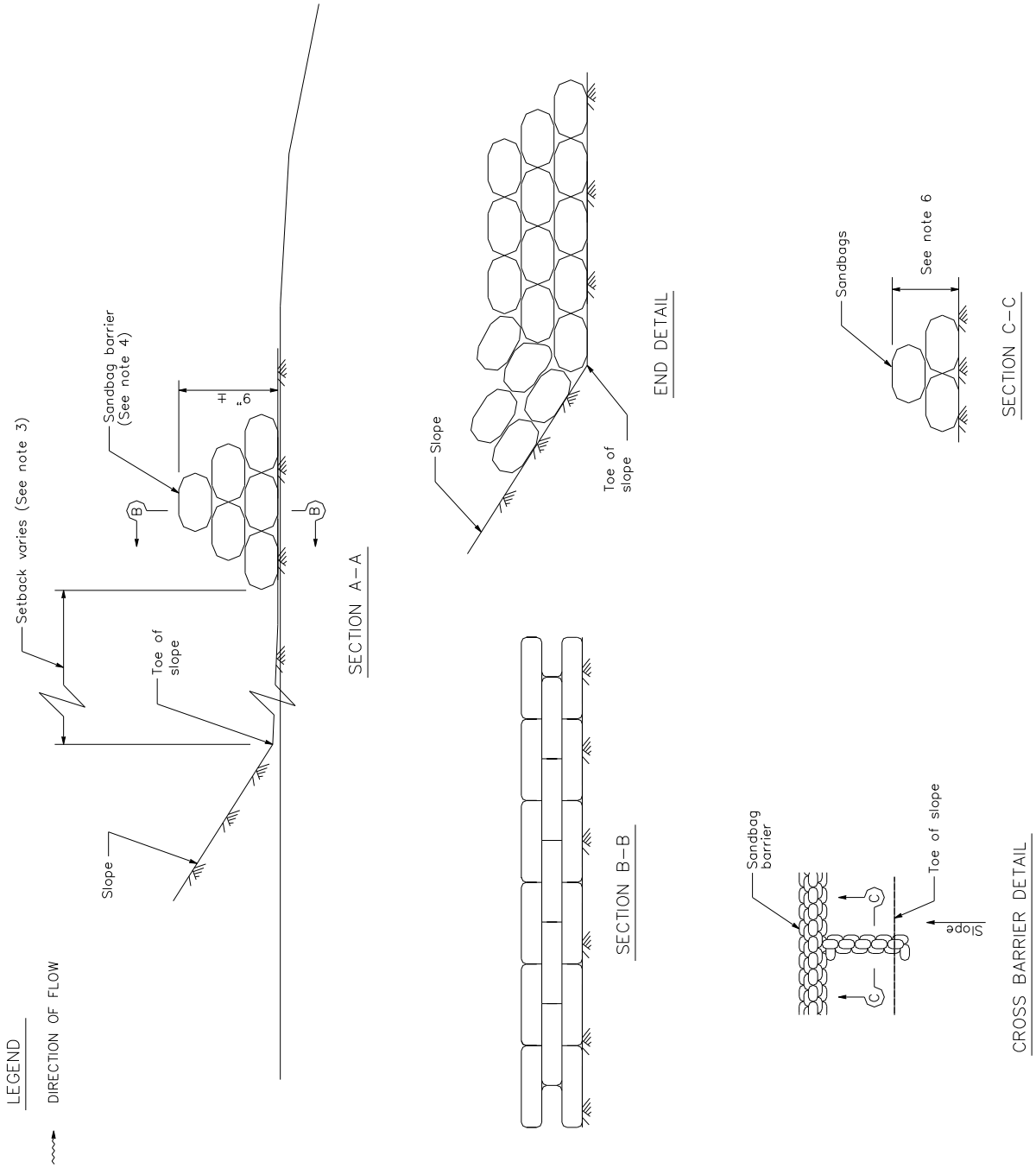
Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.



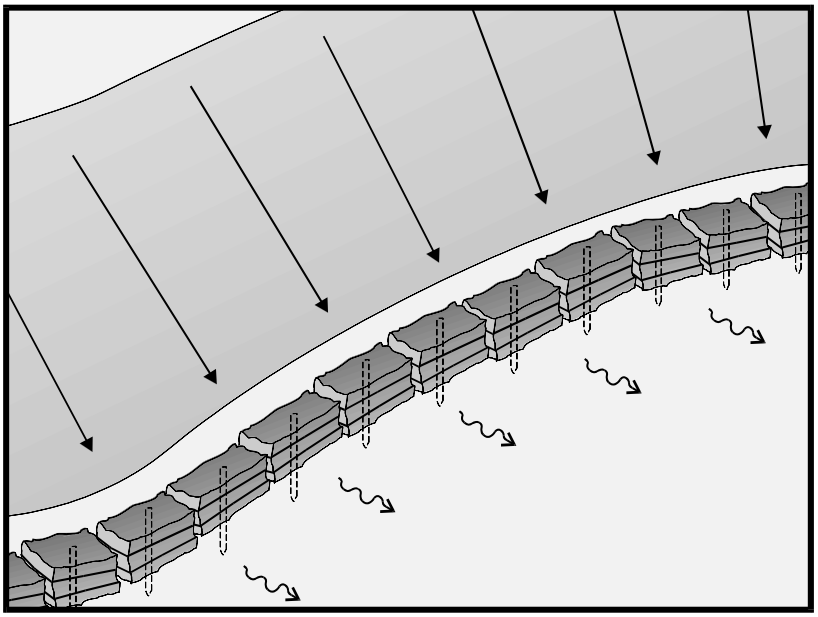
SANDBAG BARRIER

NOTES

1. Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/2 the height of the linear barrier. In no case shall the reach length exceed 500'.
2. Place sandbags tightly.
3. Dimension may vary to fit field condition.
4. Sandbag barrier shall be a minimum of 3 bags high.
5. The end of the barrier shall be turned up slope.
6. Cross barriers shall be a min of 1/2 and a max of 2/3 the height of the linear barrier.
7. Sandbag rows and layers shall be staggered to eliminate gaps.


LEGEND
DIRECTION OF FLOW
Setback varies (See note 3)
Sandbag barrier (See note 4)
H
B
B
Toe of slope
Slope
SECTION A-A
Slope
Toe of slope
END DETAIL
SECTION B-B
Sandbags
See note 6
SECTION C-C
Sandbag barrier
C
C
Toe of slope
Slope
CROSS BARRIER DETAIL

Straw Bale Barrier SE-9



Description and Purpose

A straw bale barrier is a series of straw bales placed on a level contour to intercept sheet flows. Straw bale barriers pond sheet-flow runoff, allowing sediment to settle out.

Suitable Applications

Straw bale barriers may be suitable:

- As a linear sediment control measure:
  - Below the toe of slopes and erodible slopes
  - As sediment traps at culvert/pipe outlets
  - Below other small cleared areas
  - Along the perimeter of a site
  - Down slope of exposed soil areas
  - Around temporary stockpiles and spoil areas
  - Parallel to a roadway to keep sediment off paved areas
  - Along streams and channels
- As linear erosion control measure:
  - Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow

Categories

EC	Erosion Control	☒
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-12 Temporary Silt Dike

SE-14 Biofilter Bags

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- At the top of slopes to divert runoff away from disturbed slopes
- As check dams across mildly sloped construction roads

Limitations

Straw bale barriers:

- Are not to be used for extended periods of time because they tend to rot and fall apart
- Are suitable only for sheet flow on slopes of 10 % or flatter
- Are not appropriate for large drainage areas, limit to one acre or less
- May require constant maintenance due to rotting
- Are not recommended for concentrated flow, inlet protection, channel flow, and live streams
- Cannot be made of bale bindings of jute or cotton
- Require labor-intensive installation and maintenance
- Cannot be used on paved surfaces
- Should not to be used for drain inlet protection
- Should not be used on lined ditches
- May introduce undesirable non-native plants to the area

Implementation

General

A straw bale barrier consists of a row of straw bales placed on a level contour. When appropriately placed, a straw bale barrier intercepts and slows sheet flow runoff, causing temporary ponding. The temporary ponding provides quiescent conditions allowing sediment to settle. Straw bale barriers also interrupt the slope length and thereby reduce erosion by reducing the tendency of sheet flows to concentrate into rivulets, which erode rills, and ultimately gullies, into disturbed, sloped soils.

Straw bale barriers have not been as effective as expected due to improper use. These barriers have been placed in streams and drainage ways where runoff volumes and velocities have caused the barriers to wash out. In addition, failure to stake and entrench the straw bale has allowed undercutting and end flow. Use of straw bale barriers in accordance with this BMP should produce acceptable results.

Design and Layout

- Locate straw bale barriers on a level contour.
  - Slopes up to 10:1 (H:V): Straw bales should be placed at a maximum interval of 50 ft (a closer spacing is more effective), with the first row near the toe of slope.
  - Slopes greater than 10:1 (H:V): Not recommended.

- Turn the ends of the straw bale barrier up slope to prevent runoff from going around the barrier.
- Allow sufficient space up slope from the barrier to allow ponding, and to provide room for sediment storage.
- For installation near the toe of the slope, consider moving the barrier away from the slope toe to facilitate cleaning. To prevent flow behind the barrier, sand bags can be placed perpendicular to the barrier to serve as cross barriers.
- Drainage area should not exceed 1 acre, or 0.25 acre per 100 ft of barrier.
- Maximum flow path to the barrier should be limited to 100 ft.
- Straw bale barriers should consist of two parallel rows.
  - Butt ends of bales tightly
  - Stagger butt joints between front and back row
  - Each row of bales must be trenched in and firmly staked
- Straw bale barriers are limited in height to one bale laid on its side.
- Anchor bales with either two wood stakes or four bars driven through the bale and into the soil. Drive the first stake towards the butt joint with the adjacent bale to force the bales together.
- See attached figure for installation details.

Materials

- ***Straw Bale Size:*** Each straw bale should be a minimum of 14 in. wide, 18 in. in height, 36 in. in length and should have a minimum mass of 50 lbs. The straw bale should be composed entirely of vegetative matter, except for the binding material.
- ***Bale Bindings:*** Bales should be bound by steel wire, nylon or polypropylene string placed horizontally. Jute and cotton binding should not be used. Baling wire should be a minimum diameter of 14 gauge. Nylon or polypropylene string should be approximately 12 gauge in diameter with a breaking strength of 80 lbs force.
- ***Stakes:*** Wood stakes should be commercial quality lumber of the size and shape shown on the plans. Each stake should be free from decay, splits or cracks longer than the thickness of the stake, or other defects that would weaken the stakes and cause the stakes to be structurally unsuitable. Steel bar reinforcement should be equal to a #4 designation or greater. End protection should be provided for any exposed bar reinforcement.

Costs

Straw bales cost $5 - $7 each. Adequate labor should be budgeted for installation and maintenance.

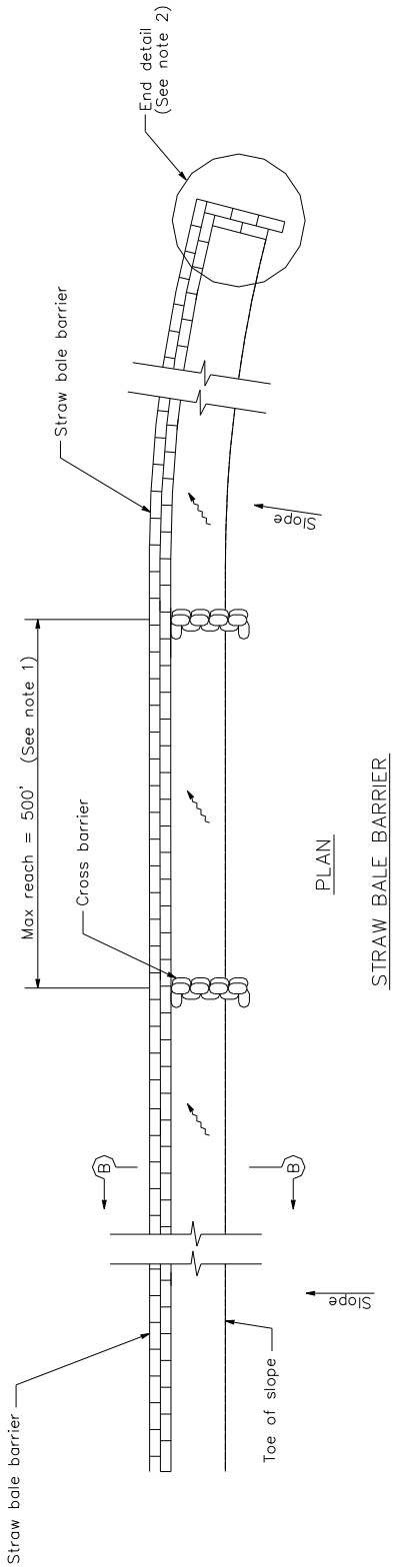
Inspection and Maintenance

Maintenance

- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Straw bales degrade, especially when exposed to moisture. Rotting bales will need to be replaced on a regular basis.
- Replace or repair damaged bales as needed.
- Repair washouts or other damages as needed.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.
- Remove straw bales when no longer needed. Remove sediment accumulation, and clean, re-grade, and stabilize the area. Removed sediment should be incorporated in the project or disposed of.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.



PLAN

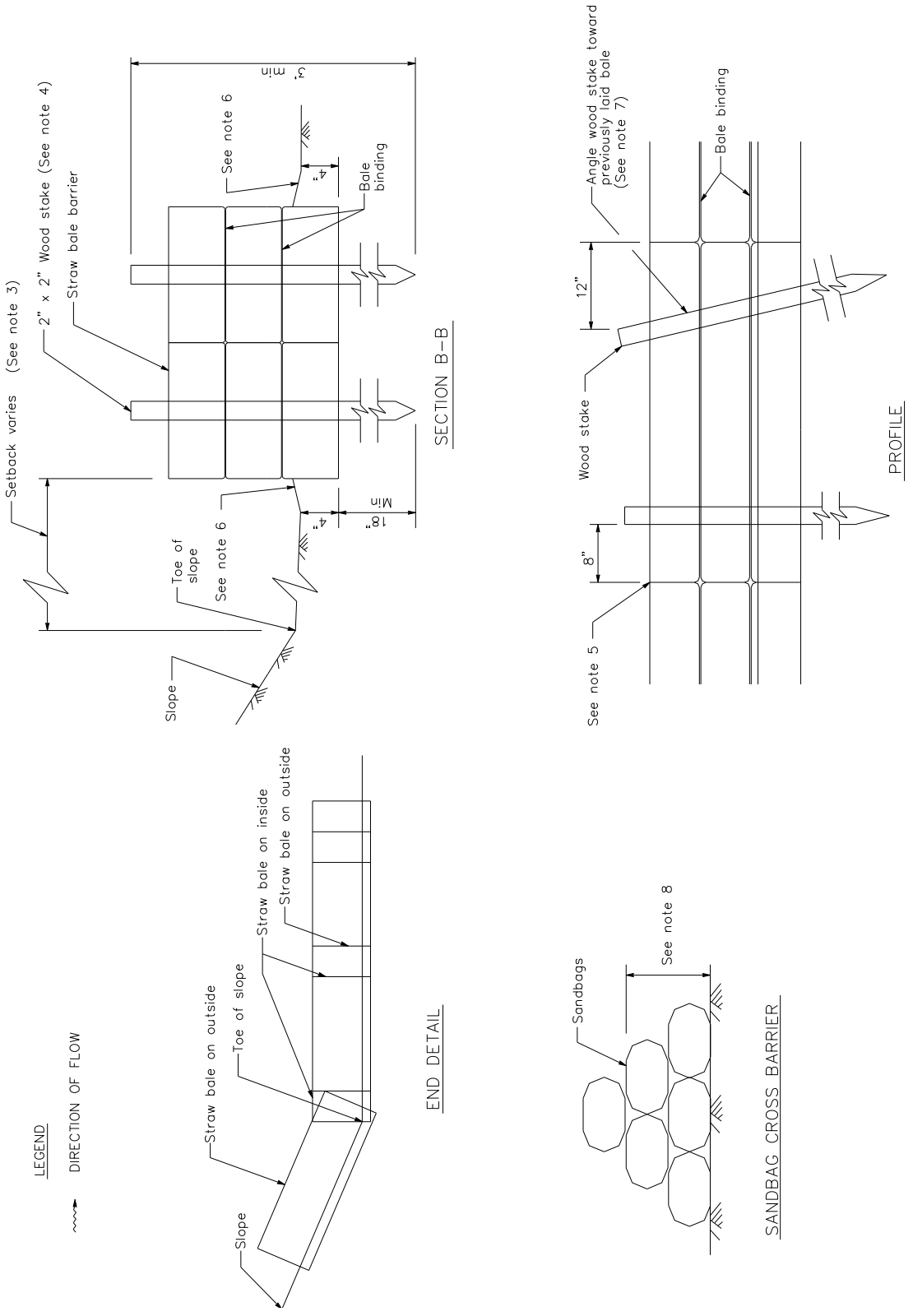
STRAW BALE BARRIER

LEGEND

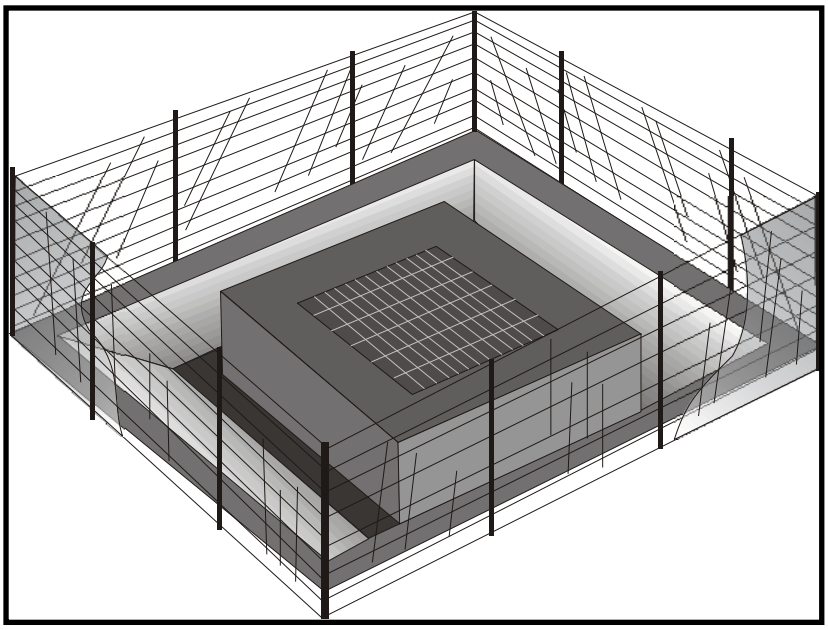
DIRECTION OF FLOW

NOTES

1. Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/2 the height of the linear barrier. In no case shall the reach length exceed 500'.
2. The end of barrier shall be turned up slope.
3. Dimension may vary to fit field condition.
4. Stake dimensions are nominal.
5. Place straw bales tightly together.
6. Tamp embedment spoils against sides of installed bales.
7. Drive angled wood stake before vertical stake to ensure tight abutment to adjacent bale.
8. Sandbag cross barriers should be a min of 1/2 and a max of 2/3 the height of the linear barrier.
9. Sandbag rows and layers should be offset to eliminate gaps.


Setback varies (See note 3)
2" x 2" Wood stake (See note 4)
Straw bale barrier
See note 6
Bale binding
Min 3"
4"
Min 18"
Toe of slope
See note 6
Slope
SECTION B-B
Angle wood stake toward previously laid bale (See note 7)
Bale binding
12"
Wood stake
8"
See note 5
PROFILE
LEGEND
DIRECTION OF FLOW
Straw bale on outside
Toe of slope
Straw bale on inside
Straw bale on outside
Slope
END DETAIL
Sandbags
See note 8
SANDBAG CROSS BARRIER

Storm Drain Inlet Protection SE-10



Description and Purpose

Storm drain inlet protection consists of a sediment filter or an impounding area in, around or upstream of a storm drain, drop inlet, or curb inlet. Storm drain inlet protection measures temporarily pond runoff before it enters the storm drain, allowing sediment to settle. Some filter configurations also remove sediment by filtering, but usually the ponding action results in the greatest sediment reduction. Temporary geotextile storm drain inserts attach underneath storm drain grates to capture and filter storm water.

Suitable Applications

- Every storm drain inlet receiving runoff from unstabilized or otherwise active work areas should be protected. Inlet protection should be used in conjunction with other erosion and sediment controls to prevent sediment-laden stormwater and non-stormwater discharges from entering the storm drain system.

Limitations

- Drainage area should not exceed 1 acre.
- In general straw bales should not be used as inlet protection.
- Requires an adequate area for water to pond without encroaching into portions of the roadway subject to traffic.
- Sediment removal may be inadequate to prevent sediment discharges in high flow conditions or if runoff is heavily sediment laden. If high flow conditions are expected, use

Categories

EC	Erosion Control	
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☒
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-14 Biofilter Bags

SE-13 Compost Socks and Berms

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

other onsite sediment trapping techniques in conjunction with inlet protection.

- Frequent maintenance is required.
- Limit drainage area to 1 acre maximum. For drainage areas larger than 1 acre, runoff should be routed to a sediment-trapping device designed for larger flows. See BMPs SE-2, Sediment Basin, and SE-3, Sediment Traps.
- Excavated drop inlet sediment traps are appropriate where relatively heavy flows are expected, and overflow capability is needed.

Implementation

General

Inlet control measures presented in this handbook should not be used for inlets draining more than one acre. Runoff from larger disturbed areas should be first routed through SE-2, Sediment Basin or SE-3, Sediment Trap and/or used in conjunction with other drainage control, erosion control, and sediment control BMPs to protect the site. Different types of inlet protection are appropriate for different applications depending on site conditions and the type of inlet. Alternative methods are available in addition to the methods described/shown herein such as prefabricated inlet insert devices, or gutter protection devices.

Design and Layout

Identify existing and planned storm drain inlets that have the potential to receive sediment-laden surface runoff. Determine if storm drain inlet protection is needed and which method to use.

- The key to successful and safe use of storm drain inlet protection devices is to know where runoff that is directed toward the inlet to be protected will pond or be diverted as a result of installing the protection device.
  - Determine the acceptable location and extent of ponding in the vicinity of the drain inlet. The acceptable location and extent of ponding will influence the type and design of the storm drain inlet protection device.
  - Determine the extent of potential runoff diversion caused by the storm drain inlet protection device. Runoff ponded by inlet protection devices may flow around the device and towards the next downstream inlet. In some cases, this is acceptable; in other cases, serious erosion or downstream property damage can be caused by these diversions. The possibility of runoff diversions will influence whether or not storm drain inlet protection is suitable; and, if suitable, the type and design of the device.
- The location and extent of ponding, and the extent of diversion, can usually be controlled through appropriate placement of the inlet protection device. In some cases, moving the inlet protection device a short distance upstream of the actual inlet can provide more efficient sediment control, limit ponding to desired areas, and prevent or control diversions.
- Seven types of inlet protection are presented below. However, it is recognized that other effective methods and proprietary devices exist and may be selected.

- Silt Fence: Appropriate for drainage basins with less than a 5% slope, sheet flows, and flows under 0.5 cfs.

- Excavated Drop Inlet Sediment Trap: An excavated area around the inlet to trap sediment (SE-3).

- Gravel bag barrier: Used to create a small sediment trap upstream of inlets on sloped, paved streets. Appropriate for sheet flow or when concentrated flow may exceed 0.5 cfs, and where overtopping is required to prevent flooding.

- Block and Gravel Filter: Appropriate for flows greater than 0.5 cfs.

- Temporary Geotextile Storm drain Inserts: Different products provide different features. Refer to manufacturer details for targeted pollutants and additional features.

- Biofilter Bag Barrier: Used to create a small retention area upstream of inlets and can be located on pavement or soil. Biofilter bags slowly filter runoff allowing sediment to settle out. Appropriate for flows under 0.5 cfs.

- Compost Socks: Allow filtered run-off to pass through the compost while retaining sediment and potentially other pollutants (SE-13). Appropriate for flows under 1.0 cfs.

- Select the appropriate type of inlet protection and design as referred to or as described in this fact sheet.

- Provide area around the inlet for water to pond without flooding structures and property.

- Grates and spaces around all inlets should be sealed to prevent seepage of sediment-laden water.

- Excavate sediment sumps (where needed) 1 to 2 ft with 2:1 side slopes around the inlet.

Installation

- ***DI Protection Type 1 - Silt Fence -*** Similar to constructing a silt fence; see BMP SE-1, Silt Fence. Do not place fabric underneath the inlet grate since the collected sediment may fall into the drain inlet when the fabric is removed or replaced and water flow through the grate will be blocked resulting in flooding. See typical Type 1 installation details at the end of this fact sheet.

  1. Excavate a trench approximately 6 in. wide and 6 in. deep along the line of the silt fence inlet protection device.

  2. Place 2 in. by 2 in. wooden stakes around the perimeter of the inlet a maximum of 3 ft apart and drive them at least 18 in. into the ground or 12 in. below the bottom of the trench. The stakes should be at least 48 in.

  3. Lay fabric along bottom of trench, up side of trench, and then up stakes. See SE-1, Silt Fence, for details. The maximum silt fence height around the inlet is 24 in.

  4. Staple the filter fabric (for materials and specifications, see SE-1, Silt Fence) to wooden stakes. Use heavy-duty wire staples at least 1 in. in length.

5. Backfill the trench with gravel or compacted earth all the way around.

- ***DI Protection Type 2 - Excavated Drop Inlet Sediment Trap -*** Install filter fabric fence in accordance with DI Protection Type 1. Size excavated trap to provide a minimum storage capacity calculated at the rate 67 yd^3/acre of drainage area. See typical Type 2 installation details at the end of this fact sheet.

- ***DI Protection Type 3 - Gravel bag -*** Flow from a severe storm should not overtop the curb. In areas of high clay and silts, use filter fabric and gravel as additional filter media. Construct gravel bags in accordance with SE-6, Gravel Bag Berm. Gravel bags should be used due to their high permeability. See typical Type 3 installation details at the end of this fact sheet.

  1. Construct on gently sloping street.

  2. Leave room upstream of barrier for water to pond and sediment to settle.

  3. Place several layers of gravel bags – overlapping the bags and packing them tightly together.

  4. Leave gap of one bag on the top row to serve as a spillway. Flow from a severe storm (e.g., 10 year storm) should not overtop the curb.

- ***DI Protection Type 4 – Block and Gravel Filter -*** Block and gravel filters are suitable for curb inlets commonly used in residential, commercial, and industrial construction. See typical Type 4 installation details at the end of this fact sheet.

  1. Place hardware cloth or comparable wire mesh with 0.5 in. openings over the drop inlet so that the wire extends a minimum of 1 ft beyond each side of the inlet structure. If more than one strip is necessary, overlap the strips. Place woven geotextile over the wire mesh.

  2. Place concrete blocks lengthwise on their sides in a single row around the perimeter of the inlet, so that the open ends face outward, not upward. The ends of adjacent blocks should abut. The height of the barrier can be varied, depending on design needs, by stacking combinations of blocks that are 4 in., 8 in., and 12 in. wide. The row of blocks should be at least 12 in. but no greater than 24 in. high.

  3. Place wire mesh over the outside vertical face (open end) of the concrete blocks to prevent stone from being washed through the blocks. Use hardware cloth or comparable wire mesh with 0.5 in. opening.

  4. Pile washed stone against the wire mesh to the top of the blocks. Use 0.75 to 3 in.

- ***DI Protection Type 5 – Temporary Geotextile Insert (proprietary) –*** Many types of temporary inserts are available. Most inserts fit underneath the grate of a drop inlet or inside of a curb inlet and are fastened to the outside of the grate or curb. These inserts are removable and many can be cleaned and reused. Installation of these inserts differs between manufacturers. Please refer to manufacturer instruction for installation of proprietary devices.

- ***DI Protection Type 6 - Biofilter bags*** – Biofilter bags may be used as a substitute for gravel bags in low-flow situations. Biofilter bags should conform to specifications detailed in SE-14, Biofilter bags.

    1. Construct in a gently sloping area.
    2. Biofilter bags should be placed around inlets to intercept runoff flows.
    3. All bag joints should overlap by 6 in.
    4. Leave room upstream for water to pond and for sediment to settle out.
    5. Stake bags to the ground as described in the following detail. Stakes may be omitted if bags are placed on a paved surface.

- ***DI Protection Type 7 – Compost Socks*** – A compost sock can be assembled on site by filling a mesh sock (e.g., with a pneumatic blower). Compost socks do not require special trenching compared to other sediment control methods (e.g., silt fence). Compost socks should conform to specification detailed in SE-13, Compost Socks and Berms.

Costs

- Average annual cost for installation and maintenance of DI Type 1-4 and 6 (one year useful life) is $200 per inlet.
- Temporary geotextile inserts are proprietary and cost varies by region. These inserts can often be reused and may have greater than 1 year of use if maintained and kept undamaged. Average cost per insert ranges from $50-75 plus installation, but costs can exceed $100. This cost does not include maintenance.
- See SE-13 for Compost Sock cost information.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Silt Fences. If the fabric becomes clogged, torn, or degrades, it should be replaced. Make sure the stakes are securely driven in the ground and are in good shape (i.e., not bent, cracked, or splintered, and are reasonably perpendicular to the ground). Replace damaged stakes. At a minimum, remove the sediment behind the fabric fence when accumulation reaches one-third the height of the fence or barrier height.
- Gravel Filters. If the gravel becomes clogged with sediment, it should be carefully removed from the inlet and either cleaned or replaced. Since cleaning gravel at a construction site may be difficult, consider using the sediment-laden stone as fill material and put fresh stone around the inlet. Inspect bags for holes, gashes, and snags, and replace bags as needed. Check gravel bags for proper arrangement and displacement.

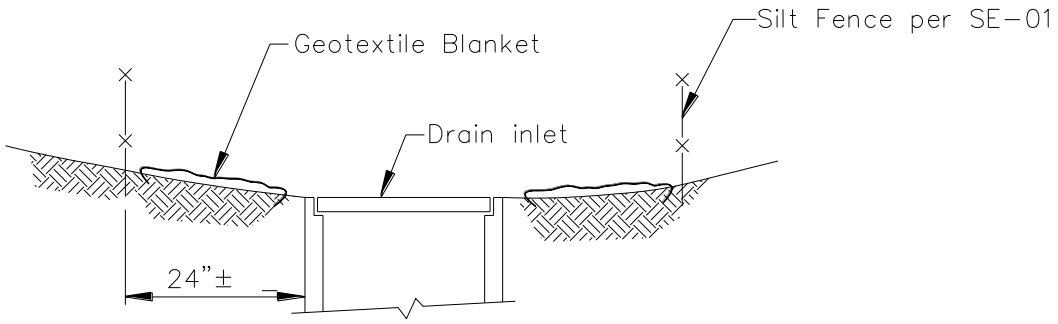
- Sediment that accumulates in the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height.
- Inspect and maintain temporary geotextile insert devices according to manufacturer's specifications.
- Remove storm drain inlet protection once the drainage area is stabilized.
    - Clean and regrade area around the inlet and clean the inside of the storm drain inlet, as it should be free of sediment and debris at the time of final inspection.

References

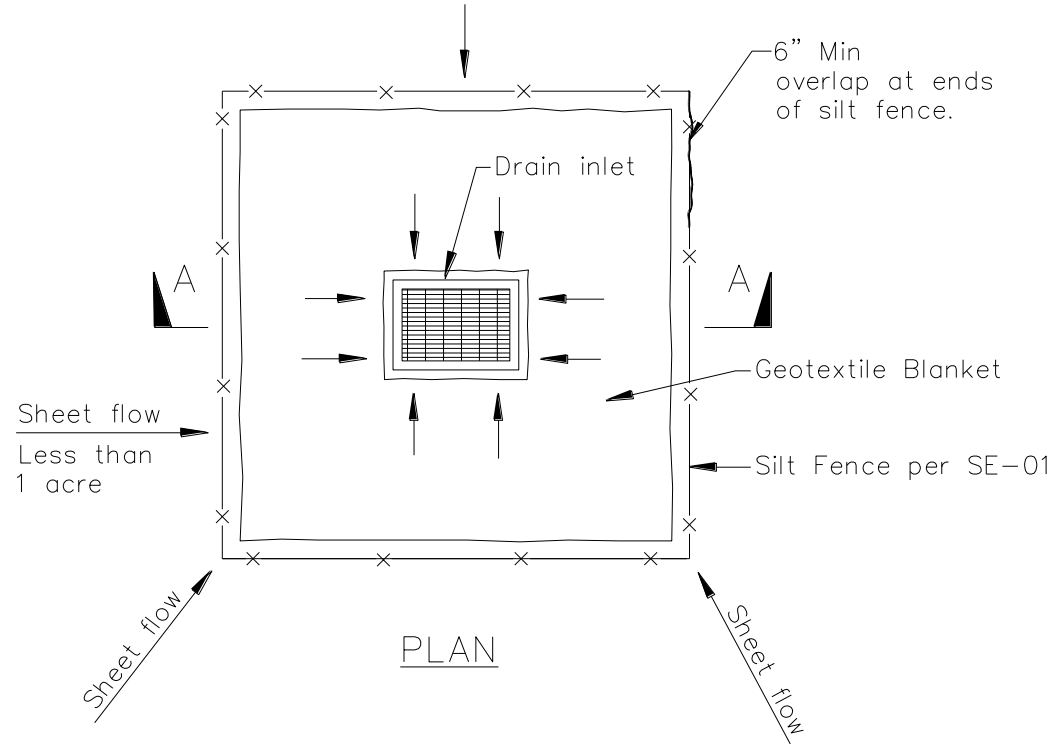
Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management Manual for The Puget Sound Basin, Washington State Department of Ecology, Public Review Draft, 1991.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.



SECTION A–A

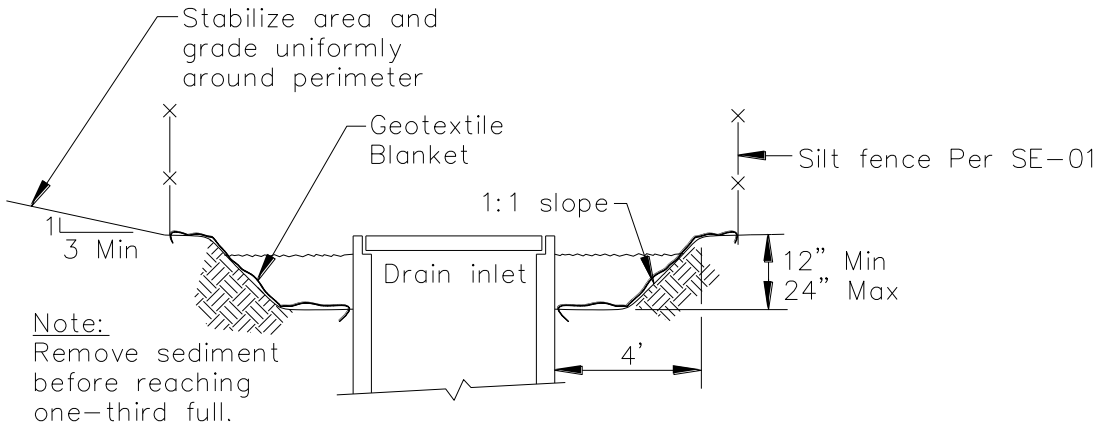


PLAN

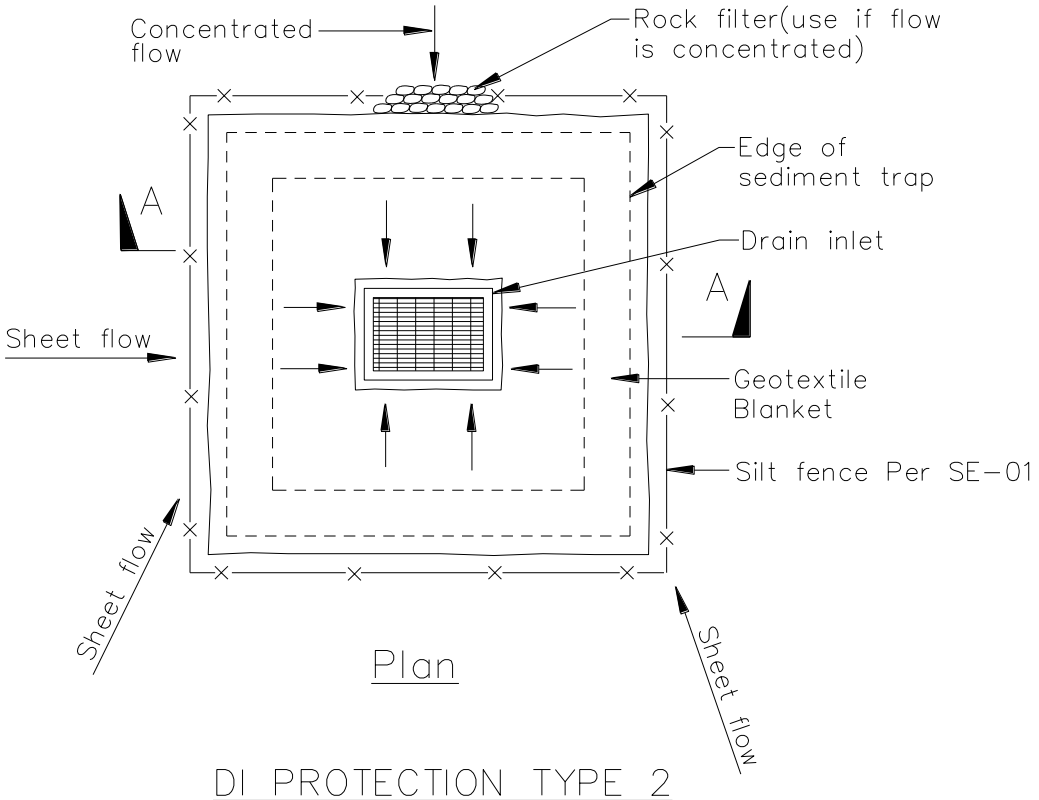
DI PROTECTION TYPE 1
NOT TO SCALE

NOTES:

1. For use in areas where grading has been completed and final soil stabilization and seeding are pending.
2. Not applicable in paved areas.
3. Not applicable with concentrated flows.



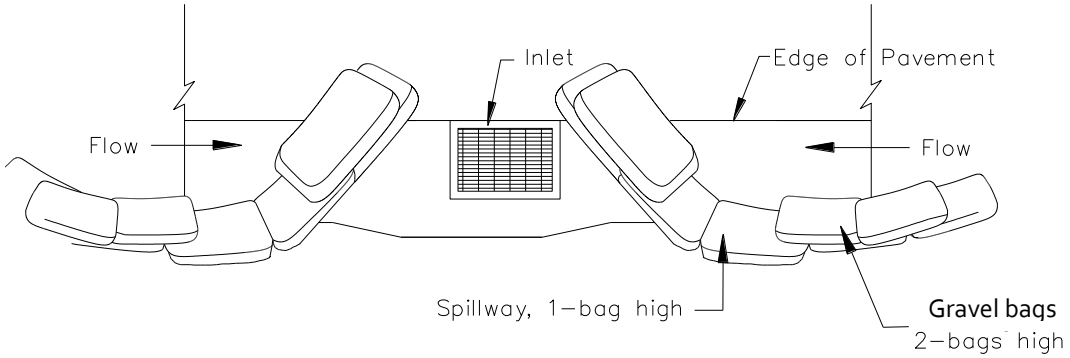
Section A–A



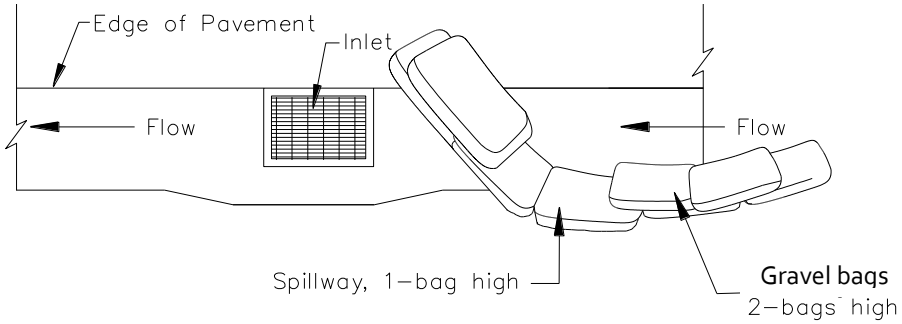
Plan

DI PROTECTION TYPE 2
NOT TO SCALE

Notes
1. For use in cleared and grubbed and in graded areas.
2. Shape basin so that longest inflow area faces longest length of trap.
3. For concentrated flows, shape basin in 2:1 ratio with length oriented towards direction of flow.



TYPICAL PROTECTION FOR INLET ON SUMP

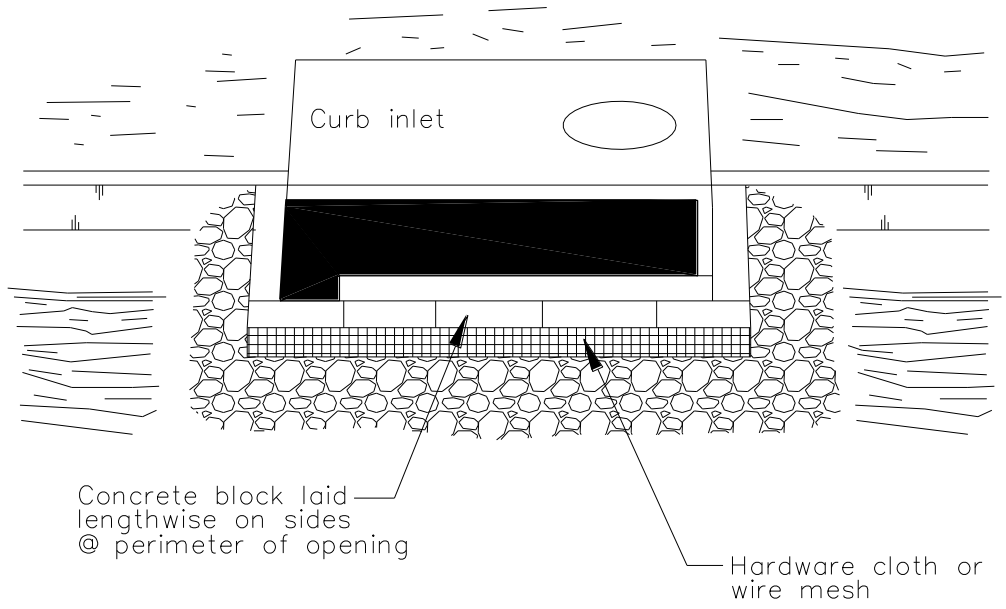


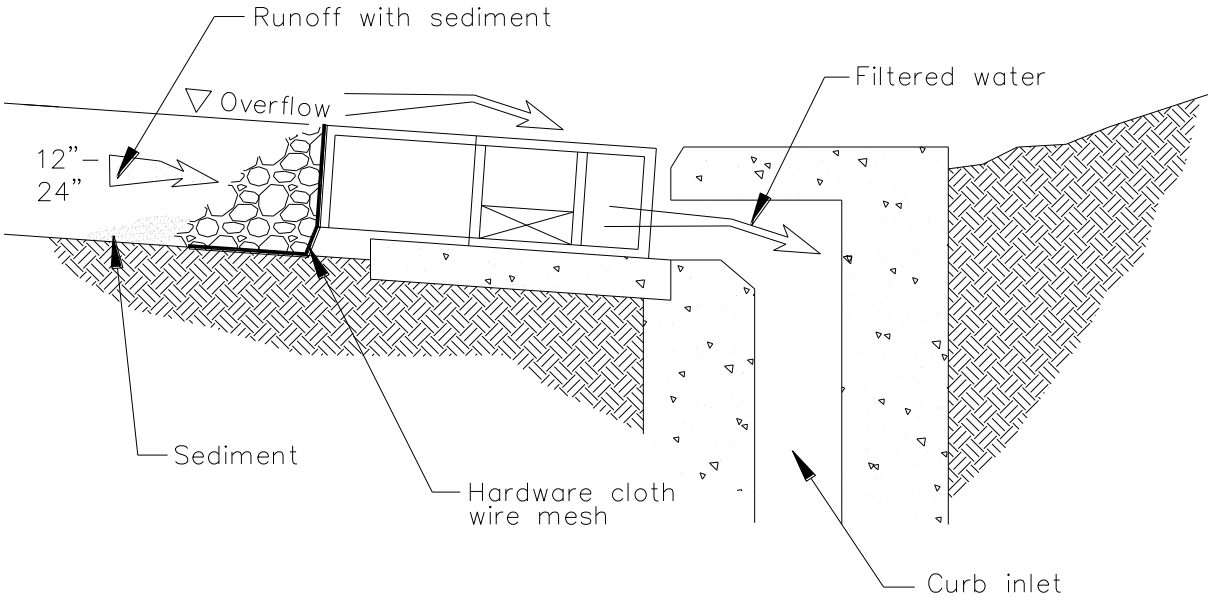
TYPICAL PROTECTION FOR INLET ON GRADE

NOTES:

1. Intended for short-term use.
2. Use to inhibit non-storm water flow.
3. Allow for proper maintenance and cleanup.
4. Bags must be removed after adjacent operation is completed
5. Not applicable in areas with high silts and clays without filter fabric.
6. Protection can be effective even if it is not immediately adjacent to the inlet provided that the inlet is protected from potential sources of pollution.

DI PROTECTION TYPE 3
NOT TO SCALE

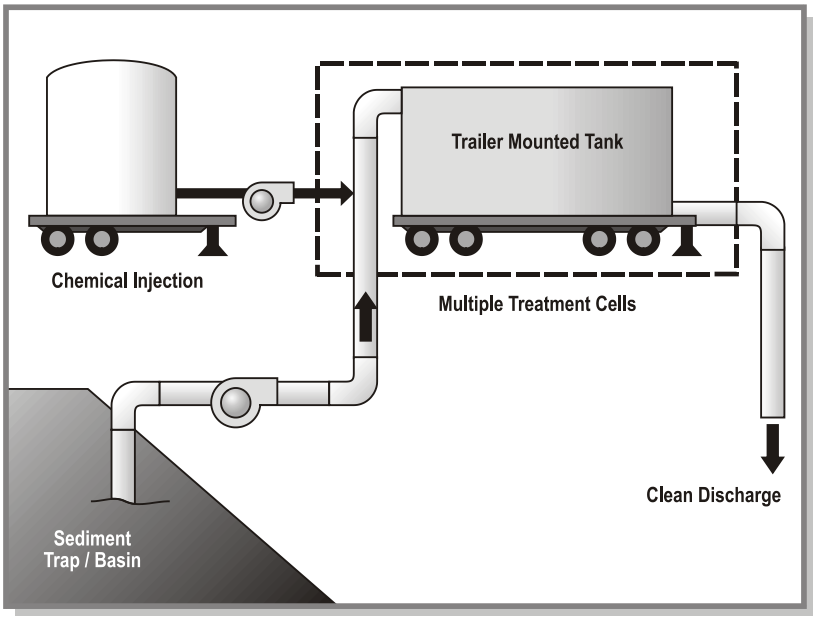




DI PROTECTION – TYPE 4

NOT TO SCALE

Active Treatment Systems SE-11



Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Active Treatment Systems (ATS) reduce turbidity of construction site runoff by introducing chemicals to stormwater through direct dosing or an electrical current to enhance flocculation, coagulation, and settling of the suspended sediment. Coagulants and flocculants are used to enhance settling and removal of suspended sediments and generally include inorganic salts and polymers (USACE, 2001). The increased flocculation aids in sedimentation and ability to remove fine suspended sediments, thus reducing stormwater runoff turbidity and improving water quality.

Suitable Applications

ATS can reliably provide exceptional reductions of turbidity and associated pollutants and should be considered where turbid discharges to sediment and turbidity sensitive waters cannot be avoided using traditional BMPs. Additionally, it may be appropriate to use an ATS when site constraints inhibit the ability to construct a correctly sized sediment basin, when clay and/or highly erosive soils are present, or when the site has very steep or long slope lengths.

Limitations

Dischargers choosing to utilize chemical treatment in an ATS must follow all guidelines of the Construction General Permit Attachment F – Active Treatment System Requirements. General limitations are as follows:

- Numeric Effluent Limit (NEL) for all discharges (10 NTU daily flow-weighted average)
- Limited availability of chemical residual testing procedures that meet permit requirements for flow-through treatment
- Specific field and classroom ATS training required to operate equipment
- Batch treatment requires extensive toxicity testing of effluent
- Batch treatment requires large footprint to accommodate treatment cells
- Requires additional filtration to remove residual floc and treatment chemicals prior to discharge
- Petroleum based polymers should not be used
- Requires site-specific design and equipment
- Limited discharge rates depending on receiving water body
- Labor intensive operation and maintenance
- ATS costs are higher on a unit basis for smaller sites that would be expected to have a lower volume of treated runoff
- ATS costs are seasonably variable due to increases or decreases in rainfall volumes

Implementation

Turbidity is difficult to control once fine particles are suspended in stormwater runoff from a construction site. Sedimentation ponds are effective at removing larger particulate matter by gravity settling, but are ineffective at removing smaller particulates such as clay and fine silt. Sediment ponds are typically designed to remove sediment no smaller than medium silt (0.02 mm). ATS may be used to reduce the turbidity of stormwater runoff. With an ATS, very high turbidities can be reduced to levels comparable to what is found in streams during dry weather.

Criteria for ATS Product Use

Chemically treated stormwater discharged from construction sites must be non-toxic to aquatic organisms. The following protocol should be used to evaluate chemicals proposed for stormwater treatment at construction sites. Authorization to use a chemical in the field based on this protocol does not relieve the applicant from responsibility for meeting all discharge and receiving water criteria applicable to a site.

- An ATS Plan, which includes an Operation and Maintenance component, a Monitoring, Sampling and Reporting component, a Health and Safety component, and a Spill Prevention component must be prepared and submitted to the Regional Water Quality Control Board (RWQCB).

- Treatment chemicals should be approved by EPA for potable water use or otherwise be demonstrated to be protective of human health and the environment. Chemical residual or whole effluent toxicity testing is required.

- Prior to field use of chemical treatment, jar tests are to be conducted to demonstrate that turbidity reduction necessary to meet the NELs and receiving water criteria can be achieved. Test conditions, including but not limited to raw water quality and jar test procedures, should be indicative of field conditions. Although these small-scale tests cannot be expected to reproduce performance under field conditions, they are indicative of treatment capability. A minimum of six site-specific jar tests must be conducted per chemical.

- The proposed maximum dosage should be at least a factor of five lower than the no observed effects concentration (NOEC).

- Effluent discharge from an ATS to a receiving water is conditional upon the favorable results of full-scale whole effluent bioassay/toxicity testing for batch treatment systems and upon chemical residuals testing for flow-through systems.

- Contact the RWQCB for a list of treatment chemicals that may be pre-approved for use.

Active Treatment System Design Considerations

The design and operation of an ATS should take into consideration the factors that determine optimum, cost-effective performance. While site characteristics will influence system design, it is important to recognize the following overriding considerations:

- The right chemical must be used at the right dosage. A dosage that is either too low or too high will not produce the lowest turbidity. There is an optimum dosage rate. This is a situation where the adage "adding more is always better" is not the case.

- The coagulant must be mixed rapidly into the water to insure proper dispersion.

- The mixing system for batch treatment must be sized to provide adequate mixing for the design storage volume. Lack of adequate mixing during the flocculation phase results in flocs that are too small and/or insufficiently dense. Too much mixing can rapidly destroy floc as it is formed.

- Care must be taken in the design of the withdrawal system to minimize outflow velocities and to prevent floc discharge. The discharge should be directed through a filtration system such as sand, bag, or cartridge filter that would catch any unintended floc discharge.

- ATS is also regulated for pH of the discharge. A pH-adjusting chemical should be added into the treated water to control pH if the selected coagulant requires alteration of the pH of the discharge outside of the acceptable range.

Active Treatment System Design

ATS can be designed as batch treatment systems using either ponds or portable trailer-mounted tanks, or as flow-through systems using any number of proprietary designed systems.

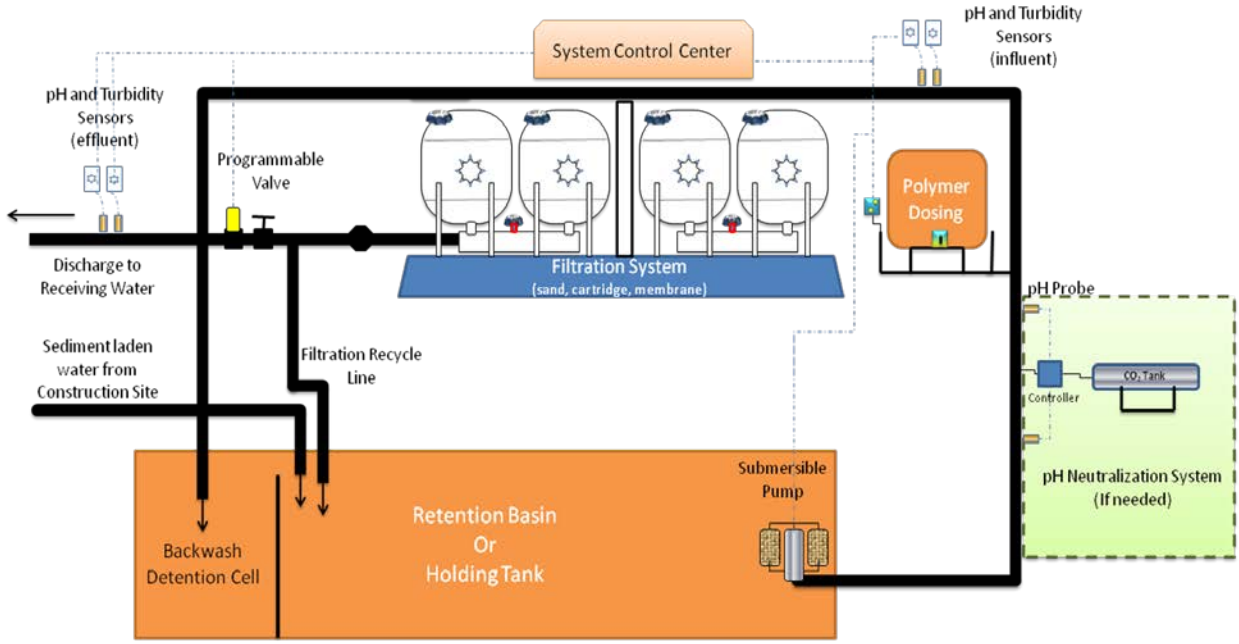


Figure has been adapted from Port of Seattle response to Washington Dept. of Ecology Action Order 2948

Batch Treatment

Batch Treatment systems consist of the stormwater collection system (either temporary diversion or the permanent site drainage system); a sediment basin, trap or holding tanks; pumps; a chemical feed system; treatment cells; and, interconnecting piping.

Batch treatment systems should use a minimum of two lined treatment cells. Multiple treatment cells allow for clarification of treated water while other cells are being filled or emptied. Treatment cells may be basins, traps, or tanks. Portable tanks may also be suitable for some sites.

The following equipment should be located in a secured, covered location:

- The chemical injector
- Secondary contaminant for acid, caustic, buffering compound, and treatment chemical
- Emergency shower and eyewash
- Monitoring equipment which consists of a pH meter and a turbidimeter (if not already within the instrumentation panel of the chemical injector)

Flow-through Treatment

At a minimum, a flow-through ATS system consists of the stormwater collection system (either temporary diversion or the permanent site drainage system), an untreated stormwater storage pond or holding tank, and a chemically enhanced filtration system.

Stormwater is collected at interception point(s) on the site and is diverted by gravity or by pumping to an untreated stormwater storage pond or other untreated stormwater holding area.

The stormwater is stored until treatment occurs. It is important that the holding pond be large enough to provide adequate storage.

Stormwater is then pumped from the untreated stormwater storage pond to the chemically enhanced filtration system where polymer is added. Adjustments to pH may be necessary before chemical addition. The filtration system continually monitors the stormwater for turbidity and pH. If the discharge water is out of the acceptable turbidity or pH range, the water is recycled to the untreated stormwater pond (or holding tank) where it can be retreated. Flow through systems must ensure that:

- Cumulative flow volume shall be recorded daily. The data recording system shall have the capacity to record a minimum of seven days of continuous data.
- Instrumentation systems are interfaced with system control to provide auto shutoff or recirculation in the event that effluent measurements exceed turbidity or pH.
- Upon system upset, power failure, or other catastrophic event, the ATS will default to a recirculation mode or safe shut down.
- The instrumentation system provides a method for controlling coagulant dose, to prevent potential overdosing.

Sizing Criteria

An ATS shall be designed and approved by a Certified Professional in Erosion and Sediment Control (CPESC), a Certified Professional in Storm Water Quality (CPSWQ); a California registered civil engineer; or any other California registered engineer.

ATS must be designed to capture and treat (within 72 hours) runoff from the 10-year 24-hour storm event. The runoff volume of the watershed area to be treated from this size storm event is required to be calculated using the Rational Method with a runoff coefficient of 1.

If sediment basins are used to capture flow-through or batch treatment, see SE-2, Sediment Basin, for design criteria. Bypass should be provided around the ATS to accommodate extreme storm events. Primary settling should be encouraged in the sediment basin/storage pond. A forebay with access for maintenance may be beneficial.

The permissible discharge rate governed by potential downstream effect should be used to calculate the recommended size of the treatment cells. Local requirements related to Phase I or Phase II NPDES permit thresholds should be considered in developing maximum discharge rates the ATS Plan.

Costs

Costs for ATS may be significant due to equipment rental requirements and cost of chemicals. ATS cost is lower on a treated unit-basis for large construction sites with large volumes of runoff.

Inspection and Maintenance

ATS must be operated and maintained by individuals with experience in their use and trained in accordance with training requirements below. ATS should be monitored continuously while in

use. A designated responsible person shall be on site daily at all times during treatment operations. Daily on-site visual monitoring of the system for proper performance shall be conducted and recorded in the project data log. The name, phone number, and training documentation of the person responsible for system operation and monitoring shall be included in the project data log.

The following monitoring requirements and results should be recorded in the data log:

Operational and Compliance Monitoring

- Effluent flow rate and volume shall be continuously monitored and recorded at 15- minute or less intervals.
- Influent and effluent pH must be continuously monitored and recorded at 15-minute or less intervals.
- Influent and effluent turbidity (expressed in NTU) must be continuously monitored and recorded at 15-minute or less intervals.
- The type and amount of chemical used for pH adjustment, if any, shall be monitored and recorded.
- Dose rate of chemical used in the ATS system (expressed in mg/L) shall be monitored and reported 15-minutes after startup and every 8 hours of operation.
- Laboratory duplicates – monthly laboratory duplicates for residual coagulant analysis must be performed and records shall be maintained onsite.
- Effluent shall be monitored and recorded for residual chemical/additive levels.
- If a residual chemical/additive test does not exist and the ATS is operating in a batch treatment mode of operation refer to the toxicity monitoring requirements below.

Toxicity Monitoring

Batch Treatment

Toxicity testing for systems operated in batch treatment mode should be made in accordance with the following:

- Acute toxicity testing on effluent samples representing effluent from each batch prior to discharge shall be undertaken. All bioassays shall be sent to a laboratory certified by the Department of Health Services (DHS) Environmental Laboratory Accreditation Program (ELAP). The required field of testing number for Whole Effluent Toxicity (WET) testing is E113.
- Acute toxicity tests shall be conducted with the following species and protocols. The methods to be used in the acute toxicity testing shall be those outlined for a 96-hour acute test in "Methods for Measuring the Acute Toxicity of Effluents and Receiving Water to Freshwater and Marine Organisms, USEPA-841-R-02-012" for Fathead minnow, *Pimephales promelas*. Rainbow trout, *Oncorhynchus mykiss*, may be used as a substitute for fathead minnow.

All toxicity tests shall meet quality assurance criteria and test acceptability criteria in the most recent versions of the EPA test method for WET testing.

Flow-through Treatment

Toxicity testing for systems operated in flow-through treatment mode should be made in accordance with the following:

- A residual chemical test method shall be used that has a method detection limit (MDL) of 10% or less than the maximum allowable threshold concentration (MATC) for the specific coagulant in use and for the most sensitive species of the chemical used. The MATC is equal to the geometric mean of the No Observed Effect Concentration (NOEC) and Lowest Observed Effect Concentration (LOEC) Acute and Chronic toxicity results for most sensitive species determined for the specific coagulant.
- The residual chemical test method shall produce a result within one hour of sampling.
- A California State certified laboratory shall validate the selected residual chemical test. Specifically the lab will review the test protocol, test parameters, and the detection limit of the coagulant. The discharger shall electronically submit this documentation as part of the ATS Plan.

Numeric Effluent Limit (NEL) Compliance:

All chemically treated stormwater must be sampled and tested for compliance with pH and turbidity limits. These limits have been established by the Construction General Permit. Sampling and testing for other pollutants may also be necessary at some sites. Turbidity limits have been set as 10 NTU as a daily flow-weighted average or 20 NTU from a single sample. pH must be within the range of 6.0 to 9.0 standard units. It is often possible to discharge treated stormwater that has a lower turbidity than the receiving water and that matches the pH.

Treated stormwater samples and measurements should be taken from the discharge pipe or another location representative of the nature of the treated stormwater discharge. Samples used for determining compliance with the water quality standards in the receiving water should not be taken from the treatment pond prior to decanting. Compliance with the water quality standards is determined in the receiving water.

Operator Training:

Operators shall have training specific to using an ATS and liquid coagulants for stormwater discharges in California. The training shall be in the form of a formal class with a certificate and requirements for testing and certificate renewal. Training shall include a minimum of eight hours classroom and 32 hours field training.

Standard BMPs:

Erosion and sediment control BMPs should be implemented throughout the site to prevent erosion and discharge of sediment to the ATS. Some types of chemical coagulation and flocculation are only achievable in water below a certain turbidity; therefore minimizing the amount of sediment reaching the system will increase the likelihood of meeting effluent limits and will potentially lower costs of chemical dosing.

Sediment Removal and Disposal

- Sediment shall be removed from the storage or treatment cells as necessary to ensure that the cells maintain their required water storage (i.e., volume) capability.
- Handling and disposal of all solids generated during ATS operations shall be done in accordance with all local, state, and federal laws and regulations.
- If sediment is determined to be non-toxic, it may be incorporated into the site away from drainages.

References

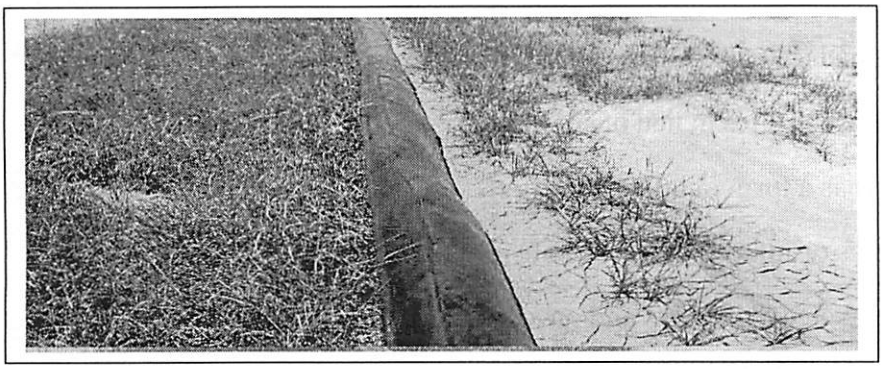
Engineering and Design – Precipitation/Coagulation/Flocculation. United States Army Corps of Engineers, EM 1110-1-4012, 2001.

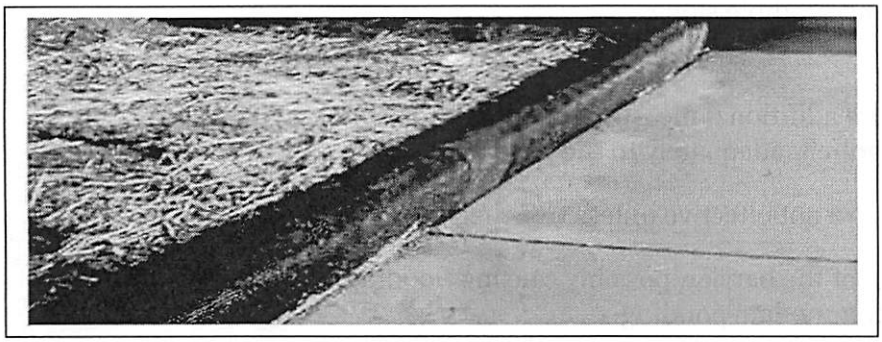
Evaluation of Active Treatment Systems (ATS) for Construction Site Runoff. California Building and Industry Association (prepared by Geosyntec Consultants), 2008.

Stormwater Management Manual for Western Washington, Volume II – Construction Stormwater Pollution Prevention, Washington State Department of Ecology, August 2001.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Temporary Silt Dike SE-12





Categories

EC	Erosion Control	☒
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☒
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Roll

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

Description and Purpose

Temporary silt dikes are pre-manufactured devices that are typically specified and installed for drainage and sediment control on the perimeter of disturbed sites or stockpiles and as check dams within channels. Manufactured products include flexible and rigid silt dikes. Both types of temporary silt dikes can be reused. Flexible temporary silt dikes typically consist of a triangular foam or recycled rubber core covered in geotextile fabric. Rigid temporary silt dikes typically consist of an outer jacket made of a rigid High Density Polyethylene (HDPE) matrix and contain an integrated HDPE or polypropylene geotextile filter or a tubular assembly of overlapping layers of porous synthetic materials (frequently called synthetic sediment control rolls). Temporary silt dikes come in a variety of profiles including triangular, round, rectangular, L-shaped, I-shaped, and T-shaped.

Suitable Applications

Temporary silt dikes are generally used in areas as a substitute for fiber rolls and silt fences in sediment control applications to slow down runoff water, divert drainage or contain fines and sediment. Temporary silt dikes are a linear control and application suitability varies based on the specific product type. They may be suitable for:

- On paved surfaces for perimeter protection.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- As check structures in channels.
- Along the perimeter of disturbed sites in lieu of silt fence.
- At operational storm drains as a form of inlet protection.
- Around temporary stockpiles or material/equipment storage areas.
- At the interface between graveled driveways and pavement.
- Along the toe of exposed and erodible slopes.

Limitations

- Temporary silt dikes require additional measures to adhere to asphalt in cold and windy climates, as glue may not adhere adequately to the pavement.
- Rigid temporary silt dikes are not effective unless trenched-in and staked.
- Runoff will pond upstream of the barrier, possibly causing flooding or bypass if sufficient space does not exist to accommodate ponding.
- Temporary silt dikes may require frequent maintenance especially when used near vehicle traffic or to detain concentrated flows (e.g. check dams or inlet protection).
- When used to detain concentrated flows, maintenance requirements increase.
- Temporary silt dikes are not biodegradable and should be removed after construction activities are complete and disturbed soil areas have been stabilized.
- Temporary silt dikes may not be suitable for application as linear slope controls (slope interruptions).
- Temporary silt dikes should not be used on slopes subject to creep, slumping, or landslide.

Implementation

General

When appropriately placed, temporary silt dikes intercept and slow sheet flow runoff, causing temporary ponding. The temporary ponding provides quiescent conditions allowing sediment to settle. The device is porous, which allows the ponded runoff to flow slowly through the silt dike, releasing the runoff as sheet flows. Generally, temporary silt dikes should be used in conjunction with temporary soil stabilization controls up-slope to provide an effective combination of erosion and sediment control.

Design and Layout

- Temporary silt dikes used on soil should be trenched or attached to the ground per manufacturer specifications in a manner that precludes runoff or ponded water from flowing around or under the silt dike.
- Temporary silt dikes used on asphalt or concrete may be attached using a variety of methods, including nailing the dikes to the pavement, or using a high strength adhesive.

- Follow manufacturer specifications when installing temporary silt dikes.
- Allow sufficient space up slope from the silt dike to allow ponding, and to provide room for sediment storage.
- For installation near the toe of the slope, temporary silt dike should be set back three feet from the slope toe to facilitate cleaning. Where site conditions do not allow set back, the silt dike may be constructed on the toe of the slope. To prevent flows behind the barrier, sand or gravel bags can be placed perpendicular and between the silt dike and slope to serve as a barrier to parallel flow.
- Drainage area should not exceed 5 acres.
- Butt ends of temporary silt dike tightly. Overlaps should be sealed in accordance with the manufacturer's detail.
- Ends of runs should be sloped uphill to prevent concentrated end-around flows.
- For installations as check dams, see SE-4.

Materials

- Several manufactured products are available.

Costs

- Flexible silt dike averages $35-45 per 7 ft. section.
- Rigid silt dike averages $1.80-$7.00 per foot.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Temporary silt dike exposed to sunlight will need to be replaced more frequently due to photo-degradation.
- Reshape or replace sections of damaged temporary silt dike as needed.
- Repair washouts or other damage as needed.
- Sediment that accumulates behind the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height.
- Remove temporary silt dikes when no longer needed. Remove sediment accumulation and clean, re-grade, and stabilize the area. Removed sediment should be incorporated in the project or disposed of properly.

References

City of Elko Construction Site Best Management Practices Handbook, December 2005

Construction Site Best Management Practices Handbook, June 2008 Update, Truckee Meadows Regional Stormwater Quality Management Program, June 2008

Complying with the Edwards Aquifer Rules Technical Guidance on Best Management Practices, Texas Commission on Environmental Quality, Revised July 2005, Addendum Sheet, January26, 2011

Stormwater Management Manual for Western Washington Volume II, Construction Stormwater Pollution Prevention, Washington State Department of Ecology, February 2005

Compost Socks and Berms SE-13



Description and Purpose

Compost socks and berms act as three-dimensional biodegradable filtering structures to intercept runoff where sheet flow occurs and are generally placed at the site perimeter or at intervals on sloped areas. Compost socks are generally a mesh sock containing compost and a compost berm is a dike of compost, trapezoidal in cross section. When employed to intercept sheet flow, both BMPs are placed perpendicular to the flow of runoff, allowing filtered runoff to pass through the compost and retaining sediment (and potentially other pollutants). A compost sock can be assembled on site by filling a mesh sock (e.g. with a pneumatic blower). The compost berm should be constructed using a backhoe or equivalent and/or a pneumatic delivery (blower) system and should be properly compacted. Compost socks and berms act as filters, reduce runoff velocities, and in some cases, aid in establishing vegetation.

Compost is organic, biodegradable, and renewable. Compost provides soil structure that allows water to infiltrate the compost medium which helps prevent rill erosion and the retained moisture promotes seed germination and vegetation growth, in addition to providing organic matter and nutrients important for fostering vegetation. Compost improves soil quality and productivity, as well as erosion and sediment control.

Categories

EC	Erosion Control	☒
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	☒
Bacteria	☒
Oil and Grease	☒
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Roll

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-14 Biofilter Bags

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

The compost of the compost sock or berm can be selected that targets site specific objectives in capturing sediment and other pollutants, supporting vegetation, or additional erosion control.

Compost is typically derived from combinations of feedstocks, biosolids, leaf and yard trimmings, manure, wood, or mixed solid waste. Many types of compost are products of municipal recycle or "Greenwaste" programs. Compost is organic and biodegradable and can be left onsite. There are many types of compost with a variety of properties with specific functions, and accordingly compost selection is an important design consideration in the application of this type of erosion and sediment control.

Suitable Applications

- Along the toe, top, face, and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow (compost berms should only be used at the top of slopes or on slopes 4:1 (H:V) or flatter, all other slope applications should use compost socks)
- Along the perimeter of a project
- As check dams in unlined ditches (compost socks only)
- Down-slope of exposed soil areas
- At operational storm drains as a form of inlet protection (compost socks only)
- Around temporary stockpiles

Compost socks and berms do not require special trenching or BMP removal compared to other sediment control methods (e.g. silt fence or fiber rolls). Compost socks and berms can remain in place after earth disturbing activities are completed or the compost components can be spread over the site providing nutrients for plant growth and augmenting soil structure. BMPs that remain in place are particularly advantageous below embankments, especially adjacent streams, by limiting re-entry and the disturbance to sensitive areas.

Compost can be pre-seeded prior to application (recommended by the EPA for construction site stormwater runoff control and required for compost socks) or seeded after installation (for compost berms only). The compost medium can also remove pollutants in stormwater including heavy metals; oil and grease; and hydrocarbons.

Limitations

- Compost can potentially leach nutrients (dissolved phosphorus and nitrogen) into runoff and potentially impact water quality. Compost should not be used directly upstream from nutrient impaired waterbodies (Adams et. al, 2008).
- Compost may also contain other undesirable constituents that are detrimental to water quality. Compost should be obtained from a supplier certified by the California Integrated Waste Management Board or compost should otherwise meet the environmental health standards of Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7. Carefully consider the qualifications and experience of any compost producer/supplier.

- Application by hand is more time intensive and potentially costly. Using a pneumatic blower truck is the recommended cost effective method of assembly.
- Compost socks and berms should not be employed at the base of slopes greater than 2:1 (H:V). They can be employed with other erosion control methods for steeper slopes.
- Difficult to move once saturated.
- Compost berms should not be applied in areas of concentrated flows.
- Compost socks and berms are easy to fix; however, they are susceptible to damage by frequent traffic. Compost socks can be used around heavy machinery, but regular disturbance decreases sock performance.

Implementation

Compost Materials

- California Compost Regulations (Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7, Section 17868.3) define and require a quality of compost for application. Compost should comply with all physical and chemical requirements. Specific requirements are provided in **Table 1**, taken from Caltrans Standard Special Provision 10-1 (SSP 10-1), Erosion Control (Compost Blanket).
- The compost producer should be fully permitted as specified under the California Integrated Waste Management Board, Local Enforcement Agencies and any other State and Local Agencies that regulate Solid Waste Facilities. If exempt from State permitting requirements, the composting facility should certify that it follows guidelines and procedures for production of compost meeting the environmental health standards of Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7.
- The compost producer should be a participant in United States Composting Council's Seal of Testing Assurance program.
- Compost medium parameter specifications for compost socks and berms have been developed to assist in compost selection, such as those provided by the American Association of State Highway Transportation Officials (AASHTO).
- Particle size is important parameter for selecting compost. Well consolidated coarser grades of compost (e.g. small and large pieces) perform better for filtration objectives, while finer grades better support vegetation. Particle size of the compost should be selected based on site conditions, such as expected precipitation, and filtration goals and / or long term plant nutrients.
- Compost moisture should be considered for composition quality and application purposes. A range of 30-50% is typical. Compost that is too dry is hard to apply and compost that is too wet is more difficult (and more expensive) to transport. For arid or semi-arid areas, or for application during the dry season, use compost with greater moisture content than areas with wetter climates. For wetter or more humid climates or for application during the wet season, drier composts can be used as the compost will absorb moisture from the ambient air.

- If vegetation establishment is a desired function of the compost, a compost sample should be inspected by a qualified individual. Vegetation has different nutrient and moisture needs.
- Organic content of the compost is also important and should range from 30 to 65% depending on site conditions.
- Compost should not be derived from mixed municipal solid waste and should be reasonably free of visible contaminates.
- Compost should not contain paint, petroleum products, pesticides or any other chemical residues harmful to animal life or plant growth. Metal concentrations in compost should not exceed the maximum metal concentrations listed under Title 14, California Code of Regulations, Division 7, Chapter 3.1, Section 17868.2.
- Compost should not possess objectionable odors.
- Compost should be weed free.

Table 1. Physical/Chemical Requirements of Compost
Reference - Caltrans SSP-10 Erosion Control Blanket (Compost)

Property	Test Method	Requirement
pH	*TMECC 04.11-A Elastometric pH 1:5 Slurry Method pH Units	6.0–8.0
Soluble Salts	TMECC 04.10-A Electrical Conductivity 1:5 Slurry Method dS/m (mmhos/cm)	0-10.0
Moisture Content	TMECC 03.09-A Total Solids & Moisture at 70+/- 5 deg C % Wet Weight Basis	30-60
Organic Matter Content	TMECC 05.07-A Loss-On-Ignition Organic Matter Method (LOI) % Dry Weight Basis	30–65
Maturity	TMECC 05.05-A Germination and Vigor Seed Emergence Seedling Vigor % Relative to Positive Control	 80 or Above 80 or Above
Stability	TMECC 05.08-B Carbon Dioxide Evolution Rate mg CO_2-C/g OM per day	8 or below
Particle Size	TMECC 02.02-B Sample Sieving for Aggregate Size Classification % Dry Weight Basis	100% Passing, 3 inch 90-100% Passing, 1 inch 65-100% Passing, 3/4 inch 0 - 75% Passing, 1/4 inch Maximum length 6 inches
Pathogen	TMECC 07.01-B Fecal Coliform Bacteria < 1000 MPN/gram dry wt.	Pass
Pathogen	TMECC 07.01-B Salmonella < 3 MPN/4 grams dry wt.	Pass
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Plastic, Glass and Metal % > 4mm fraction	Combined Total: < 1.0
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Sharps (Sewing needles, straight pins and hypodermic needles) % > 4mm fraction	None Detected

*TMECC refers to "Test Methods for the Examination of Composting and Compost," published by the United States Department of Agriculture and the United States Compost Council (USCC).

Installation

- Prior to application, prepare locations for socks and berms by removing brush and thick vegetation. The compost of the sock and/or berm should be allowed to come in full contact with the ground surface.

- Select method to apply the compost sock or berm. A pneumatic blower is most cost effective and most adaptive in applying compost to steep, rough terrain, and hard to reach locations.

- The compost of the berm should be distributed evenly to the surface, compacted, and shaped trapezoidal in cross section. Berm design is generally consists of a base two times the height. AASHTO specification MP 9-03 provides compost berm dimensions based on anticipated

site precipitation (AASHTO, 2003 and USEPA, 2009). State agencies, such as Oregon Department of Environmental Quality (ODEQ) have developed berm dimension based on slope steepness and length (ODEQ, 2004).

- Compost socks can be assembled on site by filling mesh socks with the selected compost. Mesh socks can be tied at one end, filled, and then tied at the other end. The ends of socks can be interlocked until the desired length is achieved. The sock diameter is a function of slope steepness and length. Again, ASSHTO provides specifications for various parameters. Compost socks range from 8" to 18", but are typically 12" to 18" in diameter.

- Compost socks are typically placed in contours perpendicular to sheet flow. They can also be placed in V formation on a slope. Compost socks need to be anchored, typically stakes, through the center of the sock. To prevent water flowing around them, the ends of compost socks should be placed upslope.

- Locate compost socks and berms on level contours spaced as follows:

  - Slope inclination of 4:1 (H:V) or flatter: Socks and/or berms should be placed at a maximum interval of 20 ft.

  - Slope inclination between 4:1 and 2:1 (H:V): Socks should be placed at a maximum interval of 15 ft. (a closer spacing is more effective).

  - Slope inclination 2:1 (H:V) or greater: Socks should be placed at a maximum interval of 10 ft. (a closer spacing is more effective).

- Place perimeter socks and berms using a j-hook installation. Use of vegetation will also provide additional anchoring.

- Compost socks and berms can be placed around the perimeter of an affected area, like a silt fence, if the area is flat or on a contour. Do not place these socks and berms where ponded water could become an issue.

- If used at the toe of slopes, the compost sock or berm should at a minimum of 5 to 10 feet away.

- Use additional anchoring and erosion control BMPs in conjunction of the compost socks and berms as needed.

- Consider using compost berms or socks as necessary at the top and/or bottom of the slope for additional erosion control performance.

- Compost socks and berms can also be effective over rocky and frozen ground if installed properly.

- It is recommended that the drainage areas of these compost BMPs do not exceed 0.25 acre per 100 feet placement interval and runoff does not exceed 1 cubic foot per second.

Costs

Recently obtained vendor costs indicated $3.50 per linear foot for compost berm application and $2.00 per linear foot for 8" socks and $2.50 per linear foot for 12"socks. Costs do not include final compost sock or berm functions at the end of construction activities, including spreading or removal, if required. ODEQ estimates that compost berms cost 30 percent less than silt fences to install.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Once damage is identified, mend or reapply the sock or berm as needed. Washed out areas should be replaced. If the sock or berm height is breached during a storm, an additional sock can be stacked to increase the sock height and similarly the berm dimensions can be increased, as applicable. An additional sock or berm may be installed upslope, as needed. It may be necessary to apply an additional type of stormwater BMP, such as a compost blanket.

- Sediment contained by the sock or berm should be removed prior reaching 1/3 of the exposed height of the BMP. The sediment can be stabilized with the compost sock or berm with vegetation at the end of construction activities.

- Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require reapplication of BMPs.

- Limit traffic to minimize damage to BMPs or impede vegetation establishment.

References

An analysis of Composting as an Environmental Remediation Technology, U.S. Environmental Protection Agency (USEPA), Solid Waste and Emergency Response (5305W), EPA530-R-8-008, 1998.

Characteristics of Compost: Moisture Holding and Water Quality Improvement, Center for Research in Water Resources, Kirchoff, C., Malina, J., and Barrett, M., 2003.

Compost Utilization for Erosion Control, The University of Georgia College of Agricultural and Environmental Sciences, pubs.caes.uga.edu/caespubs/pubcd/B1200.htm, Faucette, B. and Risse, M., 2001.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Standard Special Provision 10-1, Erosion Control (Compost Blanket), State of California Department of Transportation (Caltrans). 2007 Update.

Evaluation of Environmental Benefits and Impacts of Compost and Industry Standard Erosion and Sediment Controls Measures Used in Construction Activities, Dissertation, Institute of Ecology, University of Georgia, Faucette, B., 2004.

National Pollutant Discharge Elimination System (NPDES), Compost Blankets, U.S. Environmental Protection Agency (USEPA). http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=118, 2009.

Standard Specifications for Transportation Materials and Methods of Sampling and Testing, Designation MP-9, Compost for Erosion/Sediment Control (Filter Berms), Provisional, American Association of State Highway Transportation Officials (AASHTO), 2003.

Stormwater Best Management Practices (BMPs) Field Trials of Erosion Control Compost in Reclamation of Rock Quarry Operations, Nonpoint Source Protection Program CWA §319(h), Texas Commission on Environmental Quality, Adams, T., McFarland, A., Hauck, L., Barrett, M., and Eck, B., 2008.

Biofilter Bags SE-14



Categories

EC	Erosion Control	
SE	Sediment Control	☑
TR	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence
SE-4 Check Dams
SE-5 Fiber Roll
SE-6 Gravel Bag Berm
SE-8 Sandbag Barrier
SE-10 Storm Drain Inlet Protection

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Biofilter bags, or bio-bags, are a multi-purpose sediment control BMP consisting of a plastic mesh bag filled with 100% recycled wood product waste. Biofilter bags come in a variety of sizes (30" x 18" and 30" x 9" being common) and generally have between 1-2 cubic yards of recycled wood waste (or wood chips). Biofilter bags work by detaining flow and allowing a slow rate of discharge through the wood media. This action removes suspended sediment through gravity settling of the detained water and filtration within the bag.

Suitable Applications

Biofilter bags are a short-term BMP that can be rapidly deployed, maintained, and replaced. Biofilter bags can be an effective short-term solution to place in developed rills to prevent further erosion until permanent measures can be established. Suitable short-term applications include:

- As a linear sediment control measure:
  - Below the toe of slopes and erodible slopes
  - Below other small cleared areas
  - Along the perimeter of a site (with low-expected flow)
  - Down slope of exposed soil areas
  - Around temporary stockpiles and spoil areas
  - Parallel to a roadway to keep sediment off paved areas

- Along streams and channels

- As linear erosion control measure:
  - Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow
  - At the top of slopes to divert runoff away from disturbed slopes
  - As check dams across mildly sloped construction roads
- Inlet Protection (See SE-10)
- Supplement to silt fences or other sediment control devices

Limitations

- Short life-span (maximum usefulness of 2-3 months and should be replaced more frequently if needed); regular maintenance and replacement required to ensure effectiveness. Bags will rapidly fill with sediment and reduce permeability.
- Easily damaged by construction vehicles.
- If not properly staked, will fail on slope applications.
- If improperly installed can allow undercutting or side-cutting flow.
- Not effective where water velocities or volumes are high.
- Potentially buoyant and easily displaced if not properly installed.

Implementation

General

Biofilter bags are a relatively low cost temporary BMP that are easily deployed and have a simple installation that can be performed by hand. Without proper installation, however, biofilter bags can fail due to their light weight, potential displacement, and multiple joint locations. One of the benefits of utilizing biofilter bags is that the media (wood-product) can be recycled or used onsite when no longer needed (where acceptable).

Design and Layout – Linear control

- Locate biofilter bags on level contours.
  - Slopes between 20:1 and 4:1 (H:V): Biofilter bags should be placed at a maximum interval of 20 ft, with the first row near the slope toe.
  - Slopes between 4:1 and 2:1 (H:V): Biofilter bags should be placed at a maximum interval of 15 ft, with the first row near the slope toe.
  - Slopes 2:1 (H:V) or steeper: Biofilter bags should be placed at a maximum interval of 10 ft., with the first row placed the slope toe.

- Turn the ends of the biofilter bag barriers up slope to prevent runoff from going around the berm.
- Allow sufficient space up slope from the biofilter bag berm to allow ponding, and to provide room for sediment storage.
- Stake biofilter bags into a 1 to 2 in. deep trench with a width equal to the bag.
  - Drive one stake at each end of the bag.
  - Use wood stakes with a nominal classification of 0.75 by 0.75 in. and minimum length of 24 in.
- Biofilter bags should be overlapped (6 in.), not abutted.

Costs

Pre-filled biofilter bags cost approximately $2.50-$3.50 per bag, dependent upon size.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Biofilter bags exposed to sunlight will need to be replaced every two to three months due to degrading of the bags.
- Reshape or replace biofilter bags as needed.
- Repair washouts or other damage as needed.
- Sediment that is retained by the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height.
- Remove biofilter bag berms when no longer needed. Remove sediment accumulation and clean, re-grade, and stabilize the area. Biofilter media may be used on-site, if allowed.

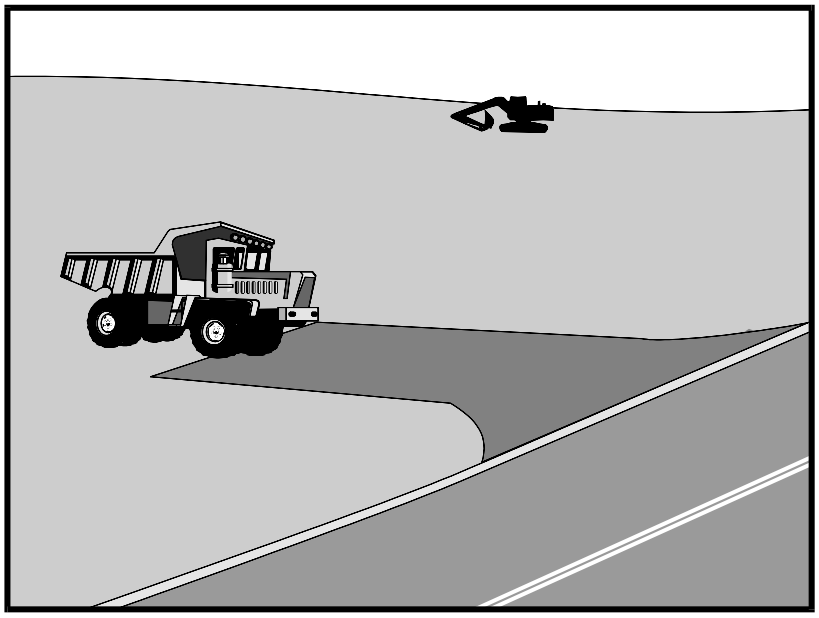
References

Catalog of Stormwater Best Management Practices for Idaho Cities and Counties. Volume 2, Section 7, BMP 34 – Biofilter Bags, Idaho Department of Environmental Quality, 2005.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stabilized Construction Entrance / Exit TC-1



Categories

EC	Erosion Control	☒
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

A stabilized construction access is defined by a point of entrance/exit to a construction site that is stabilized to reduce the tracking of mud and dirt onto public roads by construction vehicles.

Suitable Applications

Use at construction sites:

- Where dirt or mud can be tracked onto public roads.
- Adjacent to water bodies.
- Where poor soils are encountered.
- Where dust is a problem during dry weather conditions.

Limitations

- Entrances and exits require periodic top dressing with additional stones.
- This BMP should be used in conjunction with street sweeping on adjacent public right of way.
- Entrances and exits should be constructed on level ground only.
- Stabilized construction entrances are rather expensive to construct and when a wash rack is included, a sediment trap of some kind must also be provided to collect wash water runoff.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Stabilized Construction Entrance/Exit TC-1

Implementation

General

A stabilized construction entrance is a pad of aggregate underlain with filter cloth located at any point where traffic will be entering or leaving a construction site to or from a public right of way, street, alley, sidewalk, or parking area. The purpose of a stabilized construction entrance is to reduce or eliminate the tracking of sediment onto public rights of way or streets. Reducing tracking of sediments and other pollutants onto paved roads helps prevent deposition of sediments into local storm drains and production of airborne dust.

Where traffic will be entering or leaving the construction site, a stabilized construction entrance should be used. NPDES permits require that appropriate measures be implemented to prevent tracking of sediments onto paved roadways, where a significant source of sediments is derived from mud and dirt carried out from unpaved roads and construction sites.

Stabilized construction entrances are moderately effective in removing sediment from equipment leaving a construction site. The entrance should be built on level ground. Advantages of the Stabilized Construction Entrance/Exit is that it does remove some sediment from equipment and serves to channel construction traffic in and out of the site at specified locations. Efficiency is greatly increased when a washing rack is included as part of a stabilized construction entrance/exit.

Design and Layout

- Construct on level ground where possible.
- Select 3 to 6 in. diameter stones.
- Use minimum depth of stones of 12 in. or as recommended by soils engineer.
- Construct length of 50 ft or maximum site will allow, and 10 ft minimum width or to accommodate traffic.
- Rumble racks constructed of steel panels with ridges and installed in the stabilized entrance/exit will help remove additional sediment and to keep adjacent streets clean.
- Provide ample turning radii as part of the entrance.
- Limit the points of entrance/exit to the construction site.
- Limit speed of vehicles to control dust.
- Properly grade each construction entrance/exit to prevent runoff from leaving the construction site.
- Route runoff from stabilized entrances/exits through a sediment trapping device before discharge.
- Design stabilized entrance/exit to support heaviest vehicles and equipment that will use it.

- Select construction access stabilization (aggregate, asphaltic concrete, concrete) based on longevity, required performance, and site conditions. Do not use asphalt concrete (AC) grindings for stabilized construction access/roadway.
- If aggregate is selected, place crushed aggregate over geotextile fabric to at least 12 in. depth, or place aggregate to a depth recommended by a geotechnical engineer. A crushed aggregate greater than 3 in. but smaller than 6 in. should be used.
- Designate combination or single purpose entrances and exits to the construction site.
- Require that all employees, subcontractors, and suppliers utilize the stabilized construction access.
- Implement SE-7, Street Sweeping and Vacuuming, as needed.
- All exit locations intended to be used for more than a two-week period should have stabilized construction entrance/exit BMPs.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMPs are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect local roads adjacent to the site daily. Sweep or vacuum to remove visible accumulated sediment.
- Remove aggregate, separate and dispose of sediment if construction entrance/exit is clogged with sediment.
- Keep all temporary roadway ditches clear.
- Check for damage and repair as needed.
- Replace gravel material when surface voids are visible.
- Remove all sediment deposited on paved roadways within 24 hours.
- Remove gravel and filter fabric at completion of construction

Costs

Average annual cost for installation and maintenance may vary from $1,200 to $4,800 each, averaging $2,400 per entrance. Costs will increase with addition of washing rack, and sediment trap. With wash rack, costs range from $1,200 - $6,000 each, averaging $3,600 per entrance.

References

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, USEPA Agency, 2002.

Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group Working Paper, USEPA, April 1992.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

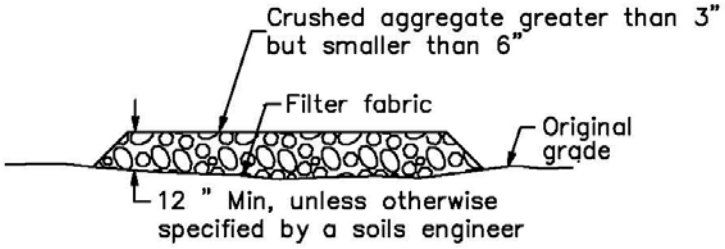
Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Virginia Erosion and Sedimentation Control Handbook, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, 1991.

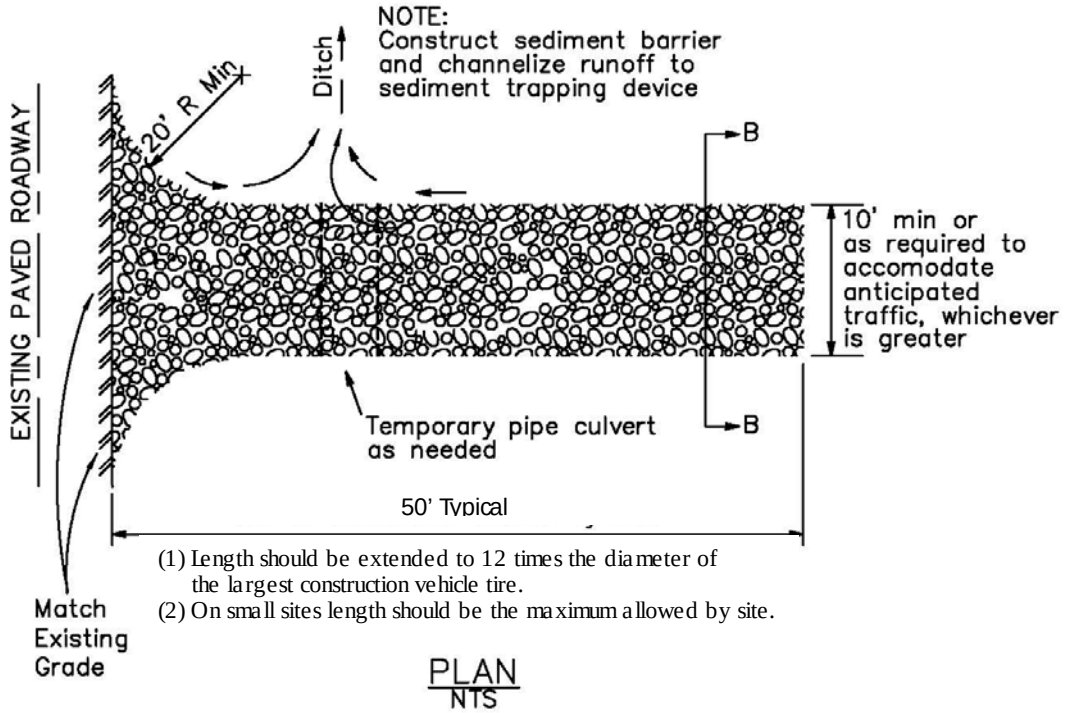
Guidance Specifying Management Measures for Nonpoint Pollution in Coastal Waters, EPA 840-B-9-002, USEPA, Office of Water, Washington, DC, 1993.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Stabilized Construction Entrance / Exit TC-1



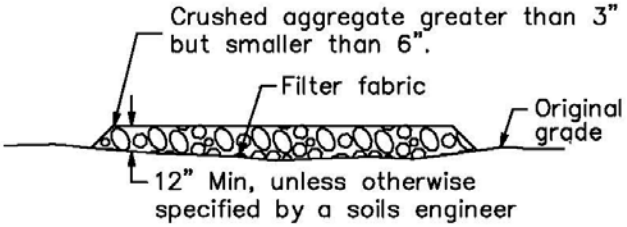
SECTION B–B
NTS



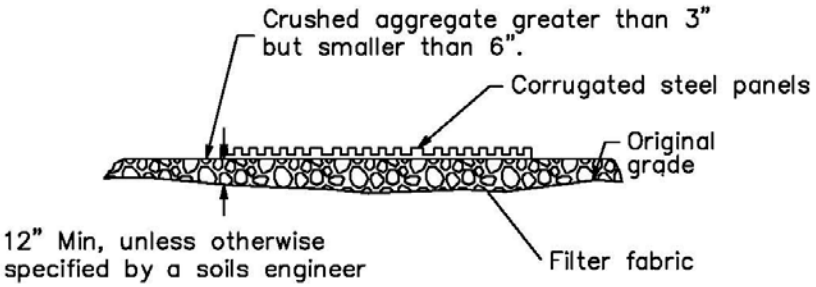
(1) Length should be extended to 12 times the diameter of the largest construction vehicle tire.
(2) On small sites length should be the maximum allowed by site.

PLAN
NTS

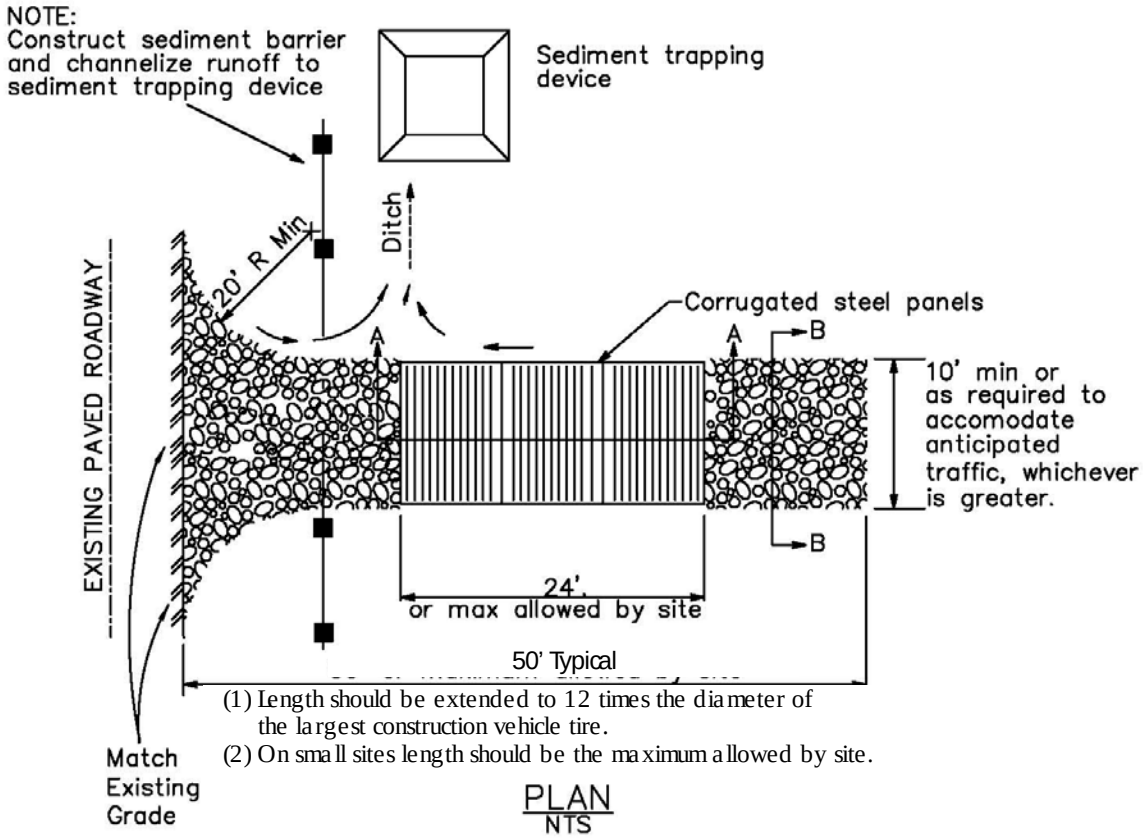
Stabilized Construction Entrance / Exit TC-1



SECTION B–B
NTS



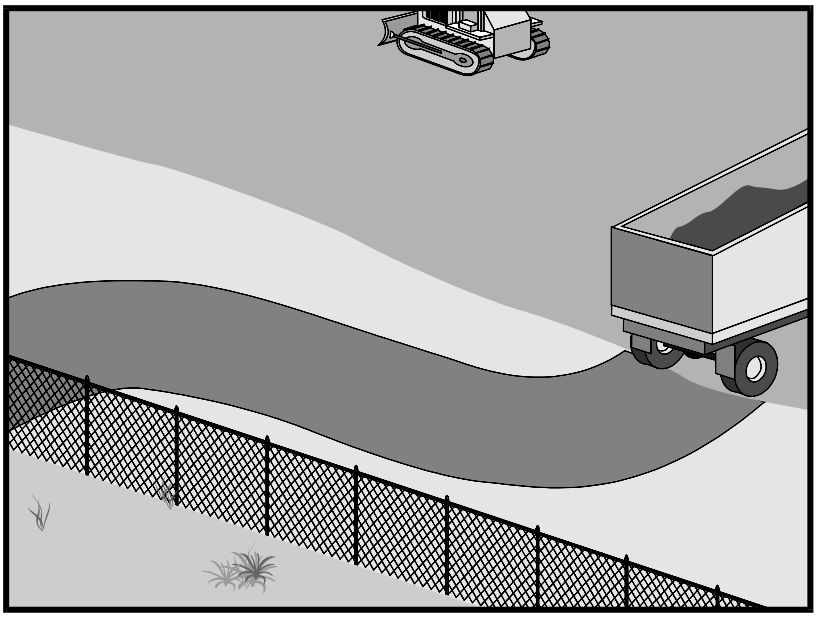
SECTION A–A
NOT TO SCALE



(1) Length should be extended to 12 times the diameter of the largest construction vehicle tire.
(2) On small sites length should be the maximum allowed by site.

PLAN
NTS

Stabilized Construction Roadway TC-2



Categories

EC	Erosion Control	☒
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Access roads, subdivision roads, parking areas, and other onsite vehicle transportation routes should be stabilized immediately after grading, and frequently maintained to prevent erosion and control dust.

Suitable Applications

This BMP should be applied for the following conditions:

- Temporary Construction Traffic:
  - Phased construction projects and offsite road access
  - Construction during wet weather
- Construction roadways and detour roads:
  - Where mud tracking is a problem during wet weather
  - Where dust is a problem during dry weather
  - Adjacent to water bodies
  - Where poor soils are encountered

Limitations

- The roadway must be removed or paved when construction is complete.

- Certain chemical stabilization methods may cause stormwater or soil pollution and should not be used. See WE-1, Wind Erosion Control.
- Management of construction traffic is subject to air quality control measures. Contact the local air quality management agency.
- Materials will likely need to be removed prior to final project grading and stabilization.
- Use of this BMP may not be applicable to very short duration projects.

Implementation

General

Areas that are graded for construction vehicle transport and parking purposes are especially susceptible to erosion and dust. The exposed soil surface is continually disturbed, leaving no opportunity for vegetative stabilization. Such areas also tend to collect and transport runoff waters along their surfaces. During wet weather, they often become muddy quagmires that generate significant quantities of sediment that may pollute nearby streams or be transported offsite on the wheels of construction vehicles. Dirt roads can become so unstable during wet weather that they are virtually unusable.

Efficient construction road stabilization not only reduces onsite erosion but also can significantly speed onsite work, avoid instances of immobilized machinery and delivery vehicles, and generally improve site efficiency and working conditions during adverse weather

Installation/Application Criteria

Permanent roads and parking areas should be paved as soon as possible after grading. As an alternative where construction will be phased, the early application of gravel or chemical stabilization may solve potential erosion and stability problems. Temporary gravel roadway should be considered during the rainy season and on slopes greater than 5%.

Temporary roads should follow the contour of the natural terrain to the maximum extent possible. Slope should not exceed 15%. Roadways should be carefully graded to drain transversely. Provide drainage swales on each side of the roadway in the case of a crowned section or one side in the case of a super elevated section. Simple gravel berms without a trench can also be used.

Installed inlets should be protected to prevent sediment laden water from entering the storm sewer system (SE-10, Storm Drain Inlet Protection). In addition, the following criteria should be considered.

- Road should follow topographic contours to reduce erosion of the roadway.
- The roadway slope should not exceed 15%.
- Chemical stabilizers or water are usually required on gravel or dirt roads to prevent dust (WE-1, Wind Erosion Control).
- Properly grade roadway to prevent runoff from leaving the construction site.
- Design stabilized access to support heaviest vehicles and equipment that will use it.

- Stabilize roadway using aggregate, asphalt concrete, or concrete based on longevity, required performance, and site conditions. The use of cold mix asphalt or asphalt concrete (AC) grindings for stabilized construction roadway is not allowed.
- Coordinate materials with those used for stabilized construction entrance/exit points.
- If aggregate is selected, place crushed aggregate over geotextile fabric to at least 12 in. depth. A crushed aggregate greater than 3 in. but smaller than 6 in. should be used.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Keep all temporary roadway ditches clear.
- When no longer required, remove stabilized construction roadway and re-grade and repair slopes.
- Periodically apply additional aggregate on gravel roads.
- Active dirt construction roads are commonly watered three or more times per day during the dry season.

Costs

Gravel construction roads are moderately expensive, but cost is often balanced by reductions in construction delay. No additional costs for dust control on construction roads should be required above that needed to meet local air quality requirements.

References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

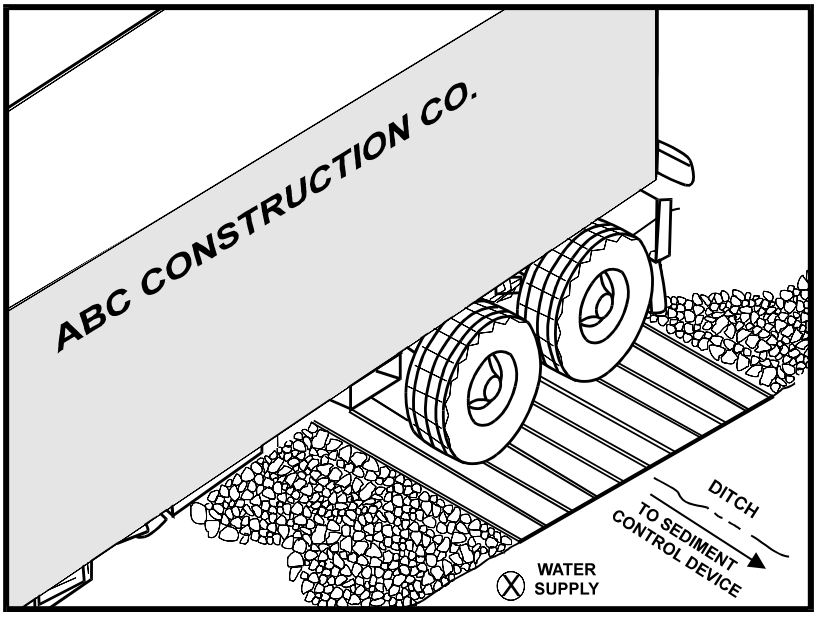
Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Virginia Erosion and Sedimentation Control Handbook, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, 1991.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Entrance/Outlet Tire Wash TC-3



Description and Purpose

A tire wash is an area located at stabilized construction access points to remove sediment from tires and under carriages and to prevent sediment from being transported onto public roadways.

Suitable Applications

Tire washes may be used on construction sites where dirt and mud tracking onto public roads by construction vehicles may occur.

Limitations

- The tire wash requires a supply of wash water.
- A turnout or doublewide exit is required to avoid having entering vehicles drive through the wash area.
- Do not use where wet tire trucks leaving the site leave the road dangerously slick.

Implementation

- Incorporate with a stabilized construction entrance/exit. See TC-1, Stabilized Construction Entrance/Exit.
- Construct on level ground when possible, on a pad of coarse aggregate greater than 3 in. but smaller than 6 in. A geotextile fabric should be placed below the aggregate.
- Wash rack should be designed and constructed/manufactured for anticipated traffic loads.

Categories

EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

TC-1 Stabilized Construction Entrance/Exit

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Provide a drainage ditch that will convey the runoff from the wash area to a sediment trapping device. The drainage ditch should be of sufficient grade, width, and depth to carry the wash runoff.
- Use hoses with automatic shutoff nozzles to prevent hoses from being left on.
- Require that all employees, subcontractors, and others that leave the site with mud caked tires and undercarriages to use the wash facility.
- Implement SC-7, Street Sweeping and Vacuuming, as needed.

Costs

Costs are low for installation of wash rack.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.
- Remove accumulated sediment in wash rack and/or sediment trap to maintain system performance.
- Inspect routinely for damage and repair as needed.

References

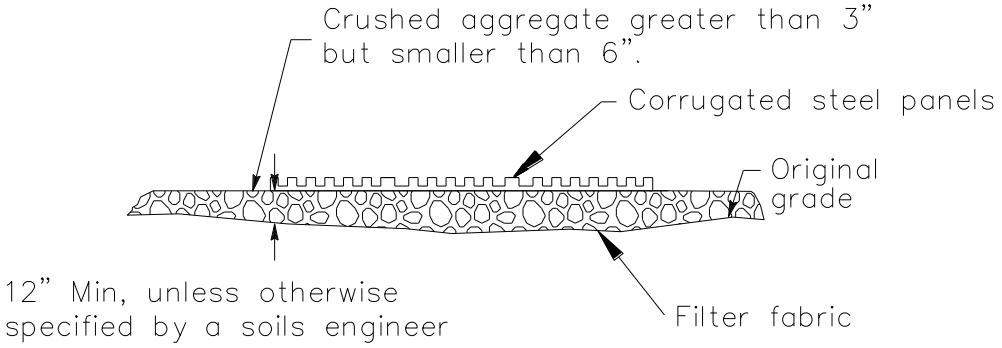
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

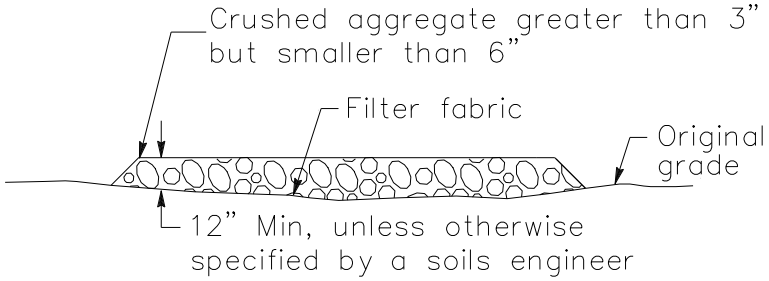
Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

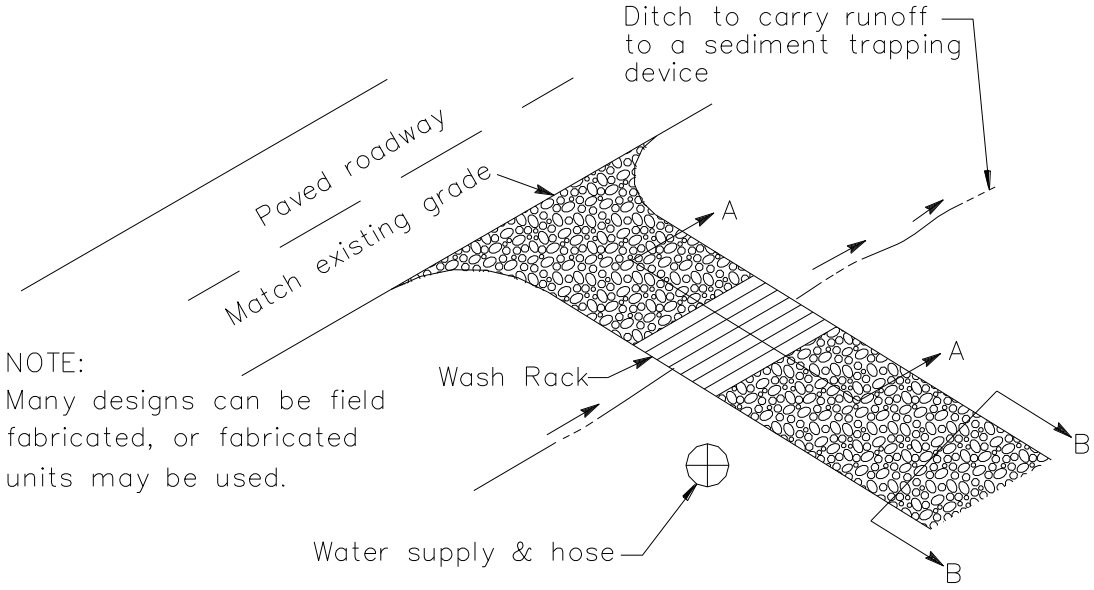
Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.



SECTION A–A
NOT TO SCALE

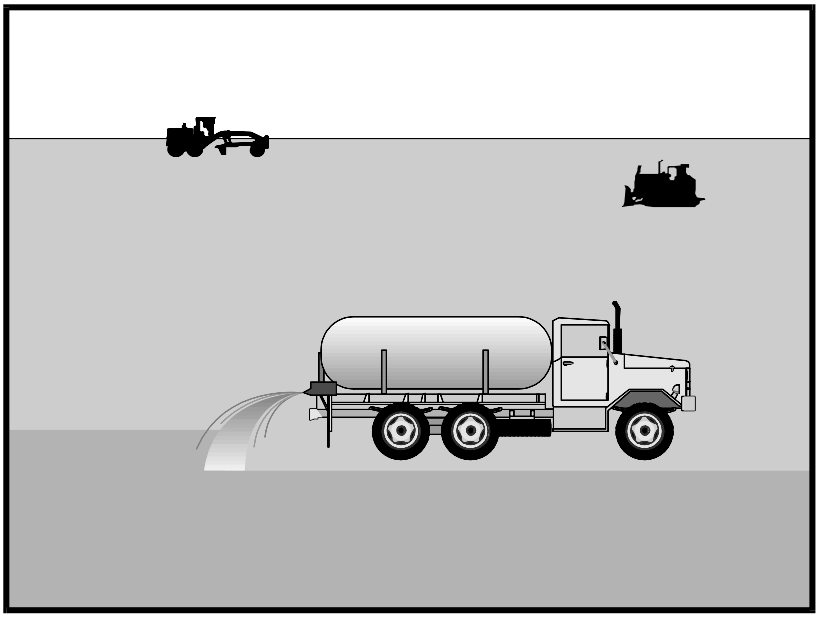


SECTION B–B
NTS



TYPICAL TIRE WASH
NOT TO SCALE

Wind Erosion Control WE-1



Categories

EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	☑
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-5 Soil Binders

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Wind erosion or dust control consists of applying water or other chemical dust suppressants as necessary to prevent or alleviate dust nuisance generated by construction activities. Covering small stockpiles or areas is an alternative to applying water or other dust palliatives.

California's Mediterranean climate, with a short "wet" season and a typically long, hot "dry" season, allows the soils to thoroughly dry out. During the dry season, construction activities are at their peak, and disturbed and exposed areas are increasingly subject to wind erosion, sediment tracking and dust generated by construction equipment. Site conditions and climate can make dust control more of an erosion problem than water based erosion. Additionally, many local agencies, including Air Quality Management Districts, require dust control and/or dust control permits in order to comply with local nuisance laws, opacity laws (visibility impairment) and the requirements of the Clean Air Act. Wind erosion control is required to be implemented at all construction sites greater than 1 acre by the General Permit.

Suitable Applications

Most BMPs that provide protection against water-based erosion will also protect against wind-based erosion and dust control requirements required by other agencies will generally meet wind erosion control requirements for water quality protection. Wind erosion control BMPs are suitable during the following construction activities:

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Construction vehicle traffic on unpaved roads
- Drilling and blasting activities
- Soils and debris storage piles
- Batch drop from front-end loaders
- Areas with unstabilized soil
- Final grading/site stabilization

Limitations

- Watering prevents dust only for a short period (generally less than a few hours) and should be applied daily (or more often) to be effective.
- Over watering may cause erosion and track-out.
- Oil or oil-treated subgrade should not be used for dust control because the oil may migrate into drainageways and/or seep into the soil.
- Chemical dust suppression agents may have potential environmental impacts. Selected chemical dust control agents should be environmentally benign.
- Effectiveness of controls depends on soil, temperature, humidity, wind velocity and traffic.
- Chemical dust suppression agents should not be used within 100 feet of wetlands or water bodies.
- Chemically treated subgrades may make the soil water repellant, interfering with long-term infiltration and the vegetation/re-vegetation of the site. Some chemical dust suppressants may be subject to freezing and may contain solvents and should be handled properly.
- In compacted areas, watering and other liquid dust control measures may wash sediment or other constituents into the drainage system.
- If the soil surface has minimal natural moisture, the affected area may need to be pre-wetted so that chemical dust control agents can uniformly penetrate the soil surface.

Implementation

Dust Control Practices

Dust control BMPs generally stabilize exposed surfaces and minimize activities that suspend or track dust particles. The following table presents dust control practices that can be applied to varying site conditions that could potentially cause dust. For heavily traveled and disturbed areas, wet suppression (watering), chemical dust suppression, gravel asphalt surfacing, temporary gravel construction entrances, equipment wash-out areas, and haul truck covers can be employed as dust control applications. Permanent or temporary vegetation and mulching can be employed for areas of occasional or no construction traffic. Preventive measures include minimizing surface areas to be disturbed, limiting onsite vehicle traffic to 15 mph or less, and controlling the number and activity of vehicles on a site at any given time.

Chemical dust suppressants include: mulch and fiber based dust palliatives (e.g. paper mulch with gypsum binder), salts and brines (e.g. calcium chloride, magnesium chloride), non-petroleum based organics (e.g. vegetable oil, lignosulfonate), petroleum based organics (e.g. asphalt emulsion, dust oils, petroleum resins), synthetic polymers (e.g. polyvinyl acetate, vinyls, acrylic), clay additives (e.g. bentonite, montimorillonite) and electrochemical products (e.g. enzymes, ionic products).

Site Condition	Dust Control Practices							
	Permanent Vegetation	Mulching	Wet Suppression (Watering)	Chemical Dust Suppression	Gravel or Asphalt	Temporary Gravel Construction Entrances/Equipment Wash Down	Synthetic Covers	Minimize Extent of Disturbed Area
Disturbed Areas not Subject to Traffic	x	x	x	x	x			x
Disturbed Areas Subject to Traffic			x	x	x	x		x
Material Stockpiles		x	x	x			x	x
Demolition			x			x	x	
Clearing/ Excavation			x	x				x
Truck Traffic on Unpaved Roads			x	x	x	x	x	
Tracking					x	x		

Additional preventive measures include:

- Schedule construction activities to minimize exposed area (see EC-1, Scheduling).
- Quickly treat exposed soils using water, mulching, chemical dust suppressants, or stone/gravel layering.
- Identify and stabilize key access points prior to commencement of construction.
- Minimize the impact of dust by anticipating the direction of prevailing winds.
- Restrict construction traffic to stabilized roadways within the project site, as practicable.
- Water should be applied by means of pressure-type distributors or pipelines equipped with a spray system or hoses and nozzles that will ensure even distribution.
- All distribution equipment should be equipped with a positive means of shutoff.
- Unless water is applied by means of pipelines, at least one mobile unit should be available at all times to apply water or dust palliative to the project.
- If reclaimed waste water is used, the sources and discharge must meet California Department of Health Services water reclamation criteria and the Regional Water Quality

Control Board (RWQCB) requirements. Non-potable water should not be conveyed in tanks or drain pipes that will be used to convey potable water and there should be no connection between potable and non-potable supplies. Non-potable tanks, pipes, and other conveyances should be marked, "NON-POTABLE WATER - DO NOT DRINK."

- Pave or chemically stabilize access points where unpaved traffic surfaces adjoin paved roads.
- Provide covers for haul trucks transporting materials that contribute to dust.
- Provide for rapid clean up of sediments deposited on paved roads. Furnish stabilized construction road entrances and wheel wash areas.
- Stabilize inactive areas of construction sites using temporary vegetation or chemical stabilization methods.

For chemical stabilization, there are many products available for chemically stabilizing gravel roadways and stockpiles. If chemical stabilization is used, the chemicals should not create any adverse effects on stormwater, plant life, or groundwater and should meet all applicable regulatory requirements.

Costs

Installation costs for water and chemical dust suppression vary based on the method used and the length of effectiveness. Annual costs may be high since some of these measures are effective for only a few hours to a few days.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Check areas protected to ensure coverage.
- Most water-based dust control measures require frequent application, often daily or even multiple times per day. Obtain vendor or independent information on longevity of chemical dust suppressants.

References

Best Management Practices and Erosion Control Manual for Construction Sites, Flood Control District of Maricopa County, Arizona, September 1992.

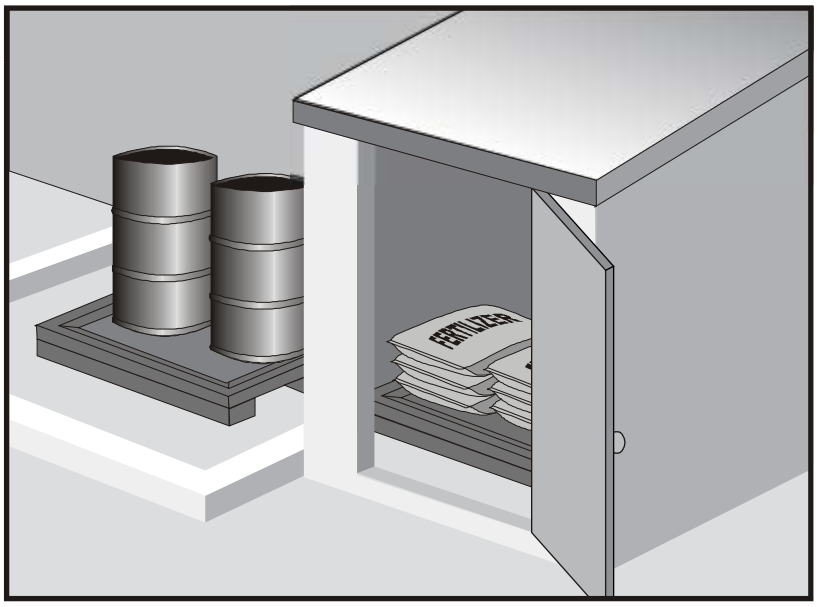
California Air Pollution Control Laws, California Air Resources Board, updated annually.

Construction Manual, Chapter 4, Section 10, "Dust Control"; Section 17, "Watering"; and Section 18, "Dust Palliative", California Department of Transportation (Caltrans), July 2001.

Prospects for Attaining the State Ambient Air Quality Standards for Suspended Particulate Matter (PM10), Visibility Reducing Particles, Sulfates, Lead, and Hydrogen Sulfide, California Air Resources Board, April 1991.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Material Delivery and Storage WM-1



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Description and Purpose

Prevent, reduce, or eliminate the discharge of pollutants from material delivery and storage to the stormwater system or watercourses by minimizing the storage of hazardous materials onsite, storing materials in watertight containers and/or a completely enclosed designated area, installing secondary containment, conducting regular inspections, and training employees and subcontractors.

This best management practice covers only material delivery and storage. For other information on materials, see WM-2, Material Use, or WM-4, Spill Prevention and Control. For information on wastes, see the waste management BMPs in this section.

Suitable Applications

These procedures are suitable for use at all construction sites with delivery and storage of the following materials:

- Soil stabilizers and binders
- Pesticides and herbicides
- Fertilizers
- Detergents
- Plaster
- Petroleum products such as fuel, oil, and grease

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Asphalt and concrete components
- Hazardous chemicals such as acids, lime, glues, adhesives, paints, solvents, and curing compounds
- Concrete compounds
- Other materials that may be detrimental if released to the environment

Limitations

- Space limitation may preclude indoor storage.
- Storage sheds often must meet building and fire code requirements.

Implementation

The following steps should be taken to minimize risk:

- Chemicals must be stored in water tight containers with appropriate secondary containment or in a storage shed.
- When a material storage area is located on bare soil, the area should be lined and bermed.
- Use containment pallets or other practical and available solutions, such as storing materials within newly constructed buildings or garages, to meet material storage requirements.
- Stack erodible landscape material on pallets and cover when not in use.
- Contain all fertilizers and other landscape materials when not in use.
- Temporary storage areas should be located away from vehicular traffic.
- Material Safety Data Sheets (MSDS) should be available on-site for all materials stored that have the potential to effect water quality.
- Construction site areas should be designated for material delivery and storage.
- Material delivery and storage areas should be located away from waterways, if possible.
    - Avoid transport near drainage paths or waterways.
    - Surround with earth berms or other appropriate containment BMP. See EC-9, Earth Dikes and Drainage Swales.
    - Place in an area that will be paved.
- Storage of reactive, ignitable, or flammable liquids must comply with the fire codes of your area. Contact the local Fire Marshal to review site materials, quantities, and proposed storage area to determine specific requirements. See the Flammable and Combustible Liquid Code, NFPA30.
- An up to date inventory of materials delivered and stored onsite should be kept.

- Hazardous materials storage onsite should be minimized.
- Hazardous materials should be handled as infrequently as possible.
- Keep ample spill cleanup supplies appropriate for the materials being stored. Ensure that cleanup supplies are in a conspicuous, labeled area.
- Employees and subcontractors should be trained on the proper material delivery and storage practices.
- Employees trained in emergency spill cleanup procedures must be present when dangerous materials or liquid chemicals are unloaded.
- If significant residual materials remain on the ground after construction is complete, properly remove and dispose of materials and any contaminated soil. See WM-7, Contaminated Soil Management. If the area is to be paved, pave as soon as materials are removed to stabilize the soil.

Material Storage Areas and Practices

- Liquids, petroleum products, and substances listed in 40 CFR Parts 110, 117, or 302 should be stored in approved containers and drums and should not be overfilled. Containers and drums should be placed in temporary containment facilities for storage.
- A temporary containment facility should provide for a spill containment volume able to contain precipitation from a 25 year storm event, plus the greater of 10% of the aggregate volume of all containers or 100% of the capacity of the largest container within its boundary, whichever is greater.
- A temporary containment facility should be impervious to the materials stored therein for a minimum contact time of 72 hours.
- A temporary containment facility should be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills should be collected and placed into drums. These liquids should be handled as a hazardous waste unless testing determines them to be non-hazardous. All collected liquids or non-hazardous liquids should be sent to an approved disposal site.
- Sufficient separation should be provided between stored containers to allow for spill cleanup and emergency response access.
- Incompatible materials, such as chlorine and ammonia, should not be stored in the same temporary containment facility.
- Materials should be covered prior to, and during rain events.
- Materials should be stored in their original containers and the original product labels should be maintained in place in a legible condition. Damaged or otherwise illegible labels should be replaced immediately.

- Bagged and boxed materials should be stored on pallets and should not be allowed to accumulate on the ground. To provide protection from wind and rain throughout the rainy season, bagged and boxed materials should be covered during non-working days and prior to and during rain events.
- Stockpiles should be protected in accordance with WM-3, Stockpile Management.
- Materials should be stored indoors within existing structures or completely enclosed storage sheds when available.
- Proper storage instructions should be posted at all times in an open and conspicuous location.
- An ample supply of appropriate spill clean up material should be kept near storage areas.
- Also see WM-6, Hazardous Waste Management, for storing of hazardous wastes.

Material Delivery Practices

- Keep an accurate, up-to-date inventory of material delivered and stored onsite.
- Arrange for employees trained in emergency spill cleanup procedures to be present when dangerous materials or liquid chemicals are unloaded.

Spill Cleanup

- Contain and clean up any spill immediately.
- Properly remove and dispose of any hazardous materials or contaminated soil if significant residual materials remain on the ground after construction is complete. See WM-7, Contaminated Soil Management.
- See WM-4, Spill Prevention and Control, for spills of chemicals and/or hazardous materials.
- If spills or leaks of materials occur that are not contained and could discharge to surface waters, non-visible sampling of site discharge may be required. Refer to the General Permit or to your project specific Construction Site Monitoring Plan to determine if and where sampling is required.

Cost

- The largest cost of implementation may be in the construction of a materials storage area that is covered and provides secondary containment.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Keep storage areas clean and well organized, including a current list of all materials onsite.
- Inspect labels on containers for legibility and accuracy.

- Repair or replace perimeter controls, containment structures, covers, and liners as needed to maintain proper function.

References

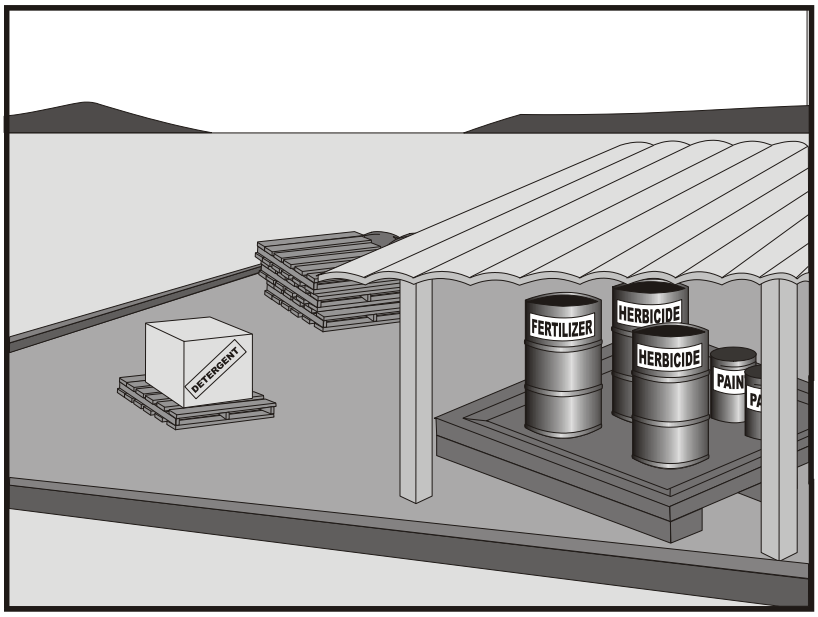
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Material Use WM-2



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Prevent or reduce the discharge of pollutants to the storm drain system or watercourses from material use by using alternative products, minimizing hazardous material use onsite, and training employees and subcontractors.

Suitable Applications

This BMP is suitable for use at all construction projects. These procedures apply when the following materials are used or prepared onsite:

- Pesticides and herbicides
- Fertilizers
- Detergents
- Petroleum products such as fuel, oil, and grease
- Asphalt and other concrete components
- Other hazardous chemicals such as acids, lime, glues, adhesives, paints, solvents, and curing compounds
- Other materials that may be detrimental if released to the environment

Limitations

Safer alternative building and construction products may not be available or suitable in every instance.

Implementation

The following steps should be taken to minimize risk:

- Minimize use of hazardous materials onsite.
- Follow manufacturer instructions regarding uses, protective equipment, ventilation, flammability, and mixing of chemicals.
- Train personnel who use pesticides. The California Department of Pesticide Regulation and county agricultural commissioners license pesticide dealers, certify pesticide applicators, and conduct onsite inspections.
- The preferred method of termiticide application is soil injection near the existing or proposed structure foundation/slab; however, if not feasible, soil drench application of termiticides should follow EPA label guidelines and the following recommendations (most of which are applicable to most pesticide applications):
  - Do not treat soil that is water-saturated or frozen.
  - Application shall not commence within 24-hours of a predicted precipitation event with a 40% or greater probability. Weather tracking must be performed on a daily basis prior to termiticide application and during the period of termiticide application.
  - Do not allow treatment chemicals to runoff from the target area. Apply proper quantity to prevent excess runoff. Provide containment for and divert stormwater from application areas using berms or diversion ditches during application.
  - Dry season: Do not apply within 10 feet of storm drains. Do not apply within 25 feet of aquatic habitats (such as, but not limited to, lakes; reservoirs; rivers; permanent streams; marshes or ponds; estuaries; and commercial fish farm ponds).
  - Wet season: Do not apply within 50 feet of storm drains or aquatic habitats (such as, but not limited to, lakes; reservoirs; rivers; permanent streams; marshes or ponds; estuaries; and commercial fish farm ponds) unless a vegetative buffer is present (if so, refer to dry season requirements).
  - Do not make on-grade applications when sustained wind speeds are above 10 mph (at application site) at nozzle end height.
  - Cover treatment site prior to a rain event in order to prevent run-off of the pesticide into non-target areas. The treated area should be limited to a size that can be backfilled and/or covered by the end of the work shift. Backfilling or covering of the treated area shall be done by the end of the same work shift in which the application is made.
  - The applicator must either cover the soil him/herself or provide written notification of the above requirement to the contractor on site and to the person commissioning the

application (if different than the contractor). If notice is provided to the contractor or the person commissioning the application, then they are responsible under the Federal Insecticide Fungicide, and Rodenticide Act (FIFRA) to ensure that: 1) if the concrete slab cannot be poured over the treated soil within 24 hours of application, the treated soil is covered with a waterproof covering (such as polyethylene sheeting), and 2) the treated soil is covered if precipitation is predicted to occur before the concrete slab is scheduled to be poured.

- Do not over-apply fertilizers, herbicides, and pesticides. Prepare only the amount needed. Follow the recommended usage instructions. Over-application is expensive and environmentally harmful. Unless on steep slopes, till fertilizers into the soil rather than hydraulic application. Apply surface dressings in several smaller applications, as opposed to one large application, to allow time for infiltration and to avoid excess material being carried offsite by runoff. Do not apply these chemicals before predicted rainfall.
- Train employees and subcontractors in proper material use.
- Supply Material Safety Data Sheets (MSDS) for all materials.
- Dispose of latex paint and paint cans, used brushes, rags, absorbent materials, and drop cloths, when thoroughly dry and are no longer hazardous, with other construction debris.
- Do not remove the original product label; it contains important safety and disposal information. Use the entire product before disposing of the container.
- Mix paint indoors or in a containment area. Never clean paintbrushes or rinse paint containers into a street, gutter, storm drain, or watercourse. Dispose of any paint thinners, residue, and sludge(s) that cannot be recycled, as hazardous waste.
- For water-based paint, clean brushes to the extent practicable, and rinse to a drain leading to a sanitary sewer where permitted, or contain for proper disposal off site. For oil-based paints, clean brushes to the extent practicable, and filter and reuse thinners and solvents.
- Use recycled and less hazardous products when practical. Recycle residual paints, solvents, non-treated lumber, and other materials.
- Use materials only where and when needed to complete the construction activity. Use safer alternative materials as much as possible. Reduce or eliminate use of hazardous materials onsite when practical.
- Document the location, time, chemicals applied, and applicator's name and qualifications.
- Keep an ample supply of spill clean up material near use areas. Train employees in spill clean up procedures.
- Avoid exposing applied materials to rainfall and runoff unless sufficient time has been allowed for them to dry.
- Discontinue use of erodible landscape material within 2 days prior to a forecasted rain event and materials should be covered and/or bermed.

- Provide containment for material use areas such as masons' areas or paint mixing/preparation areas to prevent materials/pollutants from entering stormwater.

Costs

All of the above are low cost measures.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Ensure employees and subcontractors throughout the job are using appropriate practices.

References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

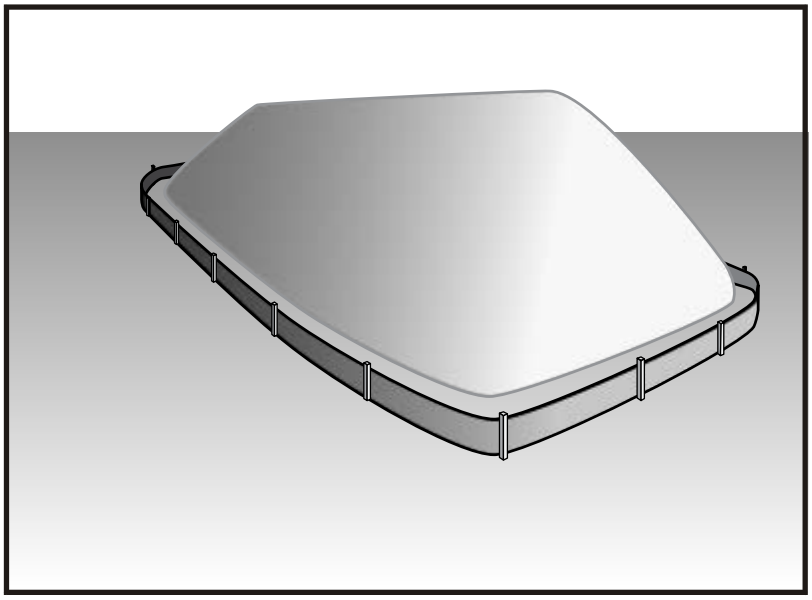
Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

Comments on Risk Assessments Risk Reduction Options for Cypermethrin: Docket No. OPP–2005–0293; California Stormwater Quality Association (CASQA) letter to USEPA, 2006.Environmental Hazard and General Labeling for Pyrethroid Non-Agricultural Outdoor Products, EPA-HQ-OPP-2008-0331-0021; USEPA, 2008.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Stockpile Management WM-3



Categories		
EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☒
WM	Waste Management and Materials Pollution Control	☑

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents	
Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Stockpile management procedures and practices are designed to reduce or eliminate air and stormwater pollution from stockpiles of soil, soil amendments, sand, paving materials such as portland cement concrete (PCC) rubble, asphalt concrete (AC), asphalt concrete rubble, aggregate base, aggregate sub base or pre-mixed aggregate, asphalt minder (so called "cold mix" asphalt), and pressure treated wood.

Suitable Applications

Implement in all projects that stockpile soil and other loose materials.

Limitations

- Plastic sheeting as a stockpile protection is temporary and hard to manage in windy conditions. Where plastic is used, consider use of plastic tarps with nylon reinforcement which may be more durable than standard sheeting.
- Plastic sheeting can increase runoff volume due to lack of infiltration and potentially cause perimeter control failure.
- Plastic sheeting breaks down faster in sunlight.
- The use of Plastic materials and photodegradable plastics should be avoided.

Implementation

Protection of stockpiles is a year-round requirement. To properly manage stockpiles:

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- On larger sites, a minimum of 50 ft separation from concentrated flows of stormwater, drainage courses, and inlets is recommended.
- After 14 days of inactivity, a stockpile is non-active and requires further protection described below. All stockpiles are required to be protected as non-active stockpiles immediately if they are not scheduled to be used within 14 days.
- Protect all stockpiles from stormwater runon using temporary perimeter sediment barriers such as compost berms (SE-13), temporary silt dikes (SE-12), fiber rolls (SE-5), silt fences (SE-1), sandbags (SE-8), gravel bags (SE-6), or biofilter bags (SE-14). Refer to the individual fact sheet for each of these controls for installation information.
- Implement wind erosion control practices as appropriate on all stockpiled material. For specific information, see WE-1, Wind Erosion Control.
- Manage stockpiles of contaminated soil in accordance with WM-7, Contaminated Soil Management.
- Place bagged materials on pallets and under cover.
- Ensure that stockpile coverings are installed securely to protect from wind and rain.
- Some plastic covers withstand weather and sunlight better than others. Select cover materials or methods based on anticipated duration of use.

Protection of Non-Active Stockpiles

A stockpile is considered non-active if it either is not used for 14 days or if it is scheduled not to be used for 14 days or more. Stockpiles need to be protected immediately if they are not scheduled to be used within 14 days. Non-active stockpiles of the identified materials should be protected as follows:

Soil stockpiles

- Soil stockpiles should be covered or protected with soil stabilization measures and a temporary perimeter sediment barrier at all times.
- Temporary vegetation should be considered for topsoil piles that will be stockpiled for extended periods.

Stockpiles of Portland cement concrete rubble, asphalt concrete, asphalt concrete rubble, aggregate base, or aggregate sub base

- Stockpiles should be covered and protected with a temporary perimeter sediment barrier at all times.

Stockpiles of "cold mix"

- Cold mix stockpiles should be placed on and covered with plastic sheeting or comparable material at all times and surrounded by a berm.

Stockpiles of fly ash, stucco, hydrated lime

- Stockpiles of materials that may raise the pH of runoff (i.e., basic materials) should be covered with plastic and surrounded by a berm.

Stockpiles/Storage of wood (Pressure treated with chromated copper arsenate or ammoniacal copper zinc arsenate

- Treated wood should be covered with plastic sheeting or comparable material at all times and surrounded by a berm.

Protection of Active Stockpiles

A stockpile is active when it is being used or is scheduled to be used within 14 days of the previous use. Active stockpiles of the identified materials should be protected as follows:

- All stockpiles should be covered and protected with a temporary linear sediment barrier prior to the onset of precipitation.
- Stockpiles of "cold mix" and treated wood, and basic materials should be placed on and covered with plastic sheeting or comparable material and surrounded by a berm prior to the onset of precipitation.
- The downstream perimeter of an active stockpile should be protected with a linear sediment barrier or berm and runoff should be diverted around or away from the stockpile on the upstream perimeter.

Costs

For cost information associated with stockpile protection refer to the individual erosion or sediment control BMP fact sheet considered for implementation (For example, refer to SE-1 Silt Fence for installation of silt fence around the perimeter of a stockpile.)

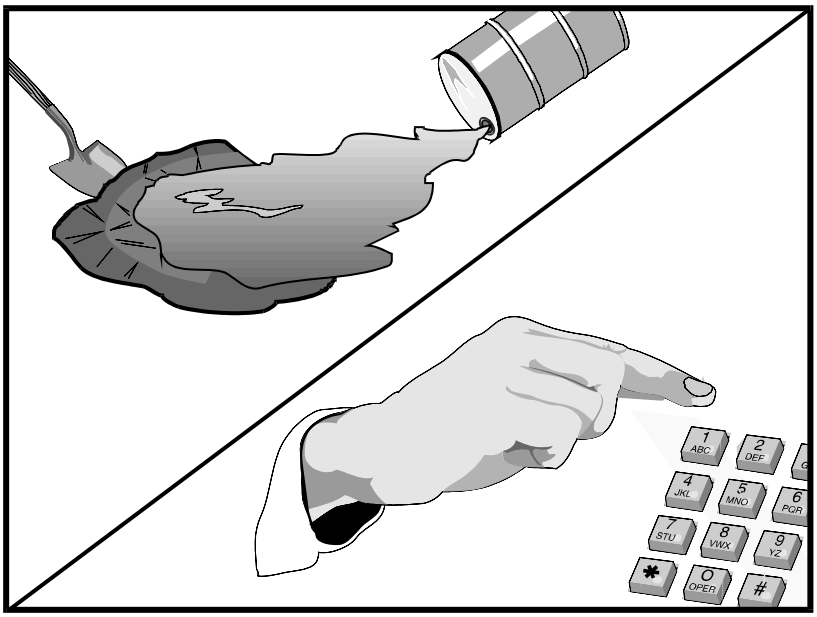
Inspection and Maintenance

- Stockpiles must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- It may be necessary to inspect stockpiles covered with plastic sheeting more frequently during certain conditions (for example, high winds or extreme heat).
- Repair and/or replace perimeter controls and covers as needed to keep them functioning properly.
- Sediment shall be removed when it reaches one-third of the barrier height.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Spill Prevention and Control WM-4



Description and Purpose

Prevent or reduce the discharge of pollutants to drainage systems or watercourses from leaks and spills by reducing the chance for spills, stopping the source of spills, containing and cleaning up spills, properly disposing of spill materials, and training employees.

This best management practice covers only spill prevention and control. However, WM-1, Materials Delivery and Storage, and WM-2, Material Use, also contain useful information, particularly on spill prevention. For information on wastes, see the waste management BMPs in this section.

Suitable Applications

This BMP is suitable for all construction projects. Spill control procedures are implemented anytime chemicals or hazardous substances are stored on the construction site, including the following materials:

- Soil stabilizers/binders
- Dust palliatives
- Herbicides
- Growth inhibitors
- Fertilizers
- Deicing/anti-icing chemicals

Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Fuels
- Lubricants
- Other petroleum distillates

Limitations

- In some cases it may be necessary to use a private spill cleanup company.
- This BMP applies to spills caused by the contractor and subcontractors.
- Procedures and practices presented in this BMP are general. Contractor should identify appropriate practices for the specific materials used or stored onsite

Implementation

The following steps will help reduce the stormwater impacts of leaks and spills:

Education

- Be aware that different materials pollute in different amounts. Make sure that each employee knows what a "significant spill" is for each material they use, and what is the appropriate response for "significant" and "insignificant" spills.
- Educate employees and subcontractors on potential dangers to humans and the environment from spills and leaks.
- Hold regular meetings to discuss and reinforce appropriate disposal procedures (incorporate into regular safety meetings).
- Establish a continuing education program to indoctrinate new employees.
- Have contractor's superintendent or representative oversee and enforce proper spill prevention and control measures.

General Measures

- To the extent that the work can be accomplished safely, spills of oil, petroleum products, substances listed under 40 CFR parts 110,117, and 302, and sanitary and septic wastes should be contained and cleaned up immediately.
- Store hazardous materials and wastes in covered containers and protect from vandalism.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Train employees in spill prevention and cleanup.
- Designate responsible individuals to oversee and enforce control measures.
- Spills should be covered and protected from stormwater runon during rainfall to the extent that it doesn't compromise clean up activities.
- Do not bury or wash spills with water.

- Store and dispose of used clean up materials, contaminated materials, and recovered spill material that is no longer suitable for the intended purpose in conformance with the provisions in applicable BMPs.
- Do not allow water used for cleaning and decontamination to enter storm drains or watercourses. Collect and dispose of contaminated water in accordance with WM-10, Liquid Waste Management.
- Contain water overflow or minor water spillage and do not allow it to discharge into drainage facilities or watercourses.
- Place proper storage, cleanup, and spill reporting instructions for hazardous materials stored or used on the project site in an open, conspicuous, and accessible location.
- Keep waste storage areas clean, well organized, and equipped with ample cleanup supplies as appropriate for the materials being stored. Perimeter controls, containment structures, covers, and liners should be repaired or replaced as needed to maintain proper function.

Cleanup

- Clean up leaks and spills immediately.
- Use a rag for small spills on paved surfaces, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to either a certified laundry (rags) or disposed of as hazardous waste.
- Never hose down or bury dry material spills. Clean up as much of the material as possible and dispose of properly. See the waste management BMPs in this section for specific information.

Minor Spills

- Minor spills typically involve small quantities of oil, gasoline, paint, etc. which can be controlled by the first responder at the discovery of the spill.
- Use absorbent materials on small spills rather than hosing down or burying the spill.
- Absorbent materials should be promptly removed and disposed of properly.
- Follow the practice below for a minor spill:
  - Contain the spread of the spill.
  - Recover spilled materials.
  - Clean the contaminated area and properly dispose of contaminated materials.

Semi-Significant Spills

- Semi-significant spills still can be controlled by the first responder along with the aid of other personnel such as laborers and the foreman, etc. This response may require the cessation of all other activities.

- Spills should be cleaned up immediately:
  - Contain spread of the spill.
  - Notify the project foreman immediately.
  - If the spill occurs on paved or impermeable surfaces, clean up using "dry" methods (absorbent materials, cat litter and/or rags). Contain the spill by encircling with absorbent materials and do not let the spill spread widely.
  - If the spill occurs in dirt areas, immediately contain the spill by constructing an earthen dike. Dig up and properly dispose of contaminated soil.
  - If the spill occurs during rain, cover spill with tarps or other material to prevent contaminating runoff.

Significant/Hazardous Spills

- For significant or hazardous spills that cannot be controlled by personnel in the immediate vicinity, the following steps should be taken:
  - Notify the local emergency response by dialing 911. In addition to 911, the contractor will notify the proper county officials. It is the contractor's responsibility to have all emergency phone numbers at the construction site.
  - Notify the Governor's Office of Emergency Services Warning Center, (916) 845-8911.
  - For spills of federal reportable quantities, in conformance with the requirements in 40 CFR parts 110,119, and 302, the contractor should notify the National Response Center at (800) 424-8802.
  - Notification should first be made by telephone and followed up with a written report.
  - The services of a spills contractor or a Haz-Mat team should be obtained immediately. Construction personnel should not attempt to clean up until the appropriate and qualified staffs have arrived at the job site.
  - Other agencies which may need to be consulted include, but are not limited to, the Fire Department, the Public Works Department, the Coast Guard, the Highway Patrol, the City/County Police Department, Department of Toxic Substances, California Division of Oil and Gas, Cal/OSHA, etc.

Reporting

- Report significant spills to local agencies, such as the Fire Department; they can assist in cleanup.
- Federal regulations require that any significant oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hours).

Use the following measures related to specific activities:

Vehicle and Equipment Maintenance

- If maintenance must occur onsite, use a designated area and a secondary containment, located away from drainage courses, to prevent the runon of stormwater and the runoff of spills.
- Regularly inspect onsite vehicles and equipment for leaks and repair immediately
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Place drip pans or absorbent materials under paving equipment when not in use.
- Use absorbent materials on small spills rather than hosing down or burying the spill. Remove the absorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around
- Oil filters disposed of in trashcans or dumpsters can leak oil and pollute stormwater. Place the oil filter in a funnel over a waste oil-recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask the oil supplier or recycler about recycling oil filters.
- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Vehicle and Equipment Fueling

- If fueling must occur onsite, use designate areas, located away from drainage courses, to prevent the runon of stormwater and the runoff of spills.
- Discourage "topping off" of fuel tanks.
- Always use secondary containment, such as a drain pan, when fueling to catch spills/ leaks.

Costs

Prevention of leaks and spills is inexpensive. Treatment and/ or disposal of contaminated soil or water can be quite expensive.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.
- Keep ample supplies of spill control and cleanup materials onsite, near storage, unloading, and maintenance areas.
- Update your spill prevention and control plan and stock cleanup materials as changes occur in the types of chemicals onsite.

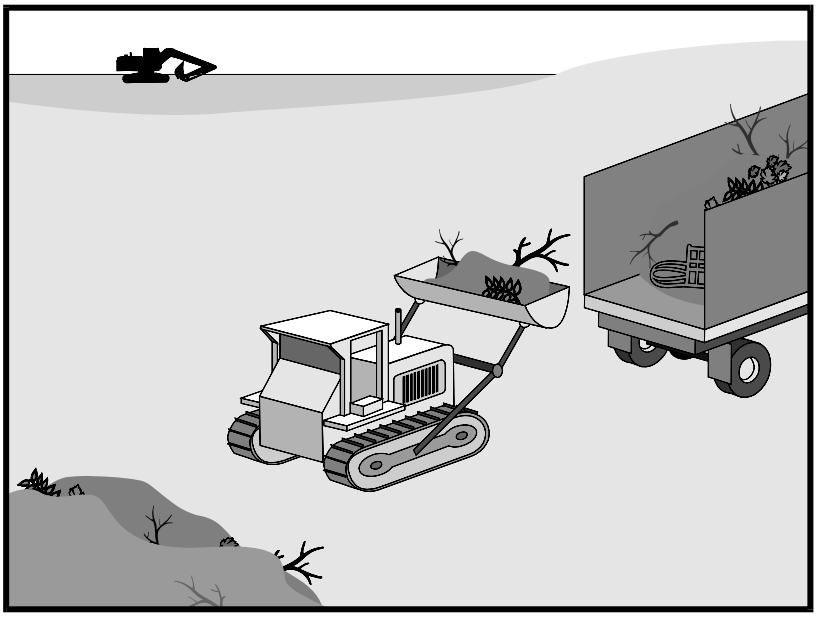
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Solid Waste Management WM-5



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Solid waste management procedures and practices are designed to prevent or reduce the discharge of pollutants to stormwater from solid or construction waste by providing designated waste collection areas and containers, arranging for regular disposal, and training employees and subcontractors.

Suitable Applications

This BMP is suitable for construction sites where the following wastes are generated or stored:

- Solid waste generated from trees and shrubs removed during land clearing, demolition of existing structures (rubble), and building construction
- Packaging materials including wood, paper, and plastic
- Scrap or surplus building materials including scrap metals, rubber, plastic, glass pieces, and masonry products
- Domestic wastes including food containers such as beverage cans, coffee cups, paper bags, plastic wrappers, and cigarettes
- Construction wastes including brick, mortar, timber, steel and metal scraps, pipe and electrical cuttings, non-hazardous equipment parts, styrofoam and other materials used to transport and package construction materials

- Highway planting wastes, including vegetative material, plant containers, and packaging materials

Limitations

Temporary stockpiling of certain construction wastes may not necessitate stringent drainage related controls during the non-rainy season or in desert areas with low rainfall.

Implementation

The following steps will help keep a clean site and reduce stormwater pollution:

- Select designated waste collection areas onsite.
- Inform trash-hauling contractors that you will accept only watertight dumpsters for onsite use. Inspect dumpsters for leaks and repair any dumpster that is not watertight.
- Locate containers in a covered area or in a secondary containment.
- Provide an adequate number of containers with lids or covers that can be placed over the container to keep rain out or to prevent loss of wastes when it is windy.
- Cover waste containers at the end of each work day and when it is raining.
- Plan for additional containers and more frequent pickup during the demolition phase of construction.
- Collect site trash daily, especially during rainy and windy conditions.
- Remove this solid waste promptly since erosion and sediment control devices tend to collect litter.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.
- Do not hose out dumpsters on the construction site. Leave dumpster cleaning to the trash hauling contractor.
- Arrange for regular waste collection before containers overflow.
- Clean up immediately if a container does spill.
- Make sure that construction waste is collected, removed, and disposed of only at authorized disposal areas.

Education

- Have the contractor's superintendent or representative oversee and enforce proper solid waste management procedures and practices.
- Instruct employees and subcontractors on identification of solid waste and hazardous waste.
- Educate employees and subcontractors on solid waste storage and disposal procedures.

- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).
- Require that employees and subcontractors follow solid waste handling and storage procedures.
- Prohibit littering by employees, subcontractors, and visitors.
- Minimize production of solid waste materials wherever possible.

Collection, Storage, and Disposal

- Littering on the project site should be prohibited.
- To prevent clogging of the storm drainage system, litter and debris removal from drainage grates, trash racks, and ditch lines should be a priority.
- Trash receptacles should be provided in the contractor's yard, field trailer areas, and at locations where workers congregate for lunch and break periods.
- Litter from work areas within the construction limits of the project site should be collected and placed in watertight dumpsters at least weekly, regardless of whether the litter was generated by the contractor, the public, or others. Collected litter and debris should not be placed in or next to drain inlets, stormwater drainage systems, or watercourses.
- Dumpsters of sufficient size and number should be provided to contain the solid waste generated by the project.
- Full dumpsters should be removed from the project site and the contents should be disposed of by the trash hauling contractor.
- Construction debris and waste should be removed from the site biweekly or more frequently as needed.
- Construction material visible to the public should be stored or stacked in an orderly manner.
- Stormwater runon should be prevented from contacting stored solid waste through the use of berms, dikes, or other temporary diversion structures or through the use of measures to elevate waste from site surfaces.
- Solid waste storage areas should be located at least 50 ft from drainage facilities and watercourses and should not be located in areas prone to flooding or ponding.
- Except during fair weather, construction and highway planting waste not stored in watertight dumpsters should be securely covered from wind and rain by covering the waste with tarps or plastic.
- Segregate potentially hazardous waste from non-hazardous construction site waste.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.

- For disposal of hazardous waste, see WM-6, Hazardous Waste Management. Have hazardous waste hauled to an appropriate disposal and/or recycling facility.

- Salvage or recycle useful vegetation debris, packaging and surplus building materials when practical. For example, trees and shrubs from land clearing can be used as a brush barrier, or converted into wood chips, then used as mulch on graded areas. Wood pallets, cardboard boxes, and construction scraps can also be recycled.

Costs

All of the above are low cost measures.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur

- Inspect construction waste area regularly.

- Arrange for regular waste collection.

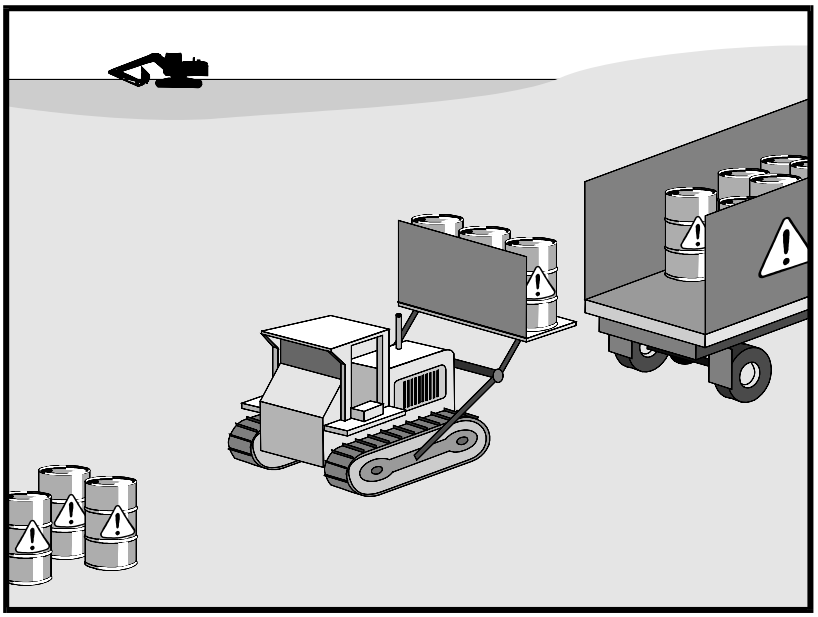
References

Processes, Procedures and Methods to Control Pollution Resulting from All Construction Activity, 430/9-73-007, USEPA, 1973.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Hazardous Waste Management WM-6



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Prevent or reduce the discharge of pollutants to stormwater from hazardous waste through proper material use, waste disposal, and training of employees and subcontractors.

Suitable Applications

This best management practice (BMP) applies to all construction projects. Hazardous waste management practices are implemented on construction projects that generate waste from the use of:

- Petroleum Products
- Asphalt Products
- Concrete Curing Compounds
- Pesticides
- Palliatives
- Acids
- Septic Wastes
- Paints
- Stains
- Solvents
- Wood Preservatives
- Roofing Tar
- Any materials deemed a hazardous waste in California, Title 22 Division 4.5, or listed in 40 CFR Parts 110, 117, 261, or 302

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

In addition, sites with existing structures may contain wastes, which must be disposed of in accordance with federal, state, and local regulations. These wastes include:

- Sandblasting grit mixed with lead-, cadmium-, or chromium-based paints
- Asbestos
- PCBs (particularly in older transformers)

Limitations

- Hazardous waste that cannot be reused or recycled must be disposed of by a licensed hazardous waste hauler.
- Nothing in this BMP relieves the contractor from responsibility for compliance with federal, state, and local laws regarding storage, handling, transportation, and disposal of hazardous wastes.
- This BMP does not cover aerially deposited lead (ADL) soils. For ADL soils refer to WM-7, Contaminated Soil Management.

Implementation

The following steps will help reduce stormwater pollution from hazardous wastes:

Material Use

- Wastes should be stored in sealed containers constructed of a suitable material and should be labeled as required by Title 22 CCR, Division 4.5 and 49 CFR Parts 172, 173, 178, and 179.
- All hazardous waste should be stored, transported, and disposed as required in Title 22 CCR, Division 4.5 and 49 CFR 261-263.
- Waste containers should be stored in temporary containment facilities that should comply with the following requirements:
  - Temporary containment facility should provide for a spill containment volume equal to 1.5 times the volume of all containers able to contain precipitation from a 25 year storm event, plus the greater of 10% of the aggregate volume of all containers or 100% of the capacity of the largest tank within its boundary, whichever is greater.
  - Temporary containment facility should be impervious to the materials stored there for a minimum contact time of 72 hours.
  - Temporary containment facilities should be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills should be placed into drums after each rainfall. These liquids should be handled as a hazardous waste unless testing determines them to be non-hazardous. Non-hazardous liquids should be sent to an approved disposal site.
  - Sufficient separation should be provided between stored containers to allow for spill cleanup and emergency response access.

- Incompatible materials, such as chlorine and ammonia, should not be stored in the same temporary containment facility.

- Throughout the rainy season, temporary containment facilities should be covered during non-working days, and prior to rain events. Covered facilities may include use of plastic tarps for small facilities or constructed roofs with overhangs.

- Drums should not be overfilled and wastes should not be mixed.

- Unless watertight, containers of dry waste should be stored on pallets.

- Do not over-apply herbicides and pesticides. Prepare only the amount needed. Follow the recommended usage instructions. Over application is expensive and environmentally harmful. Apply surface dressings in several smaller applications, as opposed to one large application. Allow time for infiltration and avoid excess material being carried offsite by runoff. Do not apply these chemicals just before it rains. People applying pesticides must be certified in accordance with federal and state regulations.

- Paint brushes and equipment for water and oil based paints should be cleaned within a contained area and should not be allowed to contaminate site soils, watercourses, or drainage systems. Waste paints, thinners, solvents, residues, and sludges that cannot be recycled or reused should be disposed of as hazardous waste. When thoroughly dry, latex paint and paint cans, used brushes, rags, absorbent materials, and drop cloths should be disposed of as solid waste.

- Do not clean out brushes or rinse paint containers into the dirt, street, gutter, storm drain, or stream. "Paint out" brushes as much as possible. Rinse water-based paints to the sanitary sewer. Filter and reuse thinners and solvents. Dispose of excess oil-based paints and sludge as hazardous waste.

- The following actions should be taken with respect to temporary contaminant:

  - Ensure that adequate hazardous waste storage volume is available.

  - Ensure that hazardous waste collection containers are conveniently located.

  - Designate hazardous waste storage areas onsite away from storm drains or watercourses and away from moving vehicles and equipment to prevent accidental spills.

  - Minimize production or generation of hazardous materials and hazardous waste on the job site.

  - Use containment berms in fueling and maintenance areas and where the potential for spills is high.

  - Segregate potentially hazardous waste from non-hazardous construction site debris.

  - Keep liquid or semi-liquid hazardous waste in appropriate containers (closed drums or similar) and under cover.

- Clearly label all hazardous waste containers with the waste being stored and the date of accumulation.
- Place hazardous waste containers in secondary containment.
- Do not allow potentially hazardous waste materials to accumulate on the ground.
- Do not mix wastes.
- Use all of the product before disposing of the container.
- Do not remove the original product label; it contains important safety and disposal information.

Waste Recycling Disposal

- Select designated hazardous waste collection areas onsite.
- Hazardous materials and wastes should be stored in covered containers and protected from vandalism.
- Place hazardous waste containers in secondary containment.
- Do not mix wastes, this can cause chemical reactions, making recycling impossible and complicating disposal.
- Recycle any useful materials such as used oil or water-based paint.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.
- Arrange for regular waste collection before containers overflow.
- Make sure that hazardous waste (e.g., excess oil-based paint and sludge) is collected, removed, and disposed of only at authorized disposal areas.

Disposal Procedures

- Waste should be disposed of by a licensed hazardous waste transporter at an authorized and licensed disposal facility or recycling facility utilizing properly completed Uniform Hazardous Waste Manifest forms.
- A Department of Health Services certified laboratory should sample waste to determine the appropriate disposal facility.
- Properly dispose of rainwater in secondary containment that may have mixed with hazardous waste.
- Attention is directed to "Hazardous Material", "Contaminated Material", and "Aerially Deposited Lead" of the contract documents regarding the handling and disposal of hazardous materials.

Education

- Educate employees and subcontractors on hazardous waste storage and disposal procedures.
- Educate employees and subcontractors on potential dangers to humans and the environment from hazardous wastes.
- Instruct employees and subcontractors on safety procedures for common construction site hazardous wastes.
- Instruct employees and subcontractors in identification of hazardous and solid waste.
- Hold regular meetings to discuss and reinforce hazardous waste management procedures (incorporate into regular safety meetings).
- The contractor's superintendent or representative should oversee and enforce proper hazardous waste management procedures and practices.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.
- Warning signs should be placed in areas recently treated with chemicals.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- If a container does spill, clean up immediately.

Costs

All of the above are low cost measures.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events..
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur
- Hazardous waste should be regularly collected.
- A foreman or construction supervisor should monitor onsite hazardous waste storage and disposal procedures.
- Waste storage areas should be kept clean, well organized, and equipped with ample cleanup supplies as appropriate for the materials being stored.
- Perimeter controls, containment structures, covers, and liners should be repaired or replaced as needed to maintain proper function.

- Hazardous spills should be cleaned up and reported in conformance with the applicable Material Safety Data Sheet (MSDS) and the instructions posted at the project site.
- The National Response Center, at (800) 424-8802, should be notified of spills of federal reportable quantities in conformance with the requirements in 40 CFR parts 110, 117, and 302. Also notify the Governors Office of Emergency Services Warning Center at (916) 845-8911.
- A copy of the hazardous waste manifests should be provided.

References

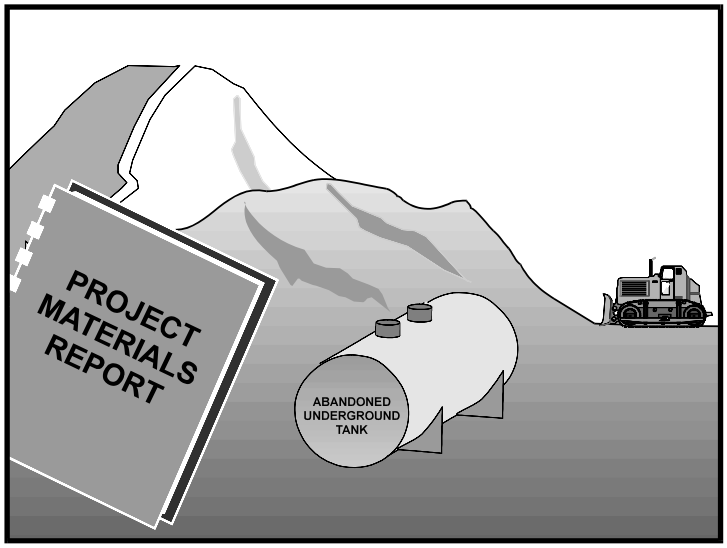
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Processes, Procedures and Methods to Control Pollution Resulting from All Construction Activity, 430/9-73-007, USEPA, 1973.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Contaminated Soil Management WM-7



Categories		
EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:
☑ **Primary Objective**
☒ **Secondary Objective**

Description and Purpose

Prevent or reduce the discharge of pollutants to stormwater from contaminated soil and highly acidic or alkaline soils by conducting pre-construction surveys, inspecting excavations regularly, and remediating contaminated soil promptly.

Suitable Applications

Contaminated soil management is implemented on construction projects in highly urbanized or industrial areas where soil contamination may have occurred due to spills, illicit discharges, aerial deposition, past use and leaks from underground storage tanks.

Limitations

Contaminated soils that cannot be treated onsite must be disposed of offsite by a licensed hazardous waste hauler. The presence of contaminated soil may indicate contaminated water as well. See NS-2, Dewatering Operations, for more information.

The procedures and practices presented in this BMP are general. The contractor should identify appropriate practices and procedures for the specific contaminants known to exist or discovered onsite.

Implementation

Most owners and developers conduct pre-construction environmental assessments as a matter of routine. Contaminated soils are often identified during project planning and development with known locations identified in the plans, specifications and in the SWPPP. The contractor should review applicable reports and investigate appropriate call-outs in the

Targeted Constituents	
Sediment	
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

plans, specifications, and SWPPP. Recent court rulings holding contractors liable for cleanup costs when they unknowingly move contaminated soil highlight the need for contractors to confirm a site assessment is completed before earth moving begins.

The following steps will help reduce stormwater pollution from contaminated soil:

- Conduct thorough, pre-construction inspections of the site and review documents related to the site. If inspection or reviews indicated presence of contaminated soils, develop a plan before starting work.
- Look for contaminated soil as evidenced by discoloration, odors, differences in soil properties, abandoned underground tanks or pipes, or buried debris.
- Prevent leaks and spills. Contaminated soil can be expensive to treat and dispose of properly. However, addressing the problem before construction is much less expensive than after the structures are in place.
- The contractor may further identify contaminated soils by investigating:
  - Past site uses and activities
  - Detected or undetected spills and leaks
  - Acid or alkaline solutions from exposed soil or rock formations high in acid or alkaline forming elements
  - Contaminated soil as evidenced by discoloration, odors, differences in soil properties, abandoned underground tanks or pipes, or buried debris.
  - Suspected soils should be tested at a certified laboratory.

Education

- Have employees and subcontractors complete a safety training program which meets 29 CFR 1910.120 and 8 CCR 5192 covering the potential hazards as identified, prior to performing any excavation work at the locations containing material classified as hazardous.
- Educate employees and subcontractors in identification of contaminated soil and on contaminated soil handling and disposal procedures.
- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).

Handling Procedures for Material with Aerially Deposited Lead (ADL)

- Materials from areas designated as containing (ADL) may, if allowed by the contract special provisions, be excavated, transported, and used in the construction of embankments and/or backfill.
- Excavation, transportation, and placement operations should result in no visible dust.
- Caution should be exercised to prevent spillage of lead containing material during transport.

- Quality should be monitored during excavation of soils contaminated with lead.

Handling Procedures for Contaminated Soils

- Minimize onsite storage. Contaminated soil should be disposed of properly in accordance with all applicable regulations. All hazardous waste storage will comply with the requirements in Title 22, CCR, Sections 66265.250 to 66265.260.
- Test suspected soils at an approved certified laboratory.
- Work with the local regulatory agencies to develop options for treatment or disposal if the soil is contaminated.
- Avoid temporary stockpiling of contaminated soils or hazardous material.
- Take the following precautions if temporary stockpiling is necessary:
  - Cover the stockpile with plastic sheeting or tarps.
  - Install a berm around the stockpile to prevent runoff from leaving the area.
  - Do not stockpile in or near storm drains or watercourses.
- Remove contaminated material and hazardous material on exteriors of transport vehicles and place either into the current transport vehicle or into the excavation prior to the vehicle leaving the exclusion zone.
- Monitor the air quality continuously during excavation operations at all locations containing hazardous material.
- Procure all permits and licenses, pay all charges and fees, and give all notices necessary and incident to the due and lawful prosecution of the work, including registration for transporting vehicles carrying the contaminated material and the hazardous material.
- Collect water from decontamination procedures and treat or dispose of it at an appropriate disposal site.
- Collect non-reusable protective equipment, once used by any personnel, and dispose of at an appropriate disposal site.
- Install temporary security fence to surround and secure the exclusion zone. Remove fencing when no longer needed.
- Excavate, transport, and dispose of contaminated material and hazardous material in accordance with the rules and regulations of the following agencies (the specifications of these agencies supersede the procedures outlined in this BMP):
  - United States Department of Transportation (USDOT)
  - United States Environmental Protection Agency (USEPA)
  - California Environmental Protection Agency (CAL-EPA)

- California Division of Occupation Safety and Health Administration (CAL-OSHA)
- Local regulatory agencies

Procedures for Underground Storage Tank Removals

- Prior to commencing tank removal operations, obtain the required underground storage tank removal permits and approval from the federal, state, and local agencies that have jurisdiction over such work.
- To determine if it contains hazardous substances, arrange to have tested, any liquid or sludge found in the underground tank prior to its removal.
- Following the tank removal, take soil samples beneath the excavated tank and perform analysis as required by the local agency representative(s).
- The underground storage tank, any liquid or sludge found within the tank, and all contaminated substances and hazardous substances removed during the tank removal and transported to disposal facilities permitted to accept such waste.

Water Control

- All necessary precautions and preventive measures should be taken to prevent the flow of water, including ground water, from mixing with hazardous substances or underground storage tank excavations. Such preventative measures may consist of, but are not limited to, berms, cofferdams, grout curtains, freeze walls, and seal course concrete or any combination thereof.
- If water does enter an excavation and becomes contaminated, such water, when necessary to proceed with the work, should be discharged to clean, closed top, watertight transportable holding tanks, treated, and disposed of in accordance with federal, state, and local laws.

Costs

Prevention of leaks and spills is inexpensive. Treatment or disposal of contaminated soil can be quite expensive.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Arrange for contractor's Water Pollution Control Manager, foreman, and/or construction supervisor to monitor onsite contaminated soil storage and disposal procedures.
- Monitor air quality continuously during excavation operations at all locations containing hazardous material.
- Coordinate contaminated soils and hazardous substances/waste management with the appropriate federal, state, and local agencies.

- Implement WM-4, Spill Prevention and Control, to prevent leaks and spills as much as possible.

References

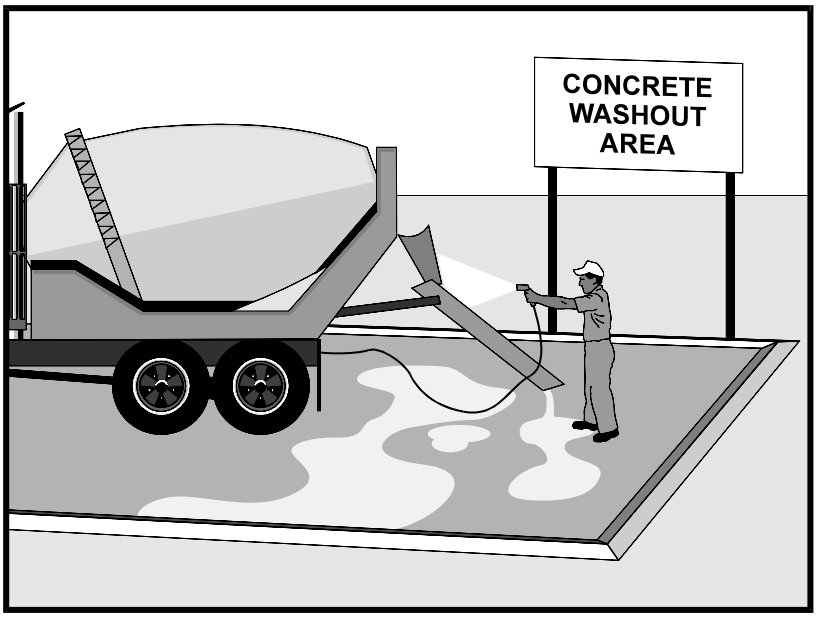
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Processes, Procedures and Methods to Control Pollution Resulting from All Construction Activity, 430/9-73-007, USEPA, 1973.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Concrete Waste Management WM-8



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☒
WM	Waste Management and Materials Pollution Control	☑

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	☑
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Prevent the discharge of pollutants to stormwater from concrete waste by conducting washout onsite or offsite in a designated area, and by employee and subcontractor training.

The General Permit incorporates Numeric Action Levels (NAL) for pH (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements).

Many types of construction materials, including mortar, concrete, stucco, cement and block and their associated wastes have basic chemical properties that can raise pH levels outside of the permitted range. Additional care should be taken when managing these materials to prevent them from coming into contact with stormwater flows and raising pH to levels outside the accepted range.

Suitable Applications

Concrete waste management procedures and practices are implemented on construction projects where:

- Concrete is used as a construction material or where concrete dust and debris result from demolition activities.
- Slurries containing portland cement concrete (PCC) are generated, such as from saw cutting, coring, grinding, grooving, and hydro-concrete demolition.
- Concrete trucks and other concrete-coated equipment are washed onsite.

- Mortar-mixing stations exist.
- Stucco mixing and spraying.
- See also NS-8, Vehicle and Equipment Cleaning.

Limitations

- Offsite washout of concrete wastes may not always be possible.
- Multiple washouts may be needed to assure adequate capacity and to allow for evaporation.

Implementation

The following steps will help reduce stormwater pollution from concrete wastes:

- Incorporate requirements for concrete waste management into material supplier and subcontractor agreements.
- Store dry and wet materials under cover, away from drainage areas. Refer to WM-1, Material Delivery and Storage for more information.
- Avoid mixing excess amounts of concrete.
- Perform washout of concrete trucks in designated areas only, where washout will not reach stormwater.
- Do not wash out concrete trucks into storm drains, open ditches, streets, streams or onto the ground. Trucks should always be washed out into designated facilities.
- Do not allow excess concrete to be dumped onsite, except in designated areas.
- For onsite washout:
  - On larger sites, it is recommended to locate washout areas at least 50 feet from storm drains, open ditches, or water bodies. Do not allow runoff from this area by constructing a temporary pit or bermed area large enough for liquid and solid waste.
  - Washout wastes into the temporary washout where the concrete can set, be broken up, and then disposed properly.
  - Washouts shall be implemented in a manner that prevents leaching to underlying soils. Washout containers must be water tight and washouts on or in the ground must be lined with a suitable impervious liner, typically a plastic type material.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile or dispose in the trash.
- See typical concrete washout installation details at the end of this fact sheet.

Education

- Educate employees, subcontractors, and suppliers on the concrete waste management techniques described herein.

- Arrange for contractor's superintendent or representative to oversee and enforce concrete waste management procedures.
- Discuss the concrete management techniques described in this BMP (such as handling of concrete waste and washout) with the ready-mix concrete supplier before any deliveries are made.

Concrete Demolition Wastes

- Stockpile concrete demolition waste in accordance with BMP WM-3, Stockpile Management.
- Dispose of or recycle hardened concrete waste in accordance with applicable federal, state or local regulations.

Concrete Slurry Wastes

- PCC and AC waste should not be allowed to enter storm drains or watercourses.
- PCC and AC waste should be collected and disposed of or placed in a temporary concrete washout facility (as described in Onsite Temporary Concrete Washout Facility, Concrete Transit Truck Washout Procedures, below).
- A foreman or construction supervisor should monitor onsite concrete working tasks, such as saw cutting, coring, grinding and grooving to ensure proper methods are implemented.
- Saw-cut concrete slurry should not be allowed to enter storm drains or watercourses. Residue from grinding operations should be picked up by means of a vacuum attachment to the grinding machine or by sweeping. Saw cutting residue should not be allowed to flow across the pavement and should not be left on the surface of the pavement. See also NS-3, Paving and Grinding Operations; and WM-10, Liquid Waste Management.
- Concrete slurry residue should be disposed in a temporary washout facility (as described in Onsite Temporary Concrete Washout Facility, Concrete Transit Truck Washout Procedures, below) and allowed to dry. Dispose of dry slurry residue in accordance with WM-5, Solid Waste Management.

Onsite Temporary Concrete Washout Facility, Transit Truck Washout Procedures

- Temporary concrete washout facilities should be located a minimum of 50 ft from storm drain inlets, open drainage facilities, and watercourses. Each facility should be located away from construction traffic or access areas to prevent disturbance or tracking.
- A sign should be installed adjacent to each washout facility to inform concrete equipment operators to utilize the proper facilities.
- Temporary concrete washout facilities should be constructed above grade or below grade at the option of the contractor. Temporary concrete washout facilities should be constructed and maintained in sufficient quantity and size to contain all liquid and concrete waste generated by washout operations.

- Temporary washout facilities should have a temporary pit or bermed areas of sufficient volume to completely contain all liquid and waste concrete materials generated during washout procedures.
- Temporary washout facilities should be lined to prevent discharge to the underlying ground or surrounding area.
- Washout of concrete trucks should be performed in designated areas only.
- Only concrete from mixer truck chutes should be washed into concrete wash out.
- Concrete washout from concrete pumper bins can be washed into concrete pumper trucks and discharged into designated washout area or properly disposed of or recycled offsite.
- Once concrete wastes are washed into the designated area and allowed to harden, the concrete should be broken up, removed, and disposed of per WM-5, Solid Waste Management. Dispose of or recycle hardened concrete on a regular basis.
- Temporary Concrete Washout Facility (Type Above Grade)
  - Temporary concrete washout facility (type above grade) should be constructed as shown on the details at the end of this BMP, with a recommended minimum length and minimum width of 10 ft; however, smaller sites or jobs may only need a smaller washout facility. With any washout, always maintain a sufficient quantity and volume to contain all liquid and concrete waste generated by washout operations.
  - Materials used to construct the washout area should conform to the provisions detailed in their respective BMPs (e.g., SE-8 Sandbag Barrier).
  - Plastic lining material should be a minimum of 10 mil in polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.
  - Alternatively, portable removable containers can be used as above grade concrete washouts. Also called a “roll-off”; this concrete washout facility should be properly sealed to prevent leakage, and should be removed from the site and replaced when the container reaches 75% capacity.
- Temporary Concrete Washout Facility (Type Below Grade)
  - Temporary concrete washout facilities (type below grade) should be constructed as shown on the details at the end of this BMP, with a recommended minimum length and minimum width of 10 ft. The quantity and volume should be sufficient to contain all liquid and concrete waste generated by washout operations.
  - Lath and flagging should be commercial type.
  - Plastic lining material should be a minimum of 10 mil polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.

- The base of a washout facility should be free of rock or debris that may damage a plastic liner.

Removal of Temporary Concrete Washout Facilities

- When temporary concrete washout facilities are no longer required for the work, the hardened concrete should be removed and properly disposed or recycled in accordance with federal, state or local regulations. Materials used to construct temporary concrete washout facilities should be removed from the site of the work and properly disposed or recycled in accordance with federal, state or local regulations..

- Holes, depressions or other ground disturbance caused by the removal of the temporary concrete washout facilities should be backfilled and repaired.

Costs

All of the above are low cost measures. Roll-0ff concrete washout facilities can be more costly than other measures due to removal and replacement; however, provide a cleaner alternative to traditional washouts. The type of washout facility, size, and availability of materials will determine the cost of the washout.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Temporary concrete washout facilities should be maintained to provide adequate holding capacity with a minimum freeboard of 4 in. for above grade facilities and 12 in. for below grade facilities. Maintaining temporary concrete washout facilities should include removing and disposing of hardened concrete and returning the facilities to a functional condition. Hardened concrete materials should be removed and properly disposed or recycled in accordance with federal, state or local regulations.

- Washout facilities must be cleaned, or new facilities must be constructed and ready for use once the washout is 75% full.

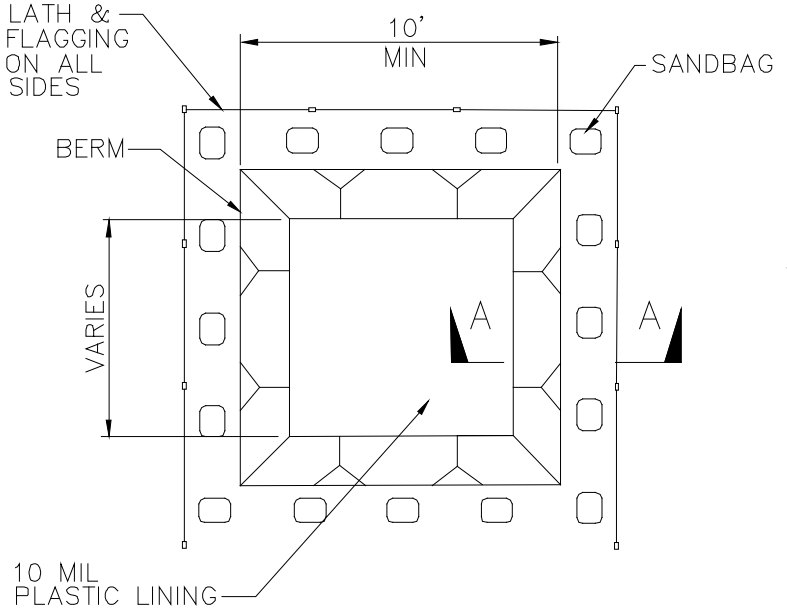
- Inspect washout facilities for damage (e.g. torn liner, evidence of leaks, signage, etc.). Repair all identified damage.

References

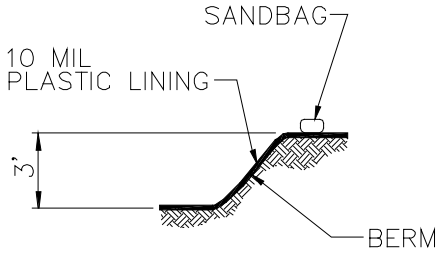
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000, Updated March 2003.

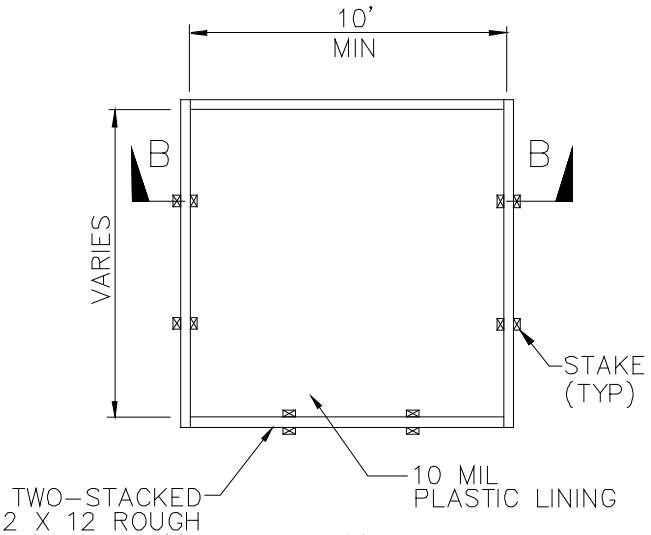
Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.



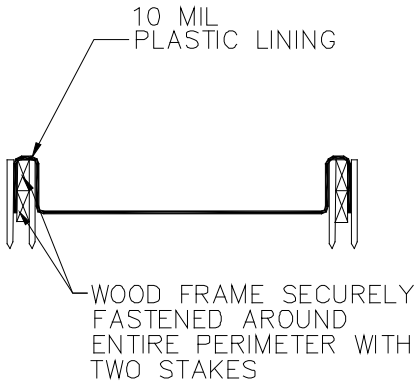
PLAN
NOT TO SCALE
TYPE "BELOW GRADE"



SECTION A–A
NOT TO SCALE



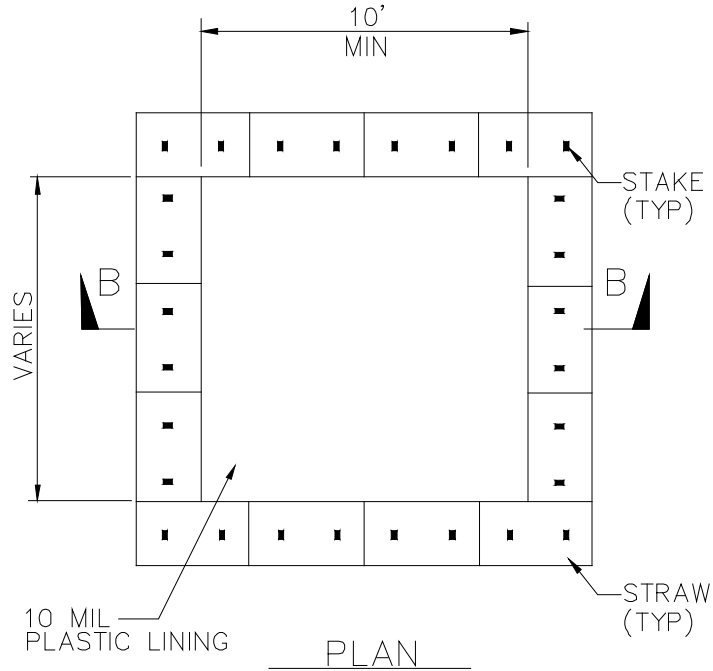
PLAN
NOT TO SCALE
TYPE "ABOVE GRADE"



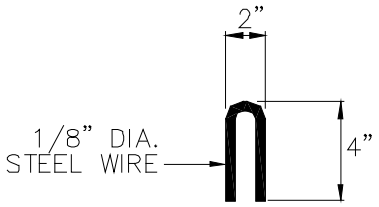
SECTION B–B
NOT TO SCALE

NOTES

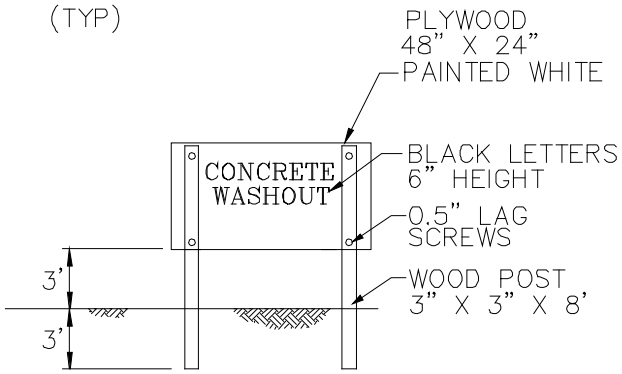
1. ACTUAL LAYOUT DETERMINED IN FIELD.
2. THE CONCRETE WASHOUT SIGN SHALL BE INSTALLED WITHIN 30 FT. OF THE TEMPORARY CONCRETE WASHOUT FACILITY.



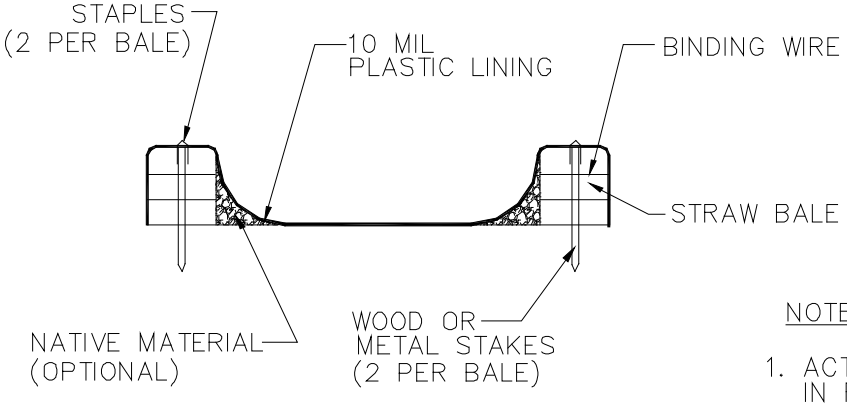
PLAN
NOT TO SCALE
TYPE "ABOVE GRADE"
WITH STRAW BALES



STAPLE DETAIL



CONCRETE WASHOUT
SIGN DETAIL
(OR EQUIVALENT)

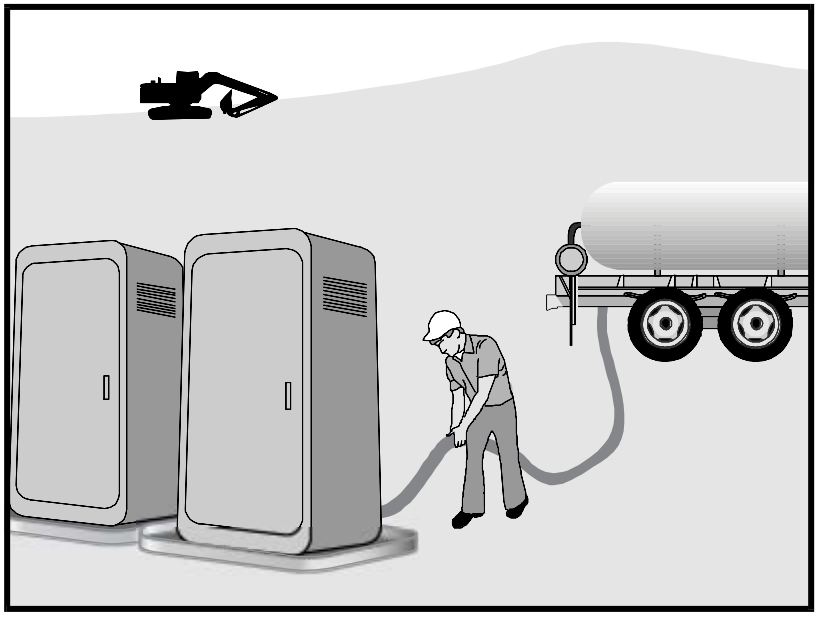


SECTION B–B
NOT TO SCALE

NOTES

1. ACTUAL LAYOUT DETERMINED IN FIELD.
2. THE CONCRETE WASHOUT SIGN SHALL BE INSTALLED WITHIN 30 FT. OF THE TEMPORARY CONCRETE WASHOUT FACILITY.

Sanitary/Septic Waste Management WM-9



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	
Nutrients	☑
Trash	☑
Metals	
Bacteria	☑
Oil and Grease	
Organics	☑

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Proper sanitary and septic waste management prevent the discharge of pollutants to stormwater from sanitary and septic waste by providing convenient, well-maintained facilities, and arranging for regular service and disposal.

Suitable Applications

Sanitary septic waste management practices are suitable for use at all construction sites that use temporary or portable sanitary and septic waste systems.

Limitations

None identified.

Implementation

Sanitary or septic wastes should be treated or disposed of in accordance with state and local requirements. In many cases, one contract with a local facility supplier will be all that it takes to make sure sanitary wastes are properly disposed.

Storage and Disposal Procedures

- Temporary sanitary facilities should be located away from drainage facilities, watercourses, and from traffic circulation. If site conditions allow, place portable facilities a minimum of 50 feet from drainage conveyances and traffic areas. When subjected to high winds or risk of high winds, temporary sanitary facilities should be secured to prevent overturning.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Temporary sanitary facilities must be equipped with containment to prevent discharge of pollutants to the stormwater drainage system of the receiving water.
- Consider safety as well as environmental implications before placing temporary sanitary facilities.
- Wastewater should not be discharged or buried within the project site.
- Sanitary and septic systems that discharge directly into sanitary sewer systems, where permissible, should comply with the local health agency, city, county, and sewer district requirements.
- Only reputable, licensed sanitary and septic waste haulers should be used.
- Sanitary facilities should be located in a convenient location.
- Temporary septic systems should treat wastes to appropriate levels before discharging.
- If using an onsite disposal system (OSDS), such as a septic system, local health agency requirements must be followed.
- Temporary sanitary facilities that discharge to the sanitary sewer system should be properly connected to avoid illicit discharges.
- Sanitary and septic facilities should be maintained in good working order by a licensed service.
- Regular waste collection by a licensed hauler should be arranged before facilities overflow.
- If a spill does occur from a temporary sanitary facility, follow federal, state and local regulations for containment and clean-up.

Education

- Educate employees, subcontractors, and suppliers on sanitary and septic waste storage and disposal procedures.
- Educate employees, subcontractors, and suppliers of potential dangers to humans and the environment from sanitary and septic wastes.
- Instruct employees, subcontractors, and suppliers in identification of sanitary and septic waste.
- Hold regular meetings to discuss and reinforce the use of sanitary facilities (incorporate into regular safety meetings).
- Establish a continuing education program to indoctrinate new employees.

Costs

All of the above are low cost measures.

Inspection and Maintenance

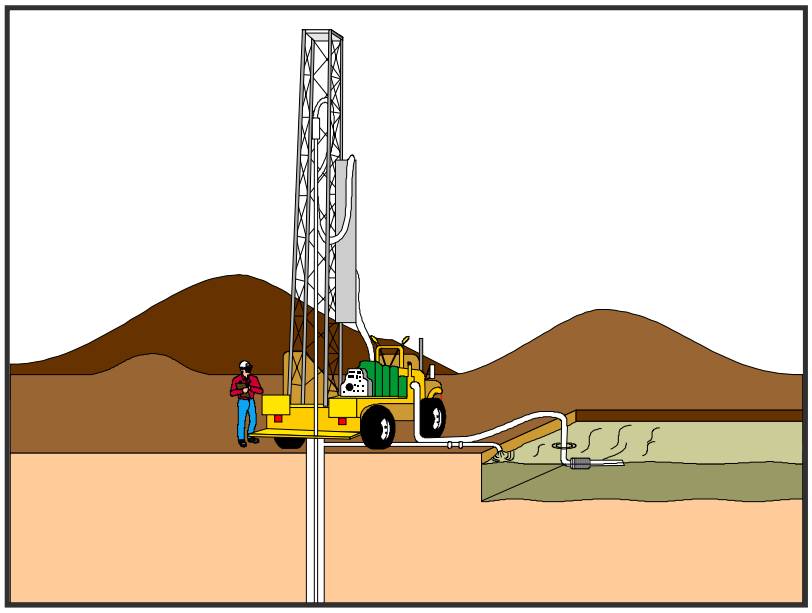
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Arrange for regular waste collection.
- If high winds are expected, portable sanitary facilities must be secured with spikes or weighed down to prevent over turning.
- If spills or leaks from sanitary or septic facilities occur that are not contained and discharge from the site, non-visible sampling of site discharge may be required. Refer to the General Permit or to your project specific Construction Site Monitoring Plan to determine if and where sampling is required.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Liquid Waste Management WM-10



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

Description and Purpose

Liquid waste management includes procedures and practices to prevent discharge of pollutants to the storm drain system or to watercourses as a result of the creation, collection, and disposal of non-hazardous liquid wastes.

Suitable Applications

Liquid waste management is applicable to construction projects that generate any of the following non-hazardous by-products, residuals, or wastes:

- Drilling slurries and drilling fluids
- Grease-free and oil-free wastewater and rinse water
- Dredgings
- Other non-stormwater liquid discharges not permitted by separate permits

Limitations

- Disposal of some liquid wastes may be subject to specific laws and regulations or to requirements of other permits secured for the construction project (e.g., NPDES permits, Army Corps permits, Coastal Commission permits, etc.).
- Liquid waste management does not apply to dewatering operations (NS-2 Dewatering Operations), solid waste management (WM-5, Solid Waste Management), hazardous wastes (WM-6, Hazardous Waste Management), or

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

concrete slurry residue (WM-8, Concrete Waste Management).

- Typical permitted non-stormwater discharges can include: water line flushing; landscape irrigation; diverted stream flows; rising ground waters; uncontaminated pumped ground water; discharges from potable water sources; foundation drains; irrigation water; springs; water from crawl space pumps; footing drains; lawn watering; flows from riparian habitats and wetlands; and discharges or flows from emergency fire fighting activities.

Implementation

General Practices

- Instruct employees and subcontractors how to safely differentiate between non-hazardous liquid waste and potential or known hazardous liquid waste.
- Instruct employees, subcontractors, and suppliers that it is unacceptable for any liquid waste to enter any storm drainage device, waterway, or receiving water.
- Educate employees and subcontractors on liquid waste generating activities and liquid waste storage and disposal procedures.
- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).
- Verify which non-stormwater discharges are permitted by the statewide NPDES permit; different regions might have different requirements not outlined in this permit.
- Apply NS-8, Vehicle and Equipment Cleaning for managing wash water and rinse water from vehicle and equipment cleaning operations.

Containing Liquid Wastes

- Drilling residue and drilling fluids should not be allowed to enter storm drains and watercourses and should be disposed of.
- If an appropriate location is available, drilling residue and drilling fluids that are exempt under Title 23, CCR § 2511(g) may be dried by infiltration and evaporation in a containment facility constructed in conformance with the provisions concerning the Temporary Concrete Washout Facilities detailed in WM-8, Concrete Waste Management.
- Liquid wastes generated as part of an operational procedure, such as water-laden dredged material and drilling mud, should be contained and not allowed to flow into drainage channels or receiving waters prior to treatment.
- Liquid wastes should be contained in a controlled area such as a holding pit, sediment basin, roll-off bin, or portable tank.
- Containment devices must be structurally sound and leak free.
- Containment devices must be of sufficient quantity or volume to completely contain the liquid wastes generated.

- Precautions should be taken to avoid spills or accidental releases of contained liquid wastes. Apply the education measures and spill response procedures outlined in WM-4, Spill Prevention and Control.

- Containment areas or devices should not be located where accidental release of the contained liquid can threaten health or safety or discharge to water bodies, channels, or storm drains.

Capturing Liquid Wastes

- Capture all liquid wastes that have the potential to affect the storm drainage system (such as wash water and rinse water from cleaning walls or pavement), before they run off a surface.

- Do not allow liquid wastes to flow or discharge uncontrolled. Use temporary dikes or berms to intercept flows and direct them to a containment area or device for capture.

- Use a sediment trap (SE-3, Sediment Trap) for capturing and treating sediment laden liquid waste or capture in a containment device and allow sediment to settle.

Disposing of Liquid Wastes

- A typical method to handle liquid waste is to dewater the contained liquid waste, using procedures such as described in NS-2, Dewatering Operations, and SE-2, Sediment Basin, and dispose of resulting solids per WM-5, Solid Waste Management.

- Methods of disposal for some liquid wastes may be prescribed in Water Quality Reports, NPDES permits, Environmental Impact Reports, 401 or 404 permits, and local agency discharge permits, etc. Review the SWPPP to see if disposal methods are identified.

- Liquid wastes, such as from dredged material, may require testing and certification whether it is hazardous or not before a disposal method can be determined.

- For disposal of hazardous waste, see WM-6, Hazardous Waste Management.

- If necessary, further treat liquid wastes prior to disposal. Treatment may include, though is not limited to, sedimentation, filtration, and chemical neutralization.

Costs

Prevention costs for liquid waste management are minimal. Costs increase if cleanup or fines are involved.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.

- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.

- Remove deposited solids in containment areas and capturing devices as needed and at the completion of the task. Dispose of any solids as described in WM-5, Solid Waste Management.

- Inspect containment areas and capturing devices and repair as needed.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

EXHIBIT 8.II

CONSTRUCTION SITE INSPECTION CHECKLIST

CITY OF LAGUNA NIGUEL
27781 LA PAZ ROAD (949) 362-4360
MUNICIPAL STORMWATER PROGRAM
CONSTRUCTION SITE INSPECTION FORM
FOR INSPECTION OF PRIVATE PROJECT'S ISSUED GRADING & BUILDING PERMITS

SECTION I - GENERAL

PERMIT # _____ INSPECTOR(S): _____

ADDRESS: _____

ARRIVAL TIME: _____ _____ PHOTOGRAPHS TAKEN: ☐ Y ☐ N

WEATHER CONDITION: _____ INSPECTION DATE: _____

SITE PRIORITY (Check Applicable)
☐ HIGH PRIORITY ☐ MEDIUM PRIORITY
☐ LOW PRIORITY ☐ PRIORITY UNKNOWN

SEASON (Check Applicable)
☐ WET (OCTOBER 1 THROUGH APRIL 30) ☐ DRY (MAY 1 THROUGH SEPTEMBER 30)

NAME OF SITE REPRESENTATIVE PRESENT DURING INSPECTION: _____ PHONE No: _____

DEVELOPMENT SIZE: _____ ESTIMATED % OF DISTURBED AREA: _____

TYPE OF CONSTRUCTION:
☐ RESIDENTIAL ☐ COMMERCIAL ☐ INDUSTRIAL ☐ RECONSTRUCTION ☐ OTHER

SECTION II - RESULTS OF INSPECTION

Erosion Control Practices	Y	N	N/A	COMMENTS
1. Are erosion controls being implemented and maintained on inactive and active disturbed soil areas (sheeting, mulch, hay, soil stabilizers, etc.), in accordance with Erosion and Sediment Control Plans (ESCPs) and provisions of the Grading Ordinance?				
2. Erosion observed? *If YES, describe the evidence of the erosion and whether it is major or minor.*				
Sediment Control Practices	**Y**	**N**	**N/A**	**COMMENTS**
3. Are sediment controls being implemented and maintained on all significant slopes (silt fences, fiber rolls, etc. at the base of slopes) and the downstream perimeter, in accordance with Erosion and Sediment Control Plans (ESCPs) and provisions of the Grading Ordinance?				
4. Sediment discharge observed? *If YES, describe the evidence of the discharge and whether it is major or minor. (If the discharge could impact wildlife, sensitive habitat/endangered species, an impaired water body (303d listed), ESA or ASBS area, go to the "Evaluation of Potential Impacts to Human or Environmental Health" form.)*				
Tracking Controls	**Y**	**N**	**N/A**	**COMMENTS**
5. Are the entrances and exits to the construction site adequately protected (tire washout, stabilized entrances, rumble strips)?				
6. Are roads free of sediment?				
Waste and Disposal Management	**Y**	**N**	**N/A**	**COMMENTS**
7. Are activities such as concrete/plastering, painting and fueling resulting in a discharge to the storm drain in violation of provisions of the Water Quality Ordinance? *If YES, describe the evidence of the discharge and whether it is major or minor.*				
8. Are containers for construction waste and debris being utilized and are they adequate?				
9. Are there potential water quality problems that have been identified on the site, which may be in violation of provisions of the Water Quality Ordinance and may require further inspection by an Authorized Water Quality Ordinance Inspector?				
10. Are there any discharges or spills of sewage, oil, or toxic/hazardous materials, which may be in violation of provisions of the Water Quality Ordinance? *If YES, go to the "Evaluation of Potential Impacts to Human or Environmental Health" form.*				

SECTION III - ENFORCEMENT ACTIONS

☐ Issued a Notice of Non-compliance
☐ Issued an Administrative Compliance Order
☐ Issued a Cease and Desist Order
☐ Issued a Stop Work Order
☐ No Action Required
☐ Request Inspection by an Authorized Water Quality Ordinance Inspector
☐ Other (Please Explain):

OTHER/COMMENTS _____

White: Building Division Copy Yellow: Planning Division Copy Pink: Owner/Contractor Copy

9.0 EXISTING DEVELOPMENT COMPONENT

9.1 INTRODUCTION

The City of Laguna Niguel requires industrial and commercial premises to implement principally pollution prevention BMPs and properly maintain any structural BMPs incorporated at development or re-development locations. This Existing Development Component establishes City requirements and guidelines for pollution prevention methods that must be used by property owners, property managers, business operators, residents and other responsible parties, to protect water quality from existing private development activities and discharges. Businesses are inventoried and the City ensures BMPs are implemented through education, inspections, and enforcement. A parallel program is implemented in residential areas with an emphasis on education and outreach but also including periodic inspections. This section does not include City requirements for existing municipal facilities, which are addressed in Section 5 of the LIP. This local regulatory oversight of the built environment supports both the principal requirements of the Fifth Term Permit and effectively addresses two of the HPWQCs identified in the WQIP, specifically, unnatural water balance in dry weather and pathogen health risk. For a detailed description of program management responsibilities, see Section 2 of the LIP.

9.2 COMMERCIAL AND INDUSTRIAL PROGRAM

The Commercial and Industrial Program implements the provisions of Provision E.5 of the Fifth Term Permit. The program establishes specific pollution prevention practices, implementation of which is verified through City inspection.

9.2.1 Source Identification and Inventory

In compliance with Provision E.5 of the Fifth Term Permit, the City maintains, and periodically updates, on an at least an annual basis, a watershed-based inventory and map of all known commercial and industrial activities within its jurisdiction that could contribute a significant pollutant load to the MS4. A map of the inventory is included as Exhibit 9.III. Currently, there are no identified private industrial land uses within the City of Laguna Niguel.

A list of commercial and industrial activities that could be present within the City are included below:

Commercial Activities

- Automobile repair, maintenance, fueling, or cleaning
- Airplane repair, maintenance, fueling, or cleaning
- Boat repair, maintenance, fueling or cleaning
- Equipment repair, maintenance, fueling, or cleaning
- Automobile and other vehicle body repair or painting
- Automobile or other vehicle washing
- Automobile or other vehicle parking lots and storage facilities

- Retail or Wholesale fueling
- Pest control services
- Eating or drinking establishments, including food markets
- Carpet, drape or furniture cleaning
- Cement mixing or cutting
- Masonry
- Painting and coating
- Botanical zoological gardens and exhibits
- Landscaping
- Nurseries and greenhouses
- Golf course, parks and other recreational areas/facilities
- Cemeteries
- Pool and fountain cleaning
- Marinas
- Portable sanitary services
- Building material retailers and storage
- Animal facilities
- Power washing services
- Mobile businesses based in the City
- Priority Projects (See **Section 7** of the LIP) approved since July of 2001
- Other activities with a history of un-authorized discharges to the MS4
- Other activities with the potential to contribute a significant pollutant load to the MS4

Industrial Activities

- Industrial facilities subject to the State General Industrial Permit or other individual NPDES permit
- Operating and closed landfills
- Activities involving significant amounts of hazardous and toxic chemicals
- Hazardous waste treatment, disposal, storage and recovery facilities
- Other activities with the potential to contribute a significant pollutant load to the MS4

In addition to those activities listed above, the City's inventory includes all other commercial or industrial activities 1) tributary to a CWA 303(d) impaired water body segment, where the activity is a significant source of a pollutant for which the water body is impaired; and/or 2) within or directly adjacent to or discharging directly to a receiving water within an ESA.

The City's inventory includes the following information about each listed activity:

- Business name
- Owner/manager contact information
- Physical address information
- Mailing address information
- Watershed
- Activity type
- Standard Industrial Code (SIC)

- Local and State licenses and permits (as applicable)
- Potential pollutants
- If tributary to a CWA 303(d) water body
- Pollutants of concern in 303(d) water body (as applicable)
- Post-construction BMPs (Priority Projects approved since July of 2001)
- Inspection and follow-up inspections (date, observations, corrective actions)
- Comments/Notes

Copies of the most current inventory are available, upon request, from the City's Community Development Department.

9.2.2 BMP Implementation

In compliance with Provision E.5 of the Fifth Term Permit, commercial and industrial activities shall implement activity specific BMPs and PPMs. A large majority of the City's commercial and industrial activities are tributary to CWA Section 303(d) impaired water bodies. Therefore, these minimum BMPs/PPMs include both general and enhanced water quality measures. A list of minimum designated BMPs and PPMs are shown in Table 9.1 below. The corresponding activity specific BMP checklists are included in Exhibit 9.I.

Table 9.1
Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs)
For Commercial & Industrial Activities

Activity	Minimum Designated BMPs/PPMs	
IC1. Animal Handling Areas	BMP1	Do not dispose of animal waste, animal food, or any other byproducts in the parking lots, streets, gutters, storm drains, natural watercourses, or landscaping areas.
	BMP2	Provide employee training.
	BMP3	Prevent wash/rinse water from interior and exterior areas from entering the parking lots, streets, gutters, storm drains, and natural watercourses.
	BMP4	Pick up and dispose of animal waste regularly.
	PPM1	Keep site free of trash & debris.
IC2. Building Maintenance	BMP1	Do not dispose of wash or wastewater in the streets, gutters, storm drains, or natural watercourses.
	BMP2	Provide employee & contractor training.
	BMP3	Use extra precautions to prevent dirt, construction debris and other solids from entering the streets, gutters, storm drains, and natural watercourses.
	PPM1	Keep site free of trash & debris.
IC3. Carpet Cleaning	BMP1	Do not dispose of wash or wastewater in the streets, gutters, storm drains, or natural watercourses.
	BMP2	Provide employee & contractor training.
	BMP3	Properly maintain fleet of vehicles and equipment.
	PPM1	Keep site free of trash & debris.

Activity	Minimum Designated BMPs/PPMs	
IC4. Concrete & Asphalt Production, Application & Cutting	BMP1	Do not dispose of process water from production, pouring, equipment cleaning, and cuffing activities in the streets, gutters, storm drains, or natural watercourses.
	BMP2	Provide employee & contractor training.
	BMP3	Pre-heat, transfer or load hot bituminous material away from storm drain inlets.
	PPM1	Sweep the production, pouring and cutting areas regularly to collect loose materials.
IC5. Contaminated or Erodible Surface Areas	BMP1	Protect contaminated or erodible surface areas from rainfall and wind dispersal.
	BMP2	Provide employee & contractor training.
	BMP3	Protect contaminated or erodible surfaces areas from stormwater run-on and runoff.
	PPM1	Keep site free of trash & debris.
IC6. Landscape Maintenance	BMP1	Do not dispose of gardening waste (green waste) in the streets, gutters, storm drains, or natural watercourses.
	BMP2	Provide employee & contractor training.
	BMP3	Use extra precautions when applying pesticides, herbicides and fungicides.
	BMP4	Use extra precautions when applying fertilizers.
	BMP5	Use extra precautions when applying soil amendments.
	PPM1	Keep site free of trash & debris.
IC7. Nurseries & Greenhouses	BMP1	Do not dispose of gardening waste (green waste) in the streets, gutters, storm drains, or natural watercourses.
	BMP2	Provide employee & contractor training.
	BMP3	Use extra precautions when applying pesticides, herbicides and fungicides.
	BMP4	Use extra precautions when applying fertilizers.
	BMP5	Use extra precautions when applying soil amendments.
	PPM1	Keep site free of trash & debris.
IC8. Outdoor Drainage from Indoor Areas	BMP1	Do not dispose of wash/rinse water in the parking lots, streets, gutters, storm drains, or natural watercourses.
	BMP2	Provide employee training.
	BMP3	Prevent wash/rinse water from trash dumpster, patio, sidewalk and other hardscape areas from entering the parking lots, streets, gutters, storm drains, and natural watercourses.
	PPM1	Keep site free of trash & debris.
IC9. Outdoor Loading/Unloading of Materials	BMP1	Prevent materials, products and other pollutants associated with loading and unloading activities from entering the streets, gutters, storm drains, or natural watercourses.
	BMP2	Provide employee & contractor training.
	BMP3	Properly maintain fleet of vehicles and equipment.
	PPM1	Keep loading & unloading areas free of trash & debris.

Activity	Minimum Designated BMPs/PPMs	
IC10. Outdoor Process Equipment Operations & Maintenance	BMP1	Prevent materials, products and other pollutants associated with outdoor processing activities from entering the streets, gutters, storm drains, or natural watercourses.
	BMP2	Provide employee & contractor training.
	BMP3	Properly maintain fleet of vehicles and equipment.
	PPM1	Keep processing areas free of trash & debris.
IC11. Outdoor Storage of Raw Materials, Products and Containers	BMP1	Prevent materials, products and other pollutants associated with the outdoor storage area from entering the streets, gutters, storm drains, or natural watercourses.
	BMP2	Provide employee & contractor training.
	BMP3	Properly maintain fleet of vehicles and equipment.
	PPM1	Keep site free of trash & debris.
IC12. Painting, Finishing, & Coatings of Vehicles, Boats, Buildings and Equipment	BMP1	Prevent paints, finishing, and coating materials, toxic substances and liquid waste from entering the streets, gutters, storm drains, and natural watercourses.
	BMP2	Provide employee & contractor training.
	BMP3	Properly clean, store, and dispose of painting, finishing and coating materials.
	PPM1	Keep site free of trash & debris.
IC13. Parking & Storage Area Maintenance	BMP1	Do not dispose of wash or wastewater in the streets, gutters, storm drains, or natural watercourses.
	BMP2	Provide employee & contractor training.
	BMP3	Prevent wash/rinse water from trash dumpster, patio, sidewalk and other hardscape areas from entering the parking lots, streets, gutters, storm drains, and natural watercourses.
	PPM1	Keep site free of trash & debris.
IC14. Pool & Fountain Cleaning	BMP1	Discharge pool & fountain water properly.
	BMP2	Provide employee training.
	BMP3	Prevent algae problems with regular cleaning, consistent adequate chlorine levels, and well maintained filtration and circulation systems.
	PPM1	Properly clean and/or dispose of filters.
IC15. Spill Prevention & Cleanup	BMP1	Clean up leaks and spills immediately.
	BMP2	Provide employee & contractor training.
	BMP3	Properly store and handle chemical materials.
	PPM1	Keep storage areas free of trash & debris.
IC16. Vehicle & Equipment Fueling	BMP1	Prevent fuel from entering the streets, gutters, storm drains, and natural watercourses.
	BMP2	Provide employee & contractor training.
	BMP3	Utilize fueling safeguards.
	PPM1	Keep fuelling area clean and free of trash and debris.

Activity	Minimum Designated BMPs/PPMs	
IC17. Vehicle & Equipment Maintenance and Repair	BMP1	Prevent materials, products and other pollutants associated with maintenance and repair activities from entering the streets, gutters, storm drains, or natural watercourses.
	BMP2	Provide employee & contractor training.
	BMP3	Properly maintain fleet of vehicles and equipment.
	PPM1	Keep maintenance and repair areas free of trash & debris.
IC18. Vehicle & Equipment Washing & Steam Cleaning	BMP1	Prevent wash/rinse water from entering the streets, gutters, storm drains or natural watercourses.
	BMP2	Provide employee & contractor training.
	BMP3	Properly maintain fleet of vehicles and equipment.
	PPM1	Keep wash areas clean of trash and debris.
IC19. Waste Handling & Disposal	BMP1	Prevent waste from coming into direct contact with wind, rain and stormwater runoff.
	BMP2	Provide employee & contractor training.
	BMP3	Prevent wash/rinse water from waste collection areas from entering the streets, gutters, storm drains or natural watercourses.
	PPM1	Keep waste collection areas clean.
IC20. Eating & Drinking Establishments	BMP1	Do not dispose of wash/rinse water in the parking lots, streets, gutters, storm drains, or natural watercourses.
	BMP2	Provide employee training.
	BMP3	Prevent wash/rinse water from trash dumpster, patio, sidewalk and other hardscape areas from entering the parking lots, streets, gutters, storm drains, and natural water courses.
	BMP4	Properly dispose of grease.
	PPM1	Keep site free of trash & debris.
IC21. Irrigation Runoff	BMP1	Implement all feasible measures to eliminate surface runoff of landscape irrigation water.
	BMP2	Comply with water conservation, drought response and waste prohibition regulations of the water district.
IC22. Power Washing	BMP1	Prevent wastewater or wash water from exterior power washing or other exterior surface cleaning activity from entering parking lots, streets, gutters, storm drains, and natural water courses.
IC23. Mobile Businesses	BMP1	Prevent wastewater or wash water from entering parking lots, streets, gutters, storm drains, and natural water courses.
	BMP2	Properly store and handle chemical materials.
	BMP3	Provide employee & contractor training.
IC24. Special Events	BMP1	Keep site free of trash & debris.
	BMP2	Provide employee & contractor training.

9.2.3 Inspection

In compliance with Provision E.5 of the Fifth Term Permit, existing commercial and industrial activities are subject to periodic City inspection to ensure compliance with applicable water quality regulations.

Inspection Frequency

City inspection frequencies for existing commercial and industrial uses are based on consideration of the following factors:

- Type of activity
- Materials used
- Wastes generated
- Pollutant discharge potential
- Non-stormwater discharges
- Size of facility
- Proximity to receiving water bodies
- Sensitivity of receiving water bodies
- Whether the activity is subject to the State General Industrial Permit or an individual NPDES permit
- Whether the activity has filed a No Exposure Certification/Notice of Non-Applicability
- Facility design
- Total area of the site, area of the site where subject activities occur, area of the site exposed to rainfall and runoff
- The activity's compliance history
- Any other relevant factors

At a minimum, 20 percent of all other activities included in the City's existing commercial and industrial inventory, are inspected each year. Commercial and industrial activities not included in the City's inventory may also be inspected on an observed or complaint response basis.

Food Facilities

On behalf of the Permittees, the Orange County Health Care Agency (OCHCA) conducts annual water quality inspection on all food service facilities, per the Food Facility Inspection Program described in DAMP Section 9.3. The City is then responsible for conducting follow-up investigations on food facilities within the City where BMP deficiencies have been identified. Follow up investigations may include facility inspection, correspondence with the responsible site manager on proper BMPs, enforcement, or some combination of these approaches to achieve compliance.

Mobile Businesses

The City is a participant in the mobile business pilot program developed by the County of Orange. As such, activity information for mobile businesses identified in the City's existing commercial and industrial inventory (mobile businesses based in the City), and any other

mobile businesses observed to be operating within the City, are forwarded to the County for inclusion in a web-based, regional inventory. Based on this regional inventory, the County takes the lead in distributing via several mechanisms, activity specific minimum BMP information to mobile business operators.

As discussed in Section 9.2.3, mobile businesses based in the City are subject to routine City inspections. Other mobile businesses operating within the City are subject to City inspection on an observed or complaint response basis.

Inspection Procedures

At least 30 days prior to commencement of routine inspections, affected businesses receive written notification of pending inspection. The notices include the following:

- Description of the inspection purpose and process
- Explanation of legal obligation to implement required BMPs
- Applicable activity specific BMP checklists

Inspections are conducted by an authorized City inspector, including both in-house staff and approved third parties, and include the following:

- Review of BMP implementation plans (as applicable)
- Review of facility monitoring data (as applicable)
- Verification of State General Industrial Permit coverage (as applicable)
- Assessment of compliance with City ordinances and permits related to runoff
- Assessment of BMP implementation, maintenance and effectiveness
- Visual observations for non-stormwater discharges, potential illicit connections, and potential discharge pollutants in stormwater runoff
- Education and training on stormwater pollution prevention (as applicable)

City inspection forms, provided in Exhibit 9.II**,** are used to document inspection results and to provide notice to the property owner and/or business operator of required corrective action(s), if any. Photographs are also taken to document any observed violations.

Businesses notified of the need for corrective action(s) are re-inspected within 30 days of the prior inspection. At the City's discretion, continued failure by notified businesses to rectify violations of City water quality regulations are forwarded to the City's Code Enforcement Division for resolution.

9.3 RESIDENTIAL PROGRAM

The Residential Program implements the provisions of Provision E.5 of the Fifth Term Permit. The program establishes specific pollution prevention practices, implementation of which is encouraged through public education and outreach efforts and verified through inspections.

9.3.1 Source Identification and Inventory

In compliance with Provision E.5 of the Fifth Term Permit and DAMP Section 9.5.2, the City has developed and maintains inventories of residential areas and activities that potentially pose a high threat to water quality. The activity inventory, and the related minimum designated BMPs are shown in Table 9.2. Defined Residential Management Areas (RMAs) as part of the existing development inventory are depicted in Exhibit 9.IV.

9.3.2 Best Management Practices

In compliance with Provision E.5 of the Fifth Term Permit residential areas shall implement the minimum designated BMPs shown below in Table 9.2. These include activity-specific BMPs for residential activities determined to pose a high threat to water quality. Additional controls for such uses occurring in areas tributary to a 303(d) listed water body and/or adjacent to, or that drain directly to, an ESA are also identified. These minimum designated BMPs are appropriate to prevent or mitigate pollution generated from the specific residential activities and areas within the City.

Due to the substantial overlap in source activities and constituents of concern for the ESA and 303(d) tributary areas, all residential areas Citywide are treated as a high-threat-to-water quality areas. Therefore, enhanced BMP implementation is required for all residential uses citywide. If particular BMPs are infeasible at any specific site, other equivalent BMPs shall be implemented. The activity specific BMP checklists are included in **Exhibit 9.I**.

Table 9.2
Minimum Designated Best Management Practices (BMPs)
For Residential Activities

Activity	Minimum Designated BMPs	
R1. Automobile Repair & Maintenance	BMP1	Prevent materials, products and other pollutants associated with maintenance and repair activities from entering the streets, gutters, storm drains, or natural watercourses.
	BMP2	Clean up leaks and spills immediately.
	BMP3	Properly store and handle chemical materials.
R2. Residential Automobile Washing	BMP1	Minimize wash/rinse water from entering the streets, gutters, storm drains, or natural watercourses.
	BMP2	Properly maintain vehicles.
	BMP3	Properly store and handle chemical materials.
R3. Residential Automobile Parking	BMP1	Adhere to applicable parking regulations, including parking restrictions to allow for street sweeping.
	BMP2	Properly maintain vehicles.
	BMP3	Properly store and handle chemical materials.
R4. Home & Garden Care Activities	BMP1	Do not dispose of wash or wastewater in the streets, gutters, storm drains, or natural watercourses.
	BMP2	Provide contractor training.
	BMP3	Use extra precautions when applying pesticides, herbicides, fungicides, fertilizers and soil amendments.

Activity	Minimum Designated BMPs	
R5. Disposal of Pet Waste	BMP1	Do not dispose of animal waste, animal food, or any other byproducts in the streets, gutters, storm drains, natural watercourses, or landscaping areas.
	BMP2	Pick up and dispose of animal waste regularly.
	BMP3	Prevent wash/rinse water from interior and exterior areas from entering the streets, gutters, storm drains, and natural watercourses.
R6. Disposal of Green Waste	BMP1	Do not dispose of gardening waste (green waste) in the streets, gutters, storm drains, or natural watercourses.
	BMP2	Provide landscape contractor and gardener training.
	BMP3	Remove on a regular basis, any accumulated dead or dying vegetation and debris from on-site drainage devices, v-ditches and natural watercourses.
R7. Household Hazardous Waste	BMP1	Do not dispose of household hazardous waste in the streets, gutters, storm drains, or natural watercourses.
	BMP2	Clean up leaks and spills immediately.
	BMP3	Properly store and handle chemical materials.
R8. Irrigation Runoff	BMP1	Implement all feasible measures to eliminate surface runoff of landscape irrigation water.
	BMP2	Comply with water conservation drought response and waste prohibition regulations of the water district.

9.3.3 BMP Implementation

In compliance with Provision E.5 of the Fifth Term Permit to ensure implementation of minimum designated BMPs, residential areas, including CIA/HOA common areas shall be subject to the following:

- *RMA Inspection*. In addition to informal inspections through City field staff, City inspectors periodically conduct inspections of defined RMAs. Any water quality violations and/or failures to properly implement minimum designated BMPs that are observed by inspectors, depending on the nature and scope of the violation, are either addressed immediately or forwarded to the City's Code Enforcement Division for resolution.

- *Field Reconnaissance*. City field personnel who have regular contact with residential areas (e.g. park maintenance personnel, street maintenance personnel, building inspectors, etc.) are trained to serve as informal inspectors.

- *Water Quality Hotline*. Upon receiving notification of a potential water quality violation, the City dispatches trained field personnel.

- *City Website*. The City's website includes a residential stormwater pollution prevention webpage. For additional water quality information, a link to the County webpage (www.ocwatersheds.com) is also included.

- *City E-Newsletter*. The City periodically includes articles in a bi-weekly e-mail newsletter detailing the reason why residential activities contribute to storm water pollution, the required residential BMPs, the household hazardous waste and waste oil collection sites, the specific 303(d) constituents of concern, kitchen grease, etc. These newsletters also include City contact information and the County hotline number 1-877-89-SPILL. The same information is posted on the City's residential stormwater page link.

- *City Postings*. The City periodically posts BMP information at City offices and libraries in display racks, in bus shelter advertisements, and at community events.

9.4 POST CONSTRUCTION BMP INSPECTION AND VERIFICATION

Priority Projects (see Section 7 of the LIP) approved since February 2003 are subject to inspection to assure that implementation and appropriate maintenance described in the project's Water Quality Management Plan (WQMP) is taking place at structural and non-structural BMPs during the post construction phase. In compliance with Provision E.3 of the Fifth Term Permit, the City maintains, and periodically updates, on at least an annual basis, a watershed-based inventory of all Priority Projects and associated structural BMPs within its jurisdiction. The inventory is then prioritized for inspection based upon:

- HPWQCs identified in the WQIP;
- Receiving water quality;
- Number and sizes of structural BMPs;
- Recommended maintenance frequency of structural BMPs;
- Likelihood of operation and maintenance issues of structural BMPs;
- Land use and expected pollutants generated; and
- Compliance record.

Verification of BMP implementation and ongoing maintenance are conducted by inspections, self-certifications, or other equally effective approaches, in compliance with the Fifth Term Permit. Currently, all private Priority Projects with structural BMPs have been designated as high priority and are inspected annually (see Section 5 for discussion on municipal facilities inspections).

9.5 IMMEDIATE THREATS TO WATER QUALITY

If at any time an incidence of non-compliance is determined by the City to pose a threat to health or the environment, upon notification, the property owner and/or business owner/operator shall immediately cease the discharge.

Such incidents are reported to the RWQCB within 24-hours of the discovery of non-compliance. Within 5 days of initial reporting, written notification is also submitted to the RWQCB. Written notification(s) contain a description of the noncompliance and its causes; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

9.6 ENFORCEMENT

In compliance with Provision E.5 of the Fifth Term Permit, at the City's discretion, failure by responsible parities to rectify observed water quality violations shall result in City Code Enforcement action. Depending on the violation severity, City enforcement actions may range from a verbal warning to civil or criminal court actions with monetary fines.

City enforcement mechanisms are as follows (in increasing order of severity):

- Public Education/BMP Distribution/Voluntary Compliance
- Verbal Warning/Written Warning/Notice of non-compliance
- Administrative compliance orders
- Cease and desist orders
- Civil or Criminal Enforcement
- Nuisance Abatement

While these measures are typically applied in an escalating manner, the City, at its discretion, applies whatever measure(s) it deems necessary to bring about the timely resolution of unresolved water quality violation(s). The City's Enforcement Response Plan is included in Exhibit 4.IV. Procedures for addressing illegal connections and illicit discharges are further discussed in **Section 10** of the LIP.

9.7 PLAN FOR RETROFITTING EXISTING DEVELOPMENT

In 2015, the Principal Permittee completed watershed characterizations to provide watershed-specific information to support integration of water quality, hydromodification, water supply, and habitat protection issues as part of selecting and designing BMPs to meet the requirements of the Model WQMP and TGD. This data compilation effort included information related to infiltration feasibility and hydromodification susceptibility at the watershed and sub-watershed scale to help inform BMP selection and design for a proposed development projects. Infiltration feasibility and hydromodification susceptibility are fundamental factors in the selection and sizing of BMPs to meet the requirements of the Model WQMP and TGD.

Another primary objective of the characterization of the South Orange County Watershed Management Area (WMA) was the identification of potentially feasible BMP opportunities for regional/subregional LID, and treatment control facilities through a preliminary screening process. Additional refined information/data and understanding of stakeholder projects/development forecasts will, however, be necessary to optimize the selection of the most effective regional BMP solutions on a watershed basis. It is intended that the different potential regional/subregional BMP facilities identified as part of this process will provide the initial basis and guidance for future watershed based participation/implementation of these facilities.

9.8 REPORTING

In addition to any reporting requirements previously discussed, the City submits an annual progress report each year to RWQCB discussing City activities conducted pursuant to the

Existing Development Component. At a minimum, the report includes the following information:

- Inventory of existing commercial and industrial activities
- Summary of inspections subject to the Commercial and Industrial Program
- Summary of inspections, including self-certifications, subject to the Residential Program
- Summary of water quality enforcement actions
- Any updates to this LIP component and related exhibits

EXHIBIT 9.I

ACTIVITY SPECIFIC BMP CHECKLISTS

IC1. Animal Handling Areas
IC2. Building Maintenance
IC3. Carpet Cleaning
IC4. Concrete & Asphalt Production, Application & Cutting
IC5. Contaminated or Erodible Surface Areas
IC6. Landscape Maintenance
IC7. Nurseries & Greenhouses
IC8. Outdoor Drainage from Indoor Areas
IC9. Outdoor Loading/Unloading of Materials
IC10. Outdoor Process Equipment Operations & Maintenance
IC11. Outdoor Storage of Raw Materials, Products & Containers
IC12. Painting, Finishing, & Coatings of Vehicles, Boats, Buildings & Equipment
IC13. Parking & Storage Area Maintenance
IC14. Pool & Fountain Cleaning
C15. Spill Prevention & Cleanup
IC16. Vehicle & Equipment Fueling
IC17. Vehicle & Equipment Maintenance and Repair
IC18. Vehicle & Equipment Washing & Steam Cleaning
IC19. Waste Handling & Disposal
IC20. Eating & Drinking Establishments
IC21. Irrigation Runoff
IC22. Power Washing
IC23. Mobile Businesses
IC24. Special Events

R1. Automobile Repair & Maintenance
R2. Residential Automobile Washing
R3. Residential Automobile Parking
R4. Home & Garden Care Activities
R5. Disposal of Pet Waste
R6. Disposal of Green Waste
R7. Household Hazardous Waste
R8. Irrigation Runoff

IC 1. Animal Handling Areas

Site Address: _____

Business Name: _____

The table below identifies activity-specific Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs and PPMs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP and PPM, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs/PPMs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs/PPMs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs/PPMs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs	
1.	Do not dispose of animal waste, animal food, or any other byproducts in the parking lots, streets, gutters, storm drains, natural watercourses, or landscaping areas.
2.	Provide employee training.
3.	Prevent wash/rinse water from interior and exterior areas from entering the parking lots, streets, gutters, storm drains, and natural watercourses.
Minimum Designated Pollution Prevention Methods PPMs	
1.	Keep site free of trash & debris.

Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Do not dispose of animal waste, animal food, or any other byproducts in the parking lots, streets, gutters, storm drains, natural watercourses, or landscaped areas.**

   A. Use sweeping and pick-up methods or vacuum all hardscape areas, including streets & gutters of all animal waste, food, and other byproducts. Do not wash these materials into the street, gutters or storm drains.
   B. Dispose of animal waste, food products and other byproducts as garbage in appropriate trash containers for disposal to the landfill.

2. **Provide employee training.**

   A. Educate and train employees on the required BMPs, storm water discharge prohibitions, and wastewater requirements.
   B. Educate and train employees on site-specific drainage facilities such as locations of streets, gutters, storm drain inlets, v-ditches and other drainage courses.
   C. Train employees on proper spill containment and cleanup methods.

3. **Prevent wash/rinse water from interior and exterior areas from entering the parking lots, streets, gutters, storm drains, and natural watercourses.**

   A. Interior floor drains in kennel areas should be plumbed to the sanitary sewer.
   B. Mop, rather than hose kennel and animal areas.
   C. Dispose of mop water from cleaning floors in a mop sink, toilet or other drain that is plumbed to the sanitary sewer.
   D. Do not hose out dumpsters or fill them with liquid waste.
   E. Regularly inspect, repair, and/or replace dumpsters.

4. **Pick up and dispose of animal waste regularly.**

   A. Pick-up on a regular basis and properly dispose of any animal waste in the planters, parking lot or other parts of the site to prevent them from entering the streets, gutters and storm drains.

Suggested Implementation Strategies for Minimum Designated Pollution Prevention Methods (PPMs)

1. **Keep site free of trash & debris**

   A. Pick-up on a regular basis and properly dispose of any trash, litter, and other debris that may have accumulated in the planters, parking lot or other parts of the site to prevent them from entering the streets, gutters and storm drains.

Other Beneficial Tips & Techniques

1. **Keep animals in covered areas.**

2. **Keep animals in areas where BMPs are in use.**

3. **Pollution Prevention.**

   A. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

   The following pollution prevention principles apply to most industries:
   - Affirmative Procurement - Use alternative, safer, or recycled products.
   - Redirect storm water flows away from areas of concern.
   - Reduce use of water or use dry methods.
   - Reduce storm water flow across facility site.
   - Recycle and reuse waste products and waste flows.
   - Move or cover potential pollution from storm water contact.
   - Provide on-going employee training in pollution prevention.

IC 2. Building Maintenance

Site Address: _____

Business Name: _____

The table below identifies activity-specific Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs and PPMs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP and PPM, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs/PPMs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs/PPMs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs/PPMs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs	
1.	Do not dispose of wash or wastewater in the streets, gutters, storm drains, or natural watercourses.
2.	Provide employee & contractor training.
3.	Use extra precautions to prevent dirt, construction debris and other solids from entering the streets, gutters, storm drains, and natural watercourses.
Minimum Designated Pollution Prevention Methods PPMs	
1.	Keep site free of trash & debris.



Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Do not dispose of wash or wastewater in the streets, gutters, storm drains, or natural watercourses.**

   A. Use sweeping and pick-up methods or vacuum to clean hardscape areas, including streets & gutters. Do not wash materials into the street, gutters or storm drains.
   B. If pressure washing, use a collection device that enables collection of wash water and associated solids. Use a sump pump, wet vacuum or similarly effective device to collect runoff and loose materials. Dispose of collected runoff and solids properly.
   C. Clean paint brushes and tools in sinks connected to sanitary sewers or in portable containers that can be dumped into a sink, toilet, or other drain that is plumbed to the sanitary sewer.
   D. Paint brushes and tools covered with non-water based materials must be cleaned in a manner that enables collection of uses solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.

2. **Provide employee & contractor training.**

   A. Educate and train employees and contractors on the required BMPs, storm water discharge prohibitions, and wastewater requirements.
   B. Educate and train employees and landscape contractors on site-specific drainage facilities such as locations of streets, gutters, storm drain inlets, v-ditches and other drainage courses.
   C. Educate and train employees and landscape contractors on the use of pesticides and fertilizers.
   D. Train employees on proper spill containment and cleanup methods.

3. **Use extra precautions to prevent dirt, construction debris and other solids from entering the streets, gutters, storm drains, and natural watercourses.**

   A. Properly prepare work area before conduction building maintenance.
   B. Use ground drop cloths underneath outdoor painting, scraping, sandblasting and cutting work. Property dispose of collected materials in the garbage in appropriate trash containers.
   C. When working near drain inlets, use storm drain covers, filter fabric or similarly effective device to prevent materials from entering the storm drain system.
   D. Use sweeping and pick-up methods or vacuum to clean work areas from construction debris daily. Do not wash work areas into the parking lot, street, gutters or storm drains.

Suggested Implementation Strategies for Minimum Designated Pollution Prevention Methods (PPMs)

1. **Keep site free of trash & debris**

   A. When doing routine maintenance, pick-up and properly dispose of any trash, litter and other debris that may have accumulated around the building, parking lot, landscape planters or other parts of the site to prevent them from entering the streets, gutters and storm drains.
   B. Regularly inspect, repair and/or replace dumpsters. Do not hose out dumpsters or fill them with liquid waste.

Other Beneficial Tips & Techniques

1. **Properly store equipment, chemicals and waste.**

   A. Store equipment indoors or in covered areas to avoid exposure to rain.
   B. Implement storage requirements for chemicals indoors or in covered areas with guidance from the local fire department.
   C. Dispose of empty containers according to the instructions on the container label.

2. **Pollution Prevention.**

   A. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

      The following pollution prevention principles apply to most industries:
      - Affirmative Procurement - Use alternative, safer, or recycled products.
      - Redirect storm water flows away from areas of concern.
      - Reduce use of water or use dry methods.
      - Reduce storm water flow across facility site.
      - Recycle and reuse waste products and waste flows.
      - Move or cover potential pollution from storm water contact.
      - Provide on-going employee training in pollution prevention.

IC 3. Carpet Cleaning

Site Address: _____

Business Name: _____

The table below identifies activity-specific Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs and PPMs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP and PPM, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs/PPMs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs/PPMs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs/PPMs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs
1. Do not dispose of wash or wastewater in the streets, gutters, storm drains, or natural watercourses.
2. Provide employee & contractor training.
3. Properly maintain fleet of vehicles and equipment.
Minimum Designated Pollution Prevention Methods PPMs
1. Keep site free of trash & debris.

Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Do not dispose of wash or wastewater in the streets, gutters, storm drains, or natural watercourses.**

   A. Never dispose of wash water to a street, gutter, parking lot, or storm drain. Either empty the spent cleaning fluid tank into a utility sink or other indoor sewer connection at the service provider's home base, or arrange with the customer to discharge into a toilet or utility sink on their premises. This also applies to cleaning products labeled "nontoxic" and "biodegradable."
   B. Check the local wastewater authority's requirements for discharge.
   C. Filter wash water before discharging to the sanitary sewer to avoid clogging pipes. Dispose of filtered material in the garbage, provided the carpet was not contaminated with hazardous materials.

2. **Provide employee & contractor training.**

   A. Educate and train employees and contractors on the required BMPs, storm water discharge prohibitions, and wastewater requirements.
   B. Educate and train employees and landscape contractors on site-specific drainage facilities such as locations of streets, gutters, storm drain inlets, v-ditches and other drainage courses.
   C. Train employees on proper spill containment and cleanup methods.

3. **Properly maintain fleet of vehicles and equipment.**

   A. Conduct regular inspections of vehicles and equipment for fluid leaks and malfunctions.
   B. Ensure all vehicles and equipment are in good working order.
   C. Promptly repair and clean up any fluid leaks from vehicles and equipment.

Suggested Implementation Strategies for Minimum Designated Pollution Prevention Methods (PPMs)

1. **Keep site free of trash & debris**

   A. Pick-up and properly dispose of any trash, litter and other debris that may have accumulated as a result of the cleaning operation to prevent them from entering the streets, gutters and storm drains.

Other Beneficial Tips & Techniques

1. Properly store equipment, chemicals and waste.

A. Store equipment indoors or in covered areas to avoid exposure to rain.
B. Implement storage requirements for chemicals indoors or in covered areas with guidance from the local fire department.
C. Dispose of empty containers according to the instructions on the container label.

2. Pollution Prevention.

A. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

The following pollution prevention principles apply to most industries:

- Affirmative Procurement - Use alternative, safer, or recycled products.
- Redirect storm water flows away from areas of concern.
- Reduce use of water or use dry methods.
- Reduce storm water flow across facility site.
- Recycle and reuse waste products and waste flows.
- Move or cover potential pollution from storm water contact.
- Provide on-going employee training in pollution prevention.

IC 4. Concrete & Asphalt Production, Application & Cutting

Site Address: _____

Business Name: _____

The table below identifies activity-specific Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs and PPMs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP and PPM, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs/PPMs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs/PPMs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs/PPMs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs	
1.	Do not dispose of process water from production, pouring, equipment cleaning, and cuffing activities in the streets, gutters, storm drains, or natural watercourses.
2.	Provide employee & contractor training.
3.	Pre-heat, transfer or load hot bituminous material away from storm drain inlets.
Minimum Designated Pollution Prevention Methods PPMs	
1.	Sweep the production, pouring and cutting areas regularly to collect loose materials.

Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Do not dispose of process water from production, pouring, equipment cleaning, and cuffing activities in the streets, gutters, storm drains, or natural watercourses.**

   A. Discharge process water from production, pouring, equipment cleaning, and cutting activities to a sump, process water treatment or recycling system, or sanitary sewer system if allowed.
   B. Do not allow concrete and concrete pumping vehicles to discharge concrete, slurry, or rinse water into gutters, storm drains, or drainage ditches.
   C. Protect production, pouring, and cutting areas from stormwater runoff and runon by constructing a berm around the perimeter of the area to prevent the runon of uncontaminated stormwater from adjacent areas as well as runoff of stormwater.

2. **Provide employee & contractor training.**

   A. Educate and train employees and contractors on the required BMPs, storm water discharge prohibitions, and wastewater requirements.
   B. Educate and train employees and contractors on site-specific drainage facilities such as locations of streets, gutters, storm drain inlets, v-ditches and other drainage courses.
   C. Train employees on proper spill containment and cleanup methods.

3. **Pre-heat, transfer or load hot bituminous material away from storm drain inlets.**

   A. Cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc.
   B. Clean covers regularly.
   C. Leave covers in place until job is complete and clean any debris for proper disposal.

Suggested Implementation Strategies for Minimum Designated Pollution Prevention Methods (PPMs)

1. **Sweep the production, pouring and cutting areas regularly to collect loose materials.**

   A. Use sweeping and pick-up methods or vacuum all hardscape areas, including streets & gutters of all loose material. Do not wash these materials into the street, gutters or storm drains.
   B. Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile, or dispose in the trash.

Other Beneficial Tips & Techniques

1. **Conduct surface repair work during dry weather to prevent contamination from contacting stormwater runoff.**

2. **To avoid runoff, use only as much water as necessary for dust control.**

3. **Pollution Prevention.**

   A. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

   The following pollution prevention principles apply to most industries:
   - Affirmative Procurement - Use alternative, safer, or recycled products.
   - Redirect storm water flows away from areas of concern.
   - Reduce use of water or use dry methods.
   - Reduce storm water flow across facility site.
   - Recycle and reuse waste products and waste flows.
   - Move or cover potential pollution from storm water contact.
   - Provide on-going employee training in pollution prevention.

IC 5. Contaminated or Erodible Surface Areas

Site Address: _____

Business Name: _____

The table below identifies activity-specific Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs and PPMs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP and PPM, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs/PPMs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs/PPMs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs/PPMs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs
1. Protect contaminated or erodible surface areas from rainfall and wind dispersal.
2. Provide employee & contractor training.
3. Protect contaminated or erodible surfaces areas from stormwater runon and runoff.
Minimum Designated Pollution Prevention Methods PPMs
1. Keep site free of trash & debris.

Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. Protect contaminated or erodible surface areas from rainfall and wind dispersal.

A. Use at least one of the following to protect contaminated or erodible surfaces:

- Preserve natural vegetation.
- Re-plant or landscaping bare ground surfaces.
- Use chemical stabilization or geosynthetics to stabilize bare ground surfaces.
- Remove contaminated soils.
- Cover materials with a fixed roof or a temporary waterproof covering made of polyethylene, polypropylene or hypalon. Keep covers in place at all times when work is not occurring. If areas are so large that they cannot feasibly be covered and contained, implement erosion control practices at the perimeter of the area and at any catch basins to prevent dispersion of the stockpiled material.

2. Provide employee & contractor training.

A. Educate and train employees and contractors on the required BMPs, storm water discharge prohibitions, and wastewater requirements.
B. Educate and train employees and contractors on site-specific drainage facilities such as locations of streets, gutters, storm drain inlets, v-ditches and other drainage courses.
C. Train employees on proper spill containment and cleanup methods.

3. Protect contaminated or erodible surfaces areas from stormwater runon and runoff.

A. Construct a berm around the perimeter of the area to prevent the runon of uncontaminated stormwater from adjacent areas as well as runoff of stormwater from the material.

Suggested Implementation Strategies for Minimum Designated Pollution Prevention Methods (PPMs)

1. Keep site free of trash & debris.

A. Use sweeping and pick-up methods or vacuum all hardscape areas, including streets & gutters of all loose material. Do not wash these materials into the street, gutters or storm drains.
B. Properly dispose of waste material.

Other Beneficial Tips & Techniques

1. **Paved areas should be sloped in a manner that minimizes the pooling of water in the area. A minimum slope of 1.5 percent is recommended.**

2. **Pollution Prevention.**

   A. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

   The following pollution prevention principles apply to most industries:
   - Affirmative Procurement - Use alternative, safer, or recycled products.
   - Redirect storm water flows away from areas of concern.
   - Reduce use of water or use dry methods.
   - Reduce storm water flow across facility site.
   - Recycle and reuse waste products and waste flows.
   - Move or cover potential pollution from storm water contact.
   - Provide on-going employee training in pollution prevention.

For more information, please contact:

City of Laguna Niguel
27801 La Paz Road
Laguna Niguel, CA 92677

Public Works Department 949.362.4337
Community Development Department 949.362.4360
Orange County 24 hr Water Quality Hotline: 714.567.6363
www.ocwatersheds.com www.ci.laguna-niguel.ca.us

IC 6. Landscape Maintenance

Site Address: _____

Business Name: _____

The table below identifies activity-specific Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs and PPMs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP and PPM, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs/PPMs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs/PPMs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs/PPMs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs	
1.	Do not dispose of gardening waste (green waste) in the streets, gutters, storm drains, or natural watercourses.
2.	Provide employee & contractor training.
3.	Use extra precautions when applying pesticides, herbicides and fungicides.
4.	Use extra precautions when applying fertilizers.
5.	Use extra precautions when applying soil amendments.
Minimum Designated Pollution Prevention Methods PPMs	
1.	Keep site free of trash & debris.

Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Do not dispose of gardening waste (green waste) in the streets, gutters, storm drains, or natural watercourses.**

   A. Use sweeping and pick-up methods or vacuum all hardscape areas, including streets & gutters of all grass clippings, leaves, sticks, and other collected vegetation. Do not wash these materials into the street, gutters or storm drains.
   B. Dispose of grass clippings, leaves, sticks, and other collected vegetation as garbage in appropriate trash containers, at the landfill or by using appropriate composting methods.
   C. Place temporary stockpiled material away from watercourses, gutters and storm drain inlets.

2. **Provide employee & contractor training.**

   A. Educate and train employees and landscape contractors on the required BMPs, storm water discharge prohibitions, and wastewater requirements.
   B. Educate and train employees and landscape contractors on site-specific drainage facilities such as locations of streets, gutters, storm drain inlets, v-ditches and other drainage courses.
   C. Educate and train employees and landscape contractors on the use of pesticides and fertilizers.
   D. Train employees on proper spill containment and cleanup methods.

3. **Use extra precaution when applying pesticides, herbicides and fungicides.**

   A. Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of pesticides and herbicides and training of applicators and pest control advisors.
   B. Follow manufacturers' recommendations and label directions.
   C. Do not apply pesticides if rain is expected or if wind speeds are above 5 mph.
   D. Do not mix or prepare pesticides for application near storm drains. Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the targeted pest.
   E. Whenever possible, use mechanical methods of vegetation removal rather than applying herbicides. Use hand weeding where practical.
   F. Do not apply any chemicals directly to surface waters, unless the application is approved and permitted by the state. Do not spray pesticides within 100 feet of open waters.
   G. Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
   H. Clean pavement and sidewalk if chemicals are spilled on these surfaces before applying irrigation water.
   I. Implement storage requirements for pesticide products with guidance from the local fire department and/or County Agricultural Commissioner.
   J. Dispose of empty containers according to the instructions on the container label.

4. Use extra precautions when applying fertilizers.

A. Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers.
B. Follow manufacturers' recommendations and label directions.
C. Employ techniques to minimize off-target application (e.g. spray drift) of fertilizer, including consideration of alternative application techniques. Calibrate fertilizer distributors to avoid excessive application.
D. Periodically test soils for determining proper fertilizer use.
E. Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
F. Clean pavement and sidewalk if chemicals are spilled on these surfaces before applying irrigation water.
G. Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
H. Use slow release fertilizers whenever possible to minimize leaching.
I. Implement storage requirements for pesticide products with guidance from the local fire department and/or County Agricultural Commissioner.
J. Dispose of empty containers according to the instructions on the container label.

5. Use extra precautions when applying soil amendments.

A. When applying or supplementing plant material, soil or soil amendments, place temporary stockpiled material in existing planters or turf area away from watercourses, gutters and storm drain inlets.
B. Use sweeping and pick-up methods or vacuum all hardscape areas, including streets & gutters of all excess materials and debris. Do not wash these materials into the street, gutters or storm drains.

Suggested Implementation Strategies for Minimum Designated Pollution Prevention Methods (PPMs)

1. Keep site free of trash & debris

A. When doing routine landscape maintenance, pick-up and properly dispose of any trash, litter and other debris that may have accumulated in planters or other parts of the site to prevent them from entering the streets, gutters and storm drains.

Other Beneficial Tips & Techniques

1. **Properly manage irrigation systems.**

   A. Irrigate slowly or pulse irrigate so the infiltration rate of the soil is not exceeded.
   B. Inspect irrigation system regularly for leaks and to ensure that excessive runoff is not occurring.
   C. If re-claimed water is used for irrigation, ensure that there is no runoff from the landscaped area(s).
   D. If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.
   E. Use automatic timers to minimize runoff.
   F. Use popup sprinkler heads in areas with a lot of activity or where pipes may be broken. Consider the use of mechanisms that reduce water flow to broken sprinkler heads.

2. **Reduce landscape maintenance requirements.**

   A. Where feasible, retain and/or plant native vegetation with features that are determined to be beneficial. Native vegetation usually requires less maintenance than planting new vegetation.
   B. When planting or replanting consider using low water use flowers, trees, shrubs, and groundcovers.

3. **Use mulch or other erosion control measures on exposed soils.**

4. **Pollution Prevention.**

   A. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

      The following pollution prevention principles apply to most industries:
      - Affirmative Procurement - Use alternative, safer, or recycled products.
      - Redirect storm water flows away from areas of concern.
      - Reduce use of water or use dry methods.
      - Reduce storm water flow across facility site.
      - Recycle and reuse waste products and waste flows.
      - Move or cover potential pollution from storm water contact.
      - Provide on-going employee training in pollution prevention.

IC 7. Nurseries & Greenhouses

Site Address: _____
Business Name: _____

The table below identifies activity-specific Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs and PPMs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP and PPM, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs/PPMs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs/PPMs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs/PPMs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs	
1.	Do not dispose of gardening waste (green waste) in the streets, gutters, storm drains, or natural watercourses.
2.	Provide employee & contractor training.
3.	Use extra precautions when applying pesticides, herbicides and fungicides.
4.	Use extra precautions when applying fertilizers.
5.	Use extra precautions when applying soil amendments.
Minimum Designated Pollution Prevention Methods PPMs	
1.	Keep site free of trash & debris.

Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Do not dispose of gardening waste (green waste) in the streets, gutters, storm drains, or natural watercourses.**

   A. Use sweeping and pick-up methods or vacuum all hardscape areas, including display areas, parking lots, streets & gutters of all grass clippings, leaves, sticks, and other collected vegetation. Do not wash these materials into the parking lot, street, gutters or storm drains.
   B. Dispose of grass clippings, leaves, sticks, and other collected vegetation as garbage in appropriate trash containers, at the landfill or by using appropriate composting methods.
   C. Place temporary stockpiled material away from watercourses, gutters and storm drain inlets.

2. **Provide employee & contractor training.**

   A. Educate and train employees and contractors on the required BMPs, storm water discharge prohibitions, and wastewater requirements.
   B. Educate and train employees and contractors on site-specific drainage facilities such as locations of streets, gutters, storm drain inlets, v-ditches and other drainage courses.
   C. Educate and train employees and contractors on the use of pesticides and fertilizers.
   D. Train employees on proper spill containment and cleanup methods.

3. **Use extra precautions when applying pesticides, herbicides and fungicides.**

   A. Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of pesticides and herbicides and training of applicators and pest control advisors.
   B. Follow manufacturers' recommendations and label directions.
   C. Do not apply pesticides if rain is expected or if wind speeds are above 5 mph.
   D. Do not mix or prepare pesticides for application near storm drains. Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the targeted pest.
   E. Whenever possible, use mechanical methods of vegetation removal rather than applying herbicides. Use hand weeding where practical.
   F. Do not apply any chemicals directly to surface waters, unless the application is approved and permitted by the state. Do not spray pesticides within 100 feet of open waters.
   G. Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
   H. Clean pavement and sidewalk if chemicals are spilled on these surfaces before applying irrigation water.
   I. Implement storage requirements for pesticide products with guidance from the local fire department and/or County Agricultural Commissioner.
   J. Dispose of empty containers according to the instructions on the container label.

4. Use extra precautions when applying fertilizers.

A. Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers.
B. Follow manufacturers' recommendations and label directions.
C. Employ techniques to minimize off-target application (e.g. spray drift) of fertilizer, including consideration of alternative application techniques. Calibrate fertilizer distributors to avoid excessive application.
D. Periodically test soils for determining proper fertilizer use.
E. Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
F. Clean pavement and sidewalk if chemicals are spilled on these surfaces before applying irrigation water.
G. Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
H. Use slow release fertilizers whenever possible to minimize leaching.
I. Implement storage requirements for pesticide products with guidance from the local fire department and/or County Agricultural Commissioner.
J. Dispose of empty containers according to the instructions on the container label.

5. Use extra precautions when applying soil amendments.

A. When applying or supplementing plant material, soil or soil amendments, place temporary stockpiled material in existing planters or turf area away from watercourses, gutters and storm drain inlets.
B. Use sweeping and pick-up methods or vacuum all hardscape areas, including streets & gutters of all excess materials and debris. Do not wash these materials into the street, gutters or storm drains.

Suggested Implementation Strategies for Minimum Designated Pollution Prevention Methods (PPMs)

1. Keep site free of trash & debris

A. Pick-up and properly dispose of any trash, litter and other debris that may have accumulated around the building, display area, parking lot, landscape planters or other parts of the site to prevent them from entering the streets, gutters and storm drains.
B. Regularly inspect, repair and/or replace dumpsters. Do not hose out dumpsters or fill them with liquid waste.

Other Beneficial Tips & Techniques

1. Properly manage irrigation systems.

A. Irrigate slowly or pulse irrigate so the infiltration rate of the soil is not exceeded.
B. Inspect irrigation system regularly for leaks and to ensure that excessive runoff is not occurring.
C. Group plants with similar water needs together to improve irrigation efficiency.

2. Pollution Prevention.

A. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

The following pollution prevention principles apply to most industries:

- Affirmative Procurement - Use alternative, safer, or recycled products.
- Redirect storm water flows away from areas of concern.
- Reduce use of water or use dry methods.
- Reduce storm water flow across facility site.
- Recycle and reuse waste products and waste flows.
- Move or cover potential pollution from storm water contact.
- Provide on-going employee training in pollution prevention.

IC 8. Outdoor Drainage from Indoor Areas

Site Address: _____

Business Name: _____

The table below identifies activity-specific Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs and PPMs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP and PPM, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs/PPMs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs/PPMs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs/PPMs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs	
1.	Do not dispose of wash/rinse water in the parking lots, streets, gutters, storm drains, or natural watercourses.
2.	Provide employee training.
3.	Prevent wash/rinse water from trash dumpster, patio, sidewalk and other hardscape areas from entering the parking lots, streets, gutters, storm drains, and natural watercourses.
Minimum Designated Pollution Prevention Methods PPMs	
1.	Keep site free of trash & debris.



Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Prevent wash/rinse water from interior areas from entering the parking lots, streets, gutters, storm drains, and natural watercourses.**

   A. Interior floor drains should be plumbed to the sanitary sewer.
   B. Mop, rather than hose indoor areas.
   C. Dispose of mop water from cleaning floors in a mop sink, toilet or other drain that is plumbed to the sanitary sewer. Do not pour wash water outside or into a parking lot, street, gutter, or storm drain.

2. **Provide employee & contractor training.**

   A. Educate and train employees on the required BMPs, storm water discharge prohibitions, and wastewater requirements.
   B. Educate and train employees on site-specific drainage facilities such as locations of streets, gutters, storm drain inlets, v-ditches and other drainage courses.
   C. Train employees on proper spill containment and cleanup methods.

3. **Prevent wash/rinse water from trash dumpster, patio, sidewalk and other hardscape areas from entering the parking lots, streets, gutters, storm drains, and natural watercourses.**

   A. Use sweeping and pick-up methods or vacuum all hardscape areas, including patios, parking lots, sidewalks, common area, and other outdoor areas. Do not wash these areas.
   B. Do not hose out dumpsters or fill them with liquid waste.
   C. Regularly inspect, repair, and/or replace dumpsters.

Suggested Implementation Strategies for Minimum Designated Pollution Prevention Methods (PPMs)

1. **Keep site free of trash & debris**

   A. Pick-up on a regular basis and properly dispose of any trash, litter, and other debris that may have accumulated in the planters, parking lot or other parts of the site to prevent them from entering the streets, gutters and storm drains.

Other Beneficial Tips & Techniques

1. Pollution Prevention.

A. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

The following pollution prevention principles apply to most industries:

- Affirmative Procurement - Use alternative, safer, or recycled products.
- Redirect storm water flows away from areas of concern.
- Reduce use of water or use dry methods.
- Reduce storm water flow across facility site.
- Recycle and reuse waste products and waste flows.
- Move or cover potential pollution from storm water contact.
- Provide on-going employee training in pollution prevention.

IC 9. Outdoor Load/Unloading of Materials

Site Address: _____

Business Name: _____

The table below identifies activity-specific Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs and PPMs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP and PPM, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs/PPMs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs/PPMs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs/PPMs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs	
1.	Prevent materials, products and other pollutants associated with loading and unloading activities from entering the streets, gutters, storm drains, or natural watercourses.
2.	Provide employee & contractor training.
3.	Properly maintain fleet of vehicles and equipment.
Minimum Designated Pollution Prevention Methods PPMs	
1.	Keep loading & unloading areas free of trash & debris.

Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Prevent materials, products and other pollutants associated with loading and unloading activities from entering the streets, gutters, storm drains, or natural watercourses.**

   A. Use sweeping and pick-up methods or vacuum to clean loading areas, including parking lots, streets & gutters. Do not wash materials into the street, gutters or storm drains.
   B. If pressure washing, use a collection device that enables collection of wash water and associated solids. Use a sump pump, wet vacuum or similarly effective device to collect runoff and loose materials.
   C. Clean oily spots with absorbent materials. Do not allow discharges to enter the street, gutters or storm drains.
   D. Dispose of collected runoff and solids properly.
   E. Avoid placing loading/unloading areas near storm drain inlets.
   F. Park vehicles and conduct loading/unloading only in designated loading/unloading areas so that spills or leaks can be contained.
   G. Use drip pans underneath hose and pipe connections and other leak-prone spots during liquid transfer operations, and when making and breaking connections.

2. **Provide employee & contractor training.**

   A. Educate and train employees and contractors on the required BMPs, storm water discharge prohibitions, and wastewater requirements.
   B. Educate and train employees and contractors on site-specific drainage facilities such as locations of streets, gutters, storm drain inlets, v-ditches and other drainage courses.
   C. Train employees on proper spill containment and cleanup methods.

3. **Properly maintain fleet of vehicles and equipment.**

   A. Conduct regular inspections of vehicles and equipment for fluid leaks and malfunctions.
   B. Ensure all vehicles and equipment are in good working order.
   C. Promptly repair and clean up any fluid leaks from vehicles and equipment.

Suggested Implementation Strategies for Minimum Designated Pollution Prevention Methods (PPMs)

1. **Keep loading & unloading areas free of trash & debris.**

   A. Do not hose out dumpsters or fill them with liquid waste.
   B. Regularly inspect, repair, and/or replace dumpsters.

C. Properly dispose of any trash, litter and other debris that may have accumulated around the loading area, parking lot, landscape planters or other parts of the site to prevent them from entering the streets, gutters and storm drains.

Other Beneficial Tips & Techniques

1. **Properly design loading/unloading areas to prevent storm water runon, runoff of spills, etc.**

   A. Grade and/or berm the area to prevent runon.
   B. Position roof downspouts to direct stormwater away from the area.
   C. Grade and/or berm the loading/unloading area to a drain that is connected to a dead-end.
   D. The area where truck transfers take place should be paved. If the liquid is reactive with the asphalt, Portland cement should be used to pave the area.

2. **Reduce exposure of materials to rain.**

   A. Cover the loading/unloading areas.
   B. If a cover is unfeasible, use overhangs, seals or door skirts to enclose areas.

3. **Pollution Prevention.**

   A. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

      The following pollution prevention principles apply to most industries:
      - Affirmative Procurement - Use alternative, safer, or recycled products.
      - Redirect storm water flows away from areas of concern.
      - Reduce use of water or use dry methods.
      - Reduce storm water flow across facility site.
      - Recycle and reuse waste products and waste flows.
      - Move or cover potential pollution from storm water contact.
      - Provide on-going employee training in pollution prevention.

IC 10. Outdoor Process Equipment Operations & Maintenance

Site Address: _____

Business Name: _____

The table below identifies activity-specific Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs and PPMs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP and PPM, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs/PPMs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs/PPMs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs/PPMs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs	
1.	Prevent materials, products and other pollutants associated with outdoor processing activities from entering the streets, gutters, storm drains, or natural watercourses.
2.	Provide employee & contractor training.
3.	Properly maintain fleet of vehicles and equipment.
Minimum Designated Pollution Prevention Methods PPMs	
1.	Keep processing areas free of trash & debris.



Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Prevent materials, products and other pollutants associated with outdoor processing activities from entering the streets, gutters, storm drains, or natural watercourses.**

   A. Use sweeping and pick-up methods or vacuum to clean outdoor processing areas, including parking lots, streets & gutters. Do not wash materials into the street, gutters or storm drains.
   B. If pressure washing, use a collection device that enables collection of wash water and associated solids. Use a sump pump, wet vacuum or similarly effective device to collect runoff and loose materials.
   C. Clean oily spots with absorbent materials. Do not allow discharges to enter the street, gutters or storm drains.
   D. Dispose of collected runoff and solids properly.
   E. Design process area to prevent stormwater runon such as grade and/or berm the area to prevent runon. Position roof downspouts to direct stormwater away from the area.
   F. Design process area to contain spills.
   G. Place equipment on an impervious surface, or install a drip pan under potential leak points.
   H. Construct a berm around the process equipment to contain spills.
   I. Install drains connected to the public sewer or the facility's process wastewater system within these contained areas. DO NOT discharge to a public sewer until contacting the local sewer authority to find out if pretreatment is required. If discharge to the sanitary sewer is not allowed, pump water to a tank and dispose of properly.

2. **Provide employee & contractor training.**

   A. Educate and train employees and contractors on the required BMPs, storm water discharge prohibitions, and wastewater requirements.
   B. Educate and train employees and contractors on site-specific drainage facilities such as locations of streets, gutters, storm drain inlets, v-ditches and other drainage courses.
   C. Train employees on proper spill containment and cleanup methods.

3. **Properly maintain fleet of vehicles and equipment.**

   A. Conduct regular and frequent inspection of fleet vehicles and equipment for leaks, malfunctions, staining on and around equipment, and other evidence of leaks.
   B. Develop a standard methodology for reporting inspection results.
   C. Develop a procedure for taking action on items in the report, responding to leaks, cleaning up spills, and completing repairs to prevent future leaks.

Suggested Implementation Strategies for Minimum Designated Pollution Prevention Methods (PPMs)

1. **Keep loading & unloading areas free of trash & debris.**

   A. Do not hose out dumpsters or fill them with liquid waste.
   B. Regularly inspect, repair, and/or replace dumpsters.
   C. Properly dispose of any trash, litter and other debris that may have accumulated around the processing area, parking lot, landscape planters or other parts of the site to prevent them from entering the streets, gutters and storm drains.

Other Beneficial Tips & Techniques

1. **Reduce exposure of materials to rain.**

   A. Cover the loading/unloading areas.
   B. If a cover is unfeasible, use overhangs, seals or door skirts to enclose areas.

2. **Pollution Prevention.**

   A. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

      The following pollution prevention principles apply to most industries:
      - Affirmative Procurement - Use alternative, safer, or recycled products.
      - Redirect storm water flows away from areas of concern.
      - Reduce use of water or use dry methods.
      - Reduce storm water flow across facility site.
      - Recycle and reuse waste products and waste flows.
      - Move or cover potential pollution from storm water contact.
      - Provide on-going employee training in pollution prevention.

B. Eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous material:
   - Use non-caustic detergents instead of caustic cleaning for parts cleaning.
   - Use a water-based cleaning service and have tank cleaned. Use detergent-based or water-based cleaning systems in place of organic solvent degreasers.
   - Replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check list of active ingredients to see whether it contains chlorinated solvents.
   - Choose cleaning agents that can be recycled.

IC 11. Outdoor Storage of Raw Materials, Products & Containers

Site Address: _____

Business Name: _____

The table below identifies activity-specific Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs and PPMs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP and PPM, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs/PPMs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs/PPMs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs/PPMs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs	
1.	Prevent materials, products and other pollutants associated with the outdoor storage area from entering the streets, gutters, storm drains, or natural watercourses.
2.	Provide employee & contractor training.
3.	Properly maintain fleet of vehicles and equipment.
Minimum Designated Pollution Prevention Methods PPMs	
1.	Keep site free of trash & debris.

Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. <u>Prevent materials, products and other pollutants associated with the outdoor storage area from entering the streets, gutters, storm drains, or natural watercourses.</u>

A. Use sweeping and pick-up methods or vacuum to clean outdoor processing areas, including parking lots, streets & gutters. Do not wash materials into the street, gutters or storm drains.
B. If pressure washing, use a collection device that enables collection of wash water and associated solids. Use a sump pump, wet vacuum or similarly effective device to collect runoff and loose materials.
C. Clean oily spots with absorbent materials. Do not allow discharges to enter the street, gutters or storm drains.
D. Dispose of collected runoff and solids properly.
E. Design storage areas to prevent stormwater runon such as grade and/or berm the area to prevent runon. Position roof downspouts to direct stormwater away from the area.
F. Design storage area to contain spills.
G. Protect materials stored outside from stormwater runon. Construct a berm around the perimeter of the material storage area to prevent the runon of uncontaminated stormwater from adjacent areas as well as runoff of stormwater from the material.
H. Minimize pooling of water. Slope paved areas to minimize the pooling of water on the site, particularly with materials that may leach pollutants into stormwater and/or groundwater, such as compost, logs, and wood chips. A minimum slope of 1.5 percent is recommended.
I. All materials stored outside should have a secondary containment system.
   - Surround storage tanks with a berm or other secondary containment system.
   - Slope the area inside the berm to a drain.
   - Drain liquids to the sanitary sewer if available.
   - DO NOT discharge wash water to sanitary sewer until contacting the local sewer authority to find out if pretreatment is required. If discharge to the sanitary sewer is not allowed, pump water to a tank and dispose of properly.
J. Properly store and handle chemical materials.
   - Designate a secure material storage area that is paved free of cracks and gaps, and impervious in order to contain leaks and spills.
   - Do not store chemicals, drums, or bagged materials directly on the ground. Place these items in secondary containers.
   - Liquid materials should be stored in UL approved double walled tanks or surrounded by a curb or dike to provide the volume to contain 10 percent of the volume of all the containers or 110 percent of the volume of the largest container, whichever is greater.
   - Keep chemicals in their original containers, if feasible, and keep them well labeled.

2. **Provide employee & contractor training.**

   A. Educate and train employees and contractors on the required BMPs, storm water discharge prohibitions, and wastewater requirements.
   B. Educate and train employees and contractors on site-specific drainage facilities such as locations of streets, gutters, storm drain inlets, v-ditches and other drainage courses.
   C. Train employees on proper spill containment and cleanup methods.

3. **Properly maintain fleet of vehicles and equipment.**

   A. Conduct regular and frequent inspection of fleet vehicles and equipment for leaks, malfunctions, staining on and around equipment, and other evidence of leaks.
   B. Develop a standard methodology for reporting inspection results.
   C. Develop a procedure for taking action on items in the report, responding to leaks, cleaning up spills, and completing repairs to prevent future leaks.

Suggested Implementation Strategies for Minimum Designated Pollution Prevention Methods (PPMs)

1. **Keep site free of trash & debris.**

   A. Do not hose out dumpsters or fill them with liquid waste.
   B. Regularly inspect, repair, and/or replace dumpsters.
   C. Properly dispose of any trash, litter and other debris that may have accumulated around the storage areas, parking lot, landscape planters or other parts of the site to prevent them from entering the streets, gutters and storm drains.

Other Beneficial Tips & Techniques

1. **Keep outdoor storage containers in good condition.**

   A. Keep storage areas clean and dry.
   B. Sweep and maintain routes to and from storage areas.

2. **Reduce exposure of materials to rain.**

   A. Store materials indoors, if feasible.
   B. Store materials on paved or impervious surfaces.
   C. Protect materials stored outside from rainfall and wind dispersal.
      - Cover materials with a fixed roof or a temporary waterproof covering made of polyethylene, polypropylene, or hypalon.
      - Keep covers in place at all times when work is not occurring.

- If areas are so large that they cannot feasibly be covered and contained, implement erosion control practices at the perimeter of the area and at any catch basins to prevent dispersion of the stockpiled material.
- If a cover is unfeasible, use overhangs, seals or door skirts to enclose areas.

3. Conduct regular inspections of storage areas.

A. Check for external corrosion of material containers, structural failures, spills and overfills due to operator error, failure of piping system, etc.
B. Inspect tank foundations, connections, coatings, tank walls, and piping system.
C. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken tanks or container systems.

4. If drums are stored in an area where unauthorized persons may gain access secure them in such a manner as to prevent accidental spillage, pilferage, or any unauthorized use.

5. Pollution Prevention.

A. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

The following pollution prevention principles apply to most industries:
- Affirmative Procurement - Use alternative, safer, or recycled products.
- Redirect storm water flows away from areas of concern.
- Reduce use of water or use dry methods.
- Reduce storm water flow across facility site.
- Recycle and reuse waste products and waste flows.
- Move or cover potential pollution from storm water contact.
- Provide on-going employee training in pollution prevention.

IC 12. Painting, Finishing, & Coating of Vehicles, Boats, Buildings & Equipment

Site Address: _____

Business Name: _____

The table below identifies activity-specific Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs and PPMs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP and PPM, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs/PPMs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs/PPMs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs/PPMs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs	
1.	Prevent paints, finishing, and coating materials, toxic substances and liquid waste from entering the streets, gutters, storm drains, and natural watercourses.
2.	Provide employee & contractor training.
3.	Properly clean, store, and dispose of painting, finishing and coating materials.
Minimum Designated Pollution Prevention Methods PPMs	
1.	Keep site free of trash & debris.

Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Prevent paints, finishing, and coating materials, toxic substances and liquid waste from entering the streets, gutters, storm drains, and natural watercourses.**
   A. Properly prepare work area.
   B. Use ground drop cloths underneath outdoor painting, scraping, sandblasting and cutting work, outdoor mixing of paint, solvents and tool cleaning. Property dispose of collected materials in the garbage in appropriate trash containers.
   C. Hang wind-blocking tarps to prevent sand blasting dust and overspray from escaping. Do not conduct these activities when wind conditions are such that containment is rendered ineffective.
   D. Do not conduct sand blasting or spray painting over open waters.
   E. When working near drain inlets, use storm drain covers, filter fabric or similarly effective device to prevent materials from entering the storm drain system.
   F. Use sweeping and pick-up methods or vacuum to clean work areas from construction debris daily. Do not wash work areas into the parking lot, street, gutters or storm drains.
   G. If pressure washing, use a collection device that enables collection of wash water and associated solids. Use a sump pump, wet vacuum or similarly effective device to collect runoff and loose materials. Dispose of collected runoff and solids properly.

2. **Provide employee & contractor training.**

   A. Educate and train employees and contractors on the required BMPs, storm water discharge prohibitions, and wastewater requirements.
   B. Educate and train employees and contractors on site-specific drainage facilities such as locations of streets, gutters, storm drain inlets, v-ditches and other drainage courses.
   C. Train employees on proper spill containment and cleanup methods.

3. **Properly clean, store, and dispose of painting, finishing and coating materials.**
   A. Clean paint brushes and tools in sinks connected to sanitary sewers or in portable containers that can be dumped into a sink, toilet, or other drain that is plumbed to the sanitary sewer.
   B. Paint brushes and tools covered with non-water based materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.

Suggested Implementation Strategies for Minimum Designated Pollution Prevention Methods (PPMs)

1. <u>Keep site free of trash & debris</u>

A. Pick-up and properly dispose of any trash, litter and other debris that may have accumulated around the work area, parking lot, landscape planters or other parts of the site to prevent them from entering the streets, gutters and storm drains.
B. Cover materials left outdoors at the end of the workday with a temporary waterproof covering made of polyethylene, polypropylene or hypalon.

Other Beneficial Tips & Techniques

1. Properly store equipment, chemicals and waste.

A. Store equipment indoors or in covered areas to avoid exposure to rain.
B. Implement storage requirements for chemicals indoors or in covered areas with guidance from the local fire department.
C. Dispose of empty containers according to the instructions on the container label.

2. Pollution Prevention.

A. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

The following pollution prevention principles apply to most industries:

- Affirmative Procurement - Use alternative, safer, or recycled products.
- Redirect storm water flows away from areas of concern.
- Reduce use of water or use dry methods.
- Reduce storm water flow across facility site.
- Recycle and reuse waste products and waste flows.
- Move or cover potential pollution from storm water contact.
- Provide on-going employee training in pollution prevention.

For more information, please contact:

City of Laguna Niguel
27801 La Paz Road
Laguna Niguel, CA 92677

Public Works Department 949.362.4337
Community Development Department 949.362.4360
Orange County 24 hr Water Quality Hotline: 714.567.6363
www.ocwatersheds.com www.ci.laguna-niguel.ca.us

IC 13. Parking & Storage Area Maintenance

Site Address: _____

Business Name: _____

The table below identifies activity-specific Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs and PPMs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP and PPM, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs/PPMs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs/PPMs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs/PPMs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs	
1.	Do not dispose of wash or wastewater in the streets, gutters, storm drains, or natural watercourses.
2.	Provide employee & contractor training.
3.	Prevent wash/rinse water from trash dumpster, patio, sidewalk and other hardscape areas from entering the parking lots, streets, gutters, storm drains, and natural watercourses.
Minimum Designated Pollution Prevention Methods PPMs	
1.	Keep site free of trash & debris.



Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Do not dispose of wash or wastewater in the streets, gutters, storm drains, or natural watercourses.**

   A. Use sweeping and pick-up methods or vacuum to clean hardscape areas, including parking lots, streets & gutters. Do not wash materials into the street, gutters or storm drains.
   B. If pressure washing, use a collection device that enables collection of wash water and associated solids. Use a sump pump, wet vacuum or similarly effective device to collect runoff and loose materials.
   C. Clean oily spots with absorbent materials. Do not allow discharges to enter the street, gutters or storm drains.
   D. Dispose of collected runoff and solids properly.

2. **Provide employee & contractor training.**

   A. Educate and train employees and contractors on the required BMPs, storm water discharge prohibitions, and wastewater requirements.
   B. Educate and train employees and contractors on site-specific drainage facilities such as locations of streets, gutters, storm drain inlets, v-ditches and other drainage courses.
   C. Train employees on proper spill containment and cleanup methods.

3. **Prevent wash/rinse water from trash dumpster, patio, sidewalk and other hardscape areas from entering the parking lots, streets, gutters, storm drains, and natural watercourses.**

   A. Use sweeping and pick-up methods or vacuum all hardscape areas, including patios, parking lots, sidewalks, common area, and other outdoor areas. Do not wash these areas.
   B. Do not hose out dumpsters or fill them with liquid waste.
   C. Regularly inspect, repair, and/or replace dumpsters.

Suggested Implementation Strategies for Minimum Designated Pollution Prevention Methods (PPMs)

1. **Keep site free of trash & debris**

   A. Pick-up and properly dispose of any trash, litter and other debris that may have accumulated around the building, parking lot, landscape planters or other parts of the site to prevent them from entering the streets, gutters and storm drains.

Other Beneficial Tips & Techniques

1. **See IC04. Concrete & Asphalt Production, Application & Cutting, for requirements for conducting parking lot surface repairs.**

2. **Conduct inspections on a regular basis.**

   A. Designate personnel to conduct inspections of the parking lot facilities and stormwater conveyance systems associated with them.
   B. Inspect cleaning equipment/sweepers for leaks on a regular basis.

3. **Pollution Prevention.**

   A. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

   The following pollution prevention principles apply to most industries:
   - Affirmative Procurement - Use alternative, safer, or recycled products.
   - Redirect storm water flows away from areas of concern.
   - Reduce use of water or use dry methods.
   - Reduce storm water flow across facility site.
   - Recycle and reuse waste products and waste flows.
   - Move or cover potential pollution from storm water contact.
   - Provide on-going employee training in pollution prevention.

For more information, please contact:

City of Laguna Niguel
27801 La Paz Road
Laguna Niguel, CA 92677

Public Works Department 949.362.4337
Community Development Department 949.362.4360
Orange County 24 hr Water Quality Hotline: 714.567.6363
www.ocwatersheds.com www.ci.laguna-niguel.ca.us

IC 14. Pool & Fountain Cleaning

Site Address: _____

Business Name: _____

The table below identifies activity-specific Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs and PPMs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP and PPM, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs/PPMs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs/PPMs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs/PPMs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs
1. Discharge pool & fountain water properly.
2. Provide employee training.
3. Prevent algae problems with regular cleaning, consistent adequate chlorine levels, and well maintained filtration and circulation systems.
Minimum Designated Pollution Prevention Methods PPMs
1. Properly clean and/or dispose of filters.

Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. Discharge pool & fountain water properly.

A. Consider hiring a professional pool-draining service to collect all pool water for off-site disposal.
B. Drain pools or fountains to the sanitary sewer if permitted to do so.
C. If draining a pool to the sanitary sewer, prevent backflow by maintaining an "air gap" between the discharge line and the sewer line (do not seal the connection between the hose and sewer line). Be sure to call the local sewer authority for guidance on flow rate restrictions, back-flow prevention, and handling special cleaning waste (such as acid wash). Keep discharge flows to the low levels. Higher flow rates may be prohibited by local ordinance.
D. If water is de-chlorinated with a neutralizing chemical or by allowing chlorine to dissipate for a few days (do not use the facility during this time), the water may be recycled/reused by draining it gradually onto a landscaped area or directly to a storm drain inlet. Water must be tested prior to discharge to ensure that chlorine is not present.

2. Provide employee training.

A. Educate and train employees on the required BMPs, storm water discharge prohibitions, and wastewater requirements.
B. Educate and train employees on site-specific drainage facilities such as locations of streets, gutters, storm drain inlets, v-ditches and other drainage courses.
C. Train employees on proper spill containment and cleanup methods.
D. Train employees and maintenance personnel on the proper techniques for testing chlorine levels and applying neutralizing chemicals.

3. Prevent algae problems with regular cleaning, consistent adequate chlorine levels, and well maintained filtration and circulation systems.

A. Do not use copper-based algaecides.
B. Control algae with chlorine or other alternatives, such as sodium bromide.
C. Manage pH and water hardness to minimize corrosion of copper pipes.

Suggested Implementation Strategies for Minimum Designated Pollution Prevention Methods (PPMs)

1. <u>Properly clean and/or dispose of filters</u>.

A. Never clean a filter in the street or near a storm drain.
B. Rinse cartridge filters onto a dirt area, and work filter residue into soil.
C. Backwash diatomaceous earth filters onto dirt. Dispose of spent diatomaceous earth in the garbage. Diatomaceous earth cannot be discharged to surface waters, storm drainage systems, septic systems, or on the ground.
D. If there is not a suitable dirt area, discharge filter backwash or rinse-water to the sanitary sewer if permitted to do so by the local sewer agency.

Other Beneficial Tips & Techniques

1. Pollution Prevention.

A. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

The following pollution prevention principles apply to most industries:

- Affirmative Procurement - Use alternative, safer, or recycled products.
- Redirect storm water flows away from areas of concern.
- Reduce use of water or use dry methods.
- Reduce storm water flow across facility site.
- Recycle and reuse waste products and waste flows.
- Move or cover potential pollution from storm water contact.
- Provide on-going employee training in pollution prevention.

For more information, please contact:

City of Laguna Niguel
27801 La Paz Road
Laguna Niguel, CA 92677

Public Works Department 949.362.4337
Community Development Department 949.362.4360
Orange County 24 hr Water Quality Hotline: 714.567.6363
www.ocwatersheds.com www.ci.laguna-niguel.ca.us

IC 15. Spill Prevention & Clean Up

Site Address: _____

Business Name: _____

The table below identifies activity-specific Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs and PPMs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP and PPM, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs/PPMs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs/PPMs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs/PPMs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs
1. Clean up leaks and spills immediately.
2. Provide employee & contractor training.
3. Properly store and handle chemical materials.
Minimum Designated Pollution Prevention Methods PPMs
1. Keep storage areas free of trash & debris.

Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. Clean up leaks and spills immediately.

A. Utilize dry cleaning methods to clean up spills to minimize the use of water. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste. Physical methods for the cleanup of dry chemicals include the use brooms, shovels, sweepers, or plows.
B. Place a stockpile of spill cleanup materials where they will be readily accessible (e.g. near storage and maintenance areas).
C. If pressure washing, use a collection device that enables collection of wash water and associated solids. Use a sump pump, wet vacuum or similarly effective device to collect runoff and loose materials. Dispose of collected runoff and solids properly. Never hose down or bury dry material spills.
D. Clean up chemical materials with absorbents, gels, and foams. Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
E. For larger spills, a private spill cleanup company or Hazmat team may be necessary.

2. Provide employee & contractor training.

A. Educate and train employees and contractors on the required BMPs, storm water discharge prohibitions, and wastewater requirements.
B. Educate and train employees and contractors on site-specific drainage facilities such as locations of streets, gutters, storm drain inlets, v-ditches and other drainage courses.
C. Train employees on proper spill containment and cleanup methods.

3. Properly store and handle chemical materials.

A. Designate a secure material storage area that is paved with Portland cement concrete, free of cracks and gaps, and impervious in order to contain leaks and spills.
B. Do not store chemicals, drums, or bagged materials directly on the ground. Place these items in secondary containers.
C. Keep chemicals in their original containers, if feasible.
D. Keep containers well labeled according to their contents (e.g., solvent, gasoline).
E. Label hazardous substances regarding the potential hazard (corrosive, radioactive, flammable, explosive, poisonous).
F. Prominently display required labels on transported hazardous and toxic materials (per US DOT regulations).

Suggested Implementation Strategies for Minimum Designated Pollution Prevention Methods (PPMs)

1. **Keep storage areas free of trash & debris.**

   A. Properly dispose of any trash, litter and other debris that may have accumulated around the processing area, parking lot, landscape planters or other parts of the site to prevent them from entering the streets, gutters and storm drains.

Other Beneficial Tips & Techniques

1. **Utilize secondary containment systems for liquid materials.**

   A. Surround storage tanks with a berm or other secondary containment system.
   B. Slope the area inside the berm to a drain.
   C. Drain liquids to the sanitary sewer if available.
   D. Pass accumulated stormwater in petroleum storage areas through an oil/water separator.
   E. **DO NOT** discharge wash water to sanitary sewer until contacting the local sewer authority to find out if pretreatment is required.
   F. If the liquid is oil, gas, or other material that separates from and floats on water, install a spill control device (such as a tee section) in the catch basins that collect runoff from the storage tank area.

2. **Protect materials stored outside from stormwater runon.**

   A. Construct a berm around the perimeter of the material storage area to prevent the runon of uncontaminated stormwater from adjacent areas as well as runoff of stormwater from the material.

3. **Identify key spill response personnel.**

4. **Reporting**

   A. Report spills that pose an immediate threat to human health or the environment to local agencies.

   B. Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour).

5. Pollution Prevention.

A. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

The following pollution prevention principles apply to most industries:

- Affirmative Procurement - Use alternative, safer, or recycled products.
- Redirect storm water flows away from areas of concern.
- Reduce use of water or use dry methods.
- Reduce storm water flow across facility site.
- Recycle and reuse waste products and waste flows.
- Move or cover potential pollution from storm water contact.
- Provide on-going employee training in pollution prevention.

B. Eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous material:

- Use non-caustic detergents instead of caustic cleaning for parts cleaning.
- Use a water-based cleaning service and have tank cleaned. Use detergent-based or water-based cleaning systems in place of organic solvent degreasers.
- Replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check list of active ingredients to see whether it contains chlorinated solvents.
- Choose cleaning agents that can be recycled.

IC 16. Vehicle & Equipment Fueling

Site Address: _____

Business Name: _____

The table below identifies activity-specific Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs and PPMs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP and PPM, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs/PPMs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs/PPMs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs/PPMs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs
1. Prevent fuel from entering the streets, gutters, storm drains, and natural watercourses.
2. Provide employee & contractor training.
3. Utilize fueling safeguards.
Minimum Designated Pollution Prevention Methods PPMs
1. Keep fuelling area clean and free of trash and debris.

Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Prevent fuel from entering the streets, gutters, storm drains, and natural watercourses**

   A. Cover the fuel dispensing area with a canopy for weather protection such that the cover's minimum dimensions are equal to or greater than the area within the grade break or concrete fuel dispensing area. Position roof downspouts to direct water away from fueling areas.
   B. Grade fuel dispensing area with a 2 to 4 percent slope to prevent ponding. Pave fuel area with Portland cement concrete or equivalent smooth impervious surface.
   C. Use secondary containment and interruptible drainage. Direct drainage from the concrete fuel dispensing area and fuel storage tank(s) to an underground clarifier/sump/tank equipped with a shut-off valve that can stop the further draining of spilled fuel to the street or storm drain system.
   D. If conducting mobile fueling, designate mobile fueling areas and bring equipment to these areas. Use secondary containment and cover storm drains in the vicinity during fueling.

2. **Provide employee & contractor training**

   A. Educate and train employees and contractors on the required BMPs, storm water discharge prohibitions, and wastewater requirements.
   B. Educate and train employees and contractors on site-specific drainage facilities such as locations of streets, gutters, storm drain inlets, v-ditches and other drainage courses.
   C. Train employees on proper spill containment and cleanup methods.

3. **Utilize fueling safeguards**

   A. Use overflow protection devices on tank systems to warn the operator to automatically shutdown transfer pumps when the tank reaches full capacity.
   B. Install protective guards around tanks and piping to prevent vehicle or forklift damage.
   C. Clearly tag or label all valves to reduce human error.
   D. Place spill kits at fueling areas and/or on vehicles.
   E. Install vapor recovery nozzles to help control drips as well as air pollution.

Suggested Implementation Strategies for Minimum Designated Pollution Prevention Methods (PPMs)

1. **Keep fuelling area clean and free of trash and debris**

   A. Pick-up and properly dispose of any trash, litter and other debris that may have accumulated around the fueling area, landscape planters or other parts of the site to prevent them from entering the streets, gutters and storm drains.

B. Use sweeping and pick-up methods or vacuum to clean fueling areas. Use rags and absorbents for leaks and spills. Do not wash materials into the street, gutters or storm drains.
C. If pressure washing, use a collection device that enables collection of wash/rinse water and associated solids. Use a sump pump, wet vacuum or similarly effective device to collect runoff and loose materials.

Other Beneficial Tips & Techniques

1. Conduct regular inspections of fueling equipment

A. Check fueling equipment for external corrosion and structural failure.
B. Check for spills and overfills due to operator error.
C. Check for failure of piping system.
D. Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or visa versa.
E. Visually inspect new tank or container installation for loose fittings, poor welding, and/or improper or poorly fitting gaskets.
F. Inspect tank foundations, connections, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.
G. Report leaking vehicles to fleet maintenance.

2. Pollution Prevention

A. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

The following pollution prevention principles apply to most industries:

- Affirmative Procurement - Use alternative, safer, or recycled products.
- Redirect storm water flows away from areas of concern.
- Reduce use of water or use dry methods.
- Reduce storm water flow across facility site.
- Recycle and reuse waste products and waste flows.
- Move or cover potential pollution from storm water contact.
- Provide on-going employee training in pollution prevention.

For more information, please contact:

City of Laguna Niguel
27801 La Paz Road
Laguna Niguel, CA 92677

Public Works Department 949.362.4337
Community Development Department 949.362.4360
Orange County 24 hr Water Quality Hotline: 714.567.6363
www.ocwatersheds.com www.ci.laguna-niguel.ca.us

IC 17. Vehicle & Equipment Maintenance & Repair

Site Address: _____

Business Name: _____

The table below identifies activity-specific Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs and PPMs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP and PPM, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs/PPMs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs/PPMs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs/PPMs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs
1. Prevent materials, products and other pollutants associated with maintenance and repair activities from entering the streets, gutters, storm drains, or natural watercourses.
2. Provide employee & contractor training.
3. Properly maintain fleet of vehicles and equipment.
Minimum Designated Pollution Prevention Methods PPMs
1. Keep maintenance and repair areas free of trash & debris.

Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Prevent materials, products and other pollutants associated with maintenance and repair activities from entering the streets, gutters, storm drains, or natural watercourses**

   A. Use sweeping and pick-up methods or vacuum to clean maintenance and repair areas. Do not wash materials into the street, gutters or storm drains.
   B. If pressure washing, use a collection device that enables collection of wash/rinse water and associated solids. Use a sump pump, wet vacuum or similarly effective device to collect runoff and loose materials.
   C. Inspect incoming vehicles and equipment for leaks. Place vehicles and equipment on an impervious surface and install a drip pan under potential leak points.
   D. Clean oily spots with absorbent materials. Do not allow discharges to enter the street, gutters or storm drains.
   E. Dispose of collected runoff and solids properly. Store waste and/or recycling drums in designated areas with spill containment
   F. Conduct maintenance and repair work in a designated area designed to contain spills.
   G. Design the maintenance and repair area to prevent stormwater runon such as grade, intercept trench and/or berm the area to prevent runon. Position roof downspouts to direct stormwater away from the area.
   H. Install drains connected to the public sewer or the facility's process-wastewater system within these contained maintenance and repair areas. DO NOT discharge to a public sewer until contacting the local sewer authority to find out if pretreatment is required. If discharge to the sanitary sewer is not allowed, pump water to a tank and dispose of properly.

2. **Provide employee & contractor training**

   A. Educate and train employees and contractors on the required BMPs, storm water discharge prohibitions, and wastewater requirements.
   B. Educate and train employees and contractors on site-specific drainage facilities such as locations of streets, gutters, storm drain inlets, v-ditches and other drainage courses.
   C. Train employees on proper spill containment and cleanup methods.

3. **Properly maintain fleet of vehicles and equipment**

   A. Conduct regular and frequent inspection of fleet vehicles and equipment for leaks, malfunctions, staining on and around equipment, and other evidence of leaks.
   B. Develop a standard methodology for reporting inspection results.
   C. Develop a procedure for taking action on items in the report, responding to leaks, cleaning up spills, and completing repairs to prevent future leaks.

Suggested Implementation Strategies for Minimum Designated Pollution Prevention Methods (PPMs)

1. **<u>Keep maintenance and repair areas free of trash & debris</u>**

   A. Do not hose out dumpsters or fill them with liquid waste.
   B. Regularly inspect, repair, and/or replace dumpsters.
   C. Properly dispose of any trash, litter and other debris that may have accumulated around the maintenance and repair area to prevent them from entering the streets, gutters and storm drains.

Other Beneficial Tips & Techniques

1. **Reduce exposure of maintenance and repair area to rain.**

   A. Cover the maintenance and repair areas.

2. **Completely drain oil filters before recycling/disposal.**

3. **Remove all fluids from retired, wrecked, or salvaged vehicles.**

4. **Store cracked batteries in a non-leaking secondary container and dispose of properly at recycling or household hazardous waste facilities.**

5. **Pollution Prevention.**

   A. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

      The following pollution prevention principles apply to most industries:
      - Affirmative Procurement - Use alternative, safer, or recycled products.
      - Redirect storm water flows away from areas of concern.
      - Reduce use of water or use dry methods.
      - Reduce storm water flow across facility site.
      - Recycle and reuse waste products and waste flows.
      - Move or cover potential pollution from storm water contact.
      - Provide on-going employee training in pollution prevention.

B. Eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous material:
   - Use non-caustic detergents instead of caustic cleaning for parts cleaning.
   - Use a water-based cleaning service and have tank cleaned. Use detergent-based or water-based cleaning systems in place of organic solvent degreasers.
   - Replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check list of active ingredients to see whether it contains chlorinated solvents.
   - Choose cleaning agents that can be recycled.

For more information, please contact:

City of Laguna Niguel
27801 La Paz Road
Laguna Niguel, CA 92677

Public Works Department 949.362.4337
Community Development Department 949.362.4360
Orange County 24 hr Water Quality Hotline: 714.567.6363
www.ocwatersheds.com www.ci.laguna-niguel.ca.us

IC 18. Vehicle & Equipment Washing & Steam Cleaning

Site Address: _____
Business Name: _____

The table below identifies activity-specific Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs and PPMs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP and PPM, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs/PPMs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs/PPMs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs/PPMs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs
1. Prevent wash/rinse water from entering the streets, gutters, storm drains or natural watercourses.
2. Provide employee & contractor training.
3. Properly maintain fleet of vehicles and equipment.
Minimum Designated Pollution Prevention Methods PPMs
1. Keep wash areas clean of trash and debris.

Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Prevent wash/rinse water from entering the streets, gutters, storm drains or natural watercourses**

   A. If possible, use off-site commercial washing and/or steam cleaning businesses. These businesses are better equipped to handle and properly dispose of the wash waters.

   B. Use mobile commercial washing and/or steam cleaning businesses capable of disposing of wastewater off-site. Mobile cleaning businesses must use a leak proof cover device that will catch and contain all wastewater runoff for later disposal in a manner that complies with all city, county, state, and federal codes.

   C. If washing occurs onsite, clearly mark and designate an impervious indoor or outdoor area to be used solely for vehicle and equipment washing/steam cleaning. Construct a berm around the designated area and grade to collect wash water as well as to prevent storm water run-on. Use a collection device that enables collection of wash water and associated solids (i.e. portable containment such as ground cover devices). Use a sump pump, wet vacuum or similarly effective device to collect runoff and loose materials. Dispose of collected runoff and solids properly.

   D. Use hoses with nozzles that automatically turn off when left unattended.

2. **Provide employee & contractor training**

   A. Educate and train employees and contractors on the required BMPs, storm water discharge prohibitions, and wastewater requirements.
   B. Educate and train employees in proper waste handling and disposal.
   C. Educate and train staff on the proper maintenance of the wash area.
   D. Train employees on proper spill containment and cleanup methods.

3. **Properly maintain fleet of vehicles and equipment**

   A. Conduct regular inspections of vehicles and equipment for fluid leaks and malfunctions.
   B. Ensure all vehicles and equipment are in good working order.
   C. Promptly repair and clean up any fluid leaks from vehicles and equipment.

Suggested Implementation Strategies for Minimum Designated Pollution Prevention Methods (PPMs)

1. **Keep the wash area free of trash & debris**

A. Pick-up and properly dispose of any trash, litter and other debris that may have accumulated around the wash area to prevent them from entering the streets, gutters and storm drains.

Other Beneficial Tips & Techniques

1. Properly use and store chemicals and waste

A. Implement storage requirements for chemicals indoors or in covered areas with guidance from the local fire department.
B. Use all of a product before disposing of the container.
C. Dispose of empty containers according to the instructions on the container label.
D. Label and store hazardous wastes according to hazardous waste regulations.
E. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc. may not be disposed of in solid waste containers.

2. Inspect and maintain equipment (such as ground cover devices) regularly to ensure proper and effective functioning

3. Pollution Prevention

A. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

The following pollution prevention principles apply to most industries:

- Affirmative Procurement - Use alternative, safer, or recycled products.
- Redirect storm water flows away from areas of concern.
- Reduce use of water or use dry methods.
- Reduce storm water flow across facility site.
- Recycle and reuse waste products and waste flows.
- Move or cover potential pollution from storm water contact.
- Provide on-going employee training in pollution prevention.

For more information, please contact:

City of Laguna Niguel
27801 La Paz Road
Laguna Niguel, CA 92677

Public Works Department 949.362.4337
Community Development Department 949.362.4360
Orange County 24 hr Water Quality Hotline: 714.567.6363
www.ocwatersheds.com www.ci.laguna-niguel.ca.us

IC 19. Waste Handling & Disposal

Site Address: _____

Business Name: _____

The table below identifies activity-specific Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs and PPMs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP and PPM, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs/PPMs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs/PPMs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs/PPMs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs
1. Prevent waste from coming into direct contact with wind, rain and stormwater runoff.
2. Provide employee & contractor training.
3. Prevent wash/rinse water from waste collection areas from entering the streets, gutters, storm drains or natural watercourses.
Minimum Designated Pollution Prevention Methods PPMs
1. Keep waste collection areas clean.



Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. Prevent waste from coming into direct contact with wind, rain and stormwater runoff

A. If feasible, cover the waste management area with a permanent roof.
B. Cover temporary waste piles with a sturdy non-permeable covering material.
C. Cover dumpsters to prevent rain from washing out waste materials.
D. Place dumpsters or other waste receptacles on an impervious surface.
E. Position roof downspouts to direct stormwater away from waste handling areas.
F. Design waste handling and disposal areas to prevent contact with stormwater runoff, including the use of berms to divert water away from the area.

2. Provide employee & contractor training

A. Educate and train employees and contractors on the required BMPs, storm water discharge prohibitions, and wastewater requirements.
B. Educate and train employees in proper waste handling and disposal.
C. Train employees on proper spill containment and cleanup methods.

3. Prevent wash/rinse water from entering the streets, gutters, storm drains or natural watercourses

A. Use sweeping and pick-up methods or vacuum to clean waste collection areas, including streets & gutters. Do not wash materials into the street, gutters or storm drains.
B. If pressure washing, use a collection device that enables collection of wash water and associated solids. Use a sump pump, wet vacuum or similarly effective device to collect runoff and loose materials. Dispose of collected runoff and solids properly.
C. Regularly inspect, repair and/or replace dumpsters. Do not hose out dumpsters or fill them with liquid waste.

Suggested Implementation Strategies for Minimum Designated Pollution Prevention Methods (PPMs)

1. Keep site free of trash & debris

A. Pick-up and properly dispose of any trash, litter and other debris that may have accumulated around the building, parking lot, landscape planters or other parts of the site to prevent them from entering the streets, gutters and storm drains.
B. Post “No Littering” signs.

Other Beneficial Tips & Techniques

1. Properly use and store equipment, chemicals and waste

A. Store equipment indoors or in covered areas to avoid exposure to rain.
B. Implement storage requirements for chemicals indoors or in covered areas with guidance from the local fire department.
C. Use all of a product before disposing of the container.
D. Dispose of empty containers according to the instructions on the container label.
E. Secure solid waste containers when not in use.
F. Segregate wastes by type and label and date wastes.
G. Label and store hazardous wastes according to hazardous waste regulations.
H. Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal.
I. Ensure that only appropriate solid wastes are added to solid waste containers.
J. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc. may not be disposed of in solid waste containers.

2. Pollution Prevention

A. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

The following pollution prevention principles apply to most industries:

- Affirmative Procurement - Use alternative, safer, or recycled products.
- Redirect storm water flows away from areas of concern.
- Reduce use of water or use dry methods.
- Reduce storm water flow across facility site.
- Recycle and reuse waste products and waste flows.
- Move or cover potential pollution from storm water contact.
- Provide on-going employee training in pollution prevention.

IC 20. Eating & Drinking Establishments

Site Address: _____

Business Name: _____

The table below identifies activity-specific Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs and PPMs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP and PPM, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs/PPMs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs/PPMs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs/PPMs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs	
1.	Do not dispose of wash/rinse water in the parking lots, streets, gutters, storm drains, or natural watercourses.
2.	Provide employee training.
3.	Prevent wash/rinse water from trash dumpster, patio, sidewalk and other hardscape areas from entering the parking lots, streets, gutters, storm drains, and natural watercourses.
4.	Properly dispose of grease.
Minimum Designated Pollution Prevention Methods PPMs	
1.	Keep site free of trash & debris.

Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Do not dispose of wash/rinse water in the parking lots, streets, gutters, storm drains, or natural watercourses.**

   A. Clean equipment (floor mats, grease filters, grills, garbage cans, etc.) indoors or in a covered outdoor wash area that is plumbed to the sanitary sewer.
   B. Clean equipment in a mop sink if possible (never in a food preparation sink). If there is no mop sink, dedicate an indoor cleaning area where a drain is plumbed to the sanitary sewer.
   C. Dispose mop water from cleaning floors in a mop sink, toilet or other drain that is plumbed to the sanitary sewer.
   D. Do not pour wash water outside or into a parking lot, street, gutter, or storm drain

2. **Provide employee & contractor training.**

   A. Educate and train employees on the required BMPs, storm water discharge prohibitions, and wastewater requirements.
   B. Educate and train employees on site-specific drainage facilities such as locations of streets, gutters, storm drain inlets, v-ditches and other drainage courses.
   C. Train employees on proper spill containment and cleanup methods.

3. **Prevent wash/rinse water from trash dumpster, patio, sidewalk and other hardscape areas from entering the parking lots, streets, gutters, storm drains, and natural watercourses.**

   A. Use sweeping and pick-up methods or vacuum all hardscape areas, including drive-thur areas, patios, parking lots, sidewalks, common area, and outdoor eating areas. Do not wash these areas.
   B. Do not hose out dumpsters or fill them with liquid waste.
   C. Regularly inspect, repair, and/or replace dumpsters.

4. **Properly dispose of grease.**

   A. Collect and dispose of concentrated waste oil and grease and disposed of by a certified waste grease hauler. NEVER pour grease or oil into a sink, floor drain, storm drain or dumpster.
   B. Dispose of all wastewater containing oil and grease in a grease trap or interceptor.

Suggested Implementation Strategies for Minimum Designated Pollution Prevention Methods (PPMs)

1. <u>Keep site free of trash & debris</u>

A. Pick-up on a regular basis and properly dispose of any trash, litter, food products and other debris that may have accumulated in the planters, parking lot or other parts of the site to prevent them from entering the streets, gutters and storm drains.

Other Beneficial Tips & Techniques

1. Pollution Prevention.

A. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

The following pollution prevention principles apply to most industries:

- Affirmative Procurement - Use alternative, safer, or recycled products.
- Redirect storm water flows away from areas of concern.
- Reduce use of water or use dry methods.
- Reduce storm water flow across facility site.
- Recycle and reuse waste products and waste flows.
- Move or cover potential pollution from storm water contact.
- Provide on-going employee training in pollution prevention.

IC 21. Irrigation Runoff

The table below identifies activity-specific Best Management Practices (BMPs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are minimum designated BMPs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs	
1.	Implement all feasible measures to reduce and eliminate surface runoff of irrigation water.
2.	Comply with water conservation, drought response and waste prohibition regulations of the water district.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. <u>Implement all feasible measures to reduce and eliminate surface runoff of irrigation water.</u>

A. Ensure that persons responsible for landscape maintenance are aware of irrigation management techniques for pollution prevention.
B. Replace irrigation controller batteries in the spring and fall.
C. Inspect the irrigation system regularly, while it is operating, to identify leaks and to determine if runoff is occurring.
D. Promptly repair any leaks or breaks. If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.
E. Adjust sprinkler heads and nozzles to avoid over-spray onto pavement and/or other impervious areas.
F. Irrigate slowly or pulse irrigate so the infiltration rate of the soil is not exceeded. This can occur in less than 2 minutes depending on landscaping, soil type and topography.

G. Adjust the watering schedule seasonally to reflect reduced winter water demand.
H. Do not water when rain is predicted, or when the ground is already moist from rainfall.

2. <u>Comply with water conservation, drought response and waste prohibition regulations of the water district.</u>

A. Adhere to the watering schedule restrictions designated by the water district, as appropriate to drought conditions. For more information on water district requirements contact Moulton Niguel Water District at (949) 831-2500 or visit their website at www.mnwd.com.

Other Beneficial Tips & Techniques

1. <u>Consider upgrading irrigation system components to increase irrigation efficiency and reduce runoff.</u>

A. Replace old timer-based irrigation controllers with new evapotranspiration-driven self-adjusting controllers.
B. Install sprinkler heads with a low precipitation rate and/or a more adjustable spray pattern or radius as needed.
C. Install popup sprinkler heads in areas with a lot of activity and/or where risers may be broken.
D. Install water-efficient drip irrigation systems for trees, shrubs and flowers.
E. Install a sensor that will reduce flow in case of breakages in the system.
F. Install an automatic rain shut-off sensor.
G. Install check valves for sprinkler heads at the bottom of slopes to eliminate low-head drainage.

2. <u>Consider reducing the need for irrigation.</u>

A. Add 2-3 inches of mulch around trees and plants to minimize runoff and reduce evaporation.
B. Replace turf areas adjacent to pavement and/or other impervious areas with drought tolerant shrubs and groundcover.



Only Rain in the Storm Drain.
The Ocean begins at your front door.

For more information, please contact:

City of Laguna Niguel
27801 La Paz Road
Laguna Niguel, CA 92677

Public Works Department 949.362.4337
Community Development Department 949.362.4360
Orange County 24 hr Water Quality Hotline: 714.567.6363
www.ocwatersheds.com www.ci.laguna-niguel.ca.us

IC 22. POWER WASHING



The checklist below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for power washing and surface cleaning activities, based on priorities determined by site location and operational characteristics. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and to limit impact on stormwater surface water quality to the maximum extent practicable. Below the Minimum Designated BMPs is a listing of suggested implementation strategies that may be utilized where appropriate.

A surface cleaning business is considered to be any operation that provides the following services:

- Cleaning (e.g., power sweeping, washing) driveways and parking lots
- Cleaning building exteriors (except sand blasting, window cleaning)
- Driveway cleaning (e.g., power sweeping, washing) services
- Parking lot cleaning (e.g., power sweeping, washing) services
- Power washing building exteriors
- Pressure washing (e.g., buildings, decks, fences)
- Steam cleaning building exteriors

Minimum Designated BMPs: Prevent wastewater or wash water from exterior power washing or other exterior surface cleaning activity from entering parking lots, streets, gutters, storm drains, and natural water courses.

SUGGESTED IMPLEMENTATION STRATEGIES

The suggested implementation strategies presented below are intended ensure compliance with the Minimum Designated BMP. The following strategies, or equivalently protective techniques, must be observed by all surface cleaners, regardless of the surface to be cleaned or the type of cleaning operation to be performed:

What needs to be done prior to conducting a job?

- Evaluate the chemicals and compounds used for cleaning and reduce or eliminate the use of those that contain solvents, heavy metals, high levels of phosphates, or very high/very low pH.
- Walk through the area where the cleaning will occur prior to the start of the job and identify all area drains, yard drains, and catch basins where wastewater could potentially enter the street or storm drain system.
- Block/seal off identified drains or catch basins using sand bags, plugs, rubber mats, or temporary berms.
- Collect all trash and debris from the area and place in a trash bin for disposal.
- Clean the area of debris prior to cleaning to minimize the amount of suspended solids, soil, and grit in the resulting wastewater.

- Identify where surface washing will occur. Avoid washing whole areas; spot clean where feasible and necessary.
- Identify the wastewater disposal option that will be used. Whether you are discharging to landscaping or sanitary sewer, make sure that the requirements will be met and/or the necessary contacts have been made, as discussed below.
- Inventory spill cleanup equipment to ensure that it is available for immediate use, if needed.
- Conduct surface cleaning in accordance with all operating instructions provided by the equipment supplier. Maintain equipment in good working order and routinely check and test all safety features.

What methods can be used to collect wastewater at a site?

There is no specific containment method that must be used for wastewater collection/diversion. However, the system must be adequately designed so that the wastewater does not flow into an on-site or off-site storm drain inlet or into the street. All surface cleaners should use one of the following methods, regardless of the surface to be cleaned or the type of cleaning operation to be performed:

- Portable containment areas can be made from waterproof tarps, heavy-duty plastic, or rubber matting equipped with berms to prevent wastewater from running into on-site or off-site storm drain inlets or into the street. Materials that have been used for berms include sand bags or water-filled tubing. Whatever containment material is used, it must seal tightly to the ground so that none of the wastewater can pass under or over the berms.
- When power washing smaller pieces of equipment, containment devices to use may include portable vinyl swimming pools, plastic 55-gallon drums on casters, and flat metal or plastic containment pads.
- Depending on the volume of wastewater generated, it may be necessary to use a pump system, which may range in size from a wet-dry vacuum to a sump pump. A basin from which to pump wastewater can also be created by establishing a slightly sloped containment area.
- Stationary or more permanent containment areas can be constructed with cement. Berms and pump systems may be used to contain wastewater and divert it to a holding tank.
- Commercial wastewater collection systems are also available for power washing. These systems can range from portable wash pits to self-contained water recycling systems. A list of companies selling this type of equipment can usually be found in the telephone book under “Pressure Washing Services and Equipment”.
- Storm drain covers can be made of an impermeable barrier such as a heavy-duty vinyl or plastic secured in place with materials such as concrete blocks, gravel bags, or sand bags. Storm drain covers may also be available though commercial vendors.

Note: Blocking storm drain inlets in the public right-of-way is prohibited as a method of containment, unless expressly permitted by the municipality, typically through an encroachment permit process. Wastewater should be contained on-site prior to entering the public right-of-way. Contact the local municipality for more information.

Wastewater Disposal Options

How can wastewater be safely disposed?

Wastewater generated by surface cleaners is not allowed in the storm drain or street. However, the wastewater may be discharged to a landscaped area, the sanitary sewer, or it may be picked up and disposed of by a waste hauler. Please note that laboratory chemical analysis of wastewater may be required

to establish the proper disposal method. A wastewater disposal option should be selected based on the conditions outlined below:

Discharge Wastewater to a Landscaped Area

The wastewater must meet the following requirements if discharging to landscaping:

- The pH must be between 6.5 and 8.5. This can be checked quickly and easily through the use of pH paper test strips.
- The wastewater should not contain large volumes or concentrations of:
    - Toxic materials
    - Degreasers
    - Pollutants that may create a fire or explosion hazard (e.g., gasoline, diesel)
    - Solid or viscous pollutants in amounts sufficient to cause obstruction or blockage of flow
    - Petroleum oil, or other products of mineral oil origin
    - Paint
- Prior to surface washing, you must exercise any reasonable means to eliminate large volumes or concentrations of the above listed pollutants. Common methods to eliminate standing pools of pollutants include the placement of absorbent to adsorb the pollutant, dry-sweeping the absorbent, and disposing of the absorbent properly.
- Wastewater from cleaning food-related vehicles or areas, vehicle exteriors or engines, and buildings with lead- or mercury-based paint should not be discharged to landscaping.
- Filter the wastewater if it contains debris, fibers, or other suspended solids.
- Ensure that the wastewater is fully contained within the landscaped area and will fully infiltrate into the ground prior to leaving the job site.

Sanitary Sewer

If discharging to the sanitary sewer, the following conditions apply:

- The wastewater temperature must be less than 140°F (60°C).
- The pH must be between 6.0 and 12.0. This can be checked quickly and easily through the use of pH paper test strips. Adjust the wastewater to a pH that is between 6.0 and 12.0. Dilution is not an effective or acceptable pretreatment method.
- The wastewater quality must comply with the sanitary sewer facility's local discharge limits and should not contain:
    - Pollutants that may create a fire or explosion hazard (e.g., gasoline, diesel).
    - Solid or viscous pollutants in amounts sufficient to cause obstruction or blockage of flow.
    - Petroleum oil, non-biodegradable cutting oil, or other products of mineral oil origin.
    - Oil based paint.
- No wastewater shall be discharged into any publicly owned manholes that directly or indirectly connect to the sanitary sewer system without express authorization from the appropriate agency.

When discharging to the sanitary sewer:

- Filter the wastewater if it contains debris, fibers, or other suspended solids.

- If chemicals (e.g., solvents or acids) are used during the cleaning process, additional precautions may be needed. Contact your local sanitation district to learn if wastewater containing these chemicals requires pretreatment before discharge to the sanitary sewer or if it needs to be treated as hazardous waste.
- Ensure that the wastewater is released at a flow rate and/or concentration that will not cause problems, pass through, or interference with the sanitary sewer facilities.
- Utilize an approved discharge point such as:
    - Privately owned cleanout (or sink, toilet or floor drain), oil/water separator, or below ground clarifier at the client's property where the wastewater is generated,
    - Privately owned industrial sewer connection at the client's property where the wastewater is generated,
    - Wastehauler station at sanitary sewer facility, and
    - Any other disposal points approved by sanitary sewer facility.
- Maintain a logbook of all discharges.

Waste Hauler

If using a waste hauler, the following types of wastewater may be disposed if it:

- Is corrosive (as indicated by a pH value of less than 5.5) or caustic (as indicated by a pH value of greater than 10.0).
- Contains a pollutant that may create a fire or explosion hazard (e.g., gasoline, diesel).
- Contains solid or viscous pollutants in amounts sufficient to cause obstruction or blockage of flow.
- Contains petroleum oil, non-biodegradable cutting oil, or other products of mineral oil origin.

When using a waste hauler:

- Ensure that the waste hauler is certified by appropriate sanitary sewer and local health care agencies, is Hazardous Waste DOT certified, and complies with applicable discharge regulations, which may include obtaining necessary permits and conducting water quality monitoring requirements.
- Identify the wastes involved and determine if a hazardous waste has been generated. Examples of situations that may potentially generate hazardous wastes include:
    - Power washing old paint off a building. Old paint stripped off commercial buildings may contain metals (e.g., lead, chromium, cadmium, and mercury), causing it to be a regulated hazardous waste. Paint chips cannot be left on the ground at the job site. Paint chips need to be collected, evaluated, and disposed of properly.
    - The use of certain solvents as degreasing agents, which may cause the wastewater to be classified as a listed or characteristic hazardous waste.
- Maintain a logbook of all discharges and hazardous waste manifests, if applicable.

IC 23. Mobile Businesses



The checklist below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for the proper disposal of wastewater generated by mobile business operations. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and to limit impact on stormwater surface water quality to the maximum extent practicable. Below the Minimum Designated BMPs is a listing of suggested implementation strategies that may be utilized where appropriate.

Minimum Designated BMPs:

1. Prevent wastewater or wash water from entering parking lots, streets, gutters, storm drains, and natural water courses.
2. Properly store and handle chemical materials.
3. Provide employee & contractor training.

SUGGESTED IMPLEMENTATION STRATEGIES

The suggested implementation strategies presented below are intended ensure compliance with the Minimum Designated BMP. The following strategies, or equivalently protective techniques, must be observed by all mobile businesses:

What needs to be done prior to conducting a job?

- Evaluate the chemicals and compounds used for cleaning and reduce or eliminate the use of those that contain solvents, heavy metals, high levels of phosphates, or very high/very low pH.
- Walk through the area where the cleaning will occur prior to the start of the job and identify all area drains, yard drains, and catch basins where wastewater could potentially enter the street or storm drain system.
- Block/seal off identified drains or catch basins using sand bags, plugs, rubber mats, or temporary berms.
- Collect all trash and debris from the area and place in a trash bin for disposal.
- Clean the area of debris prior to cleaning to minimize the amount of suspended solids, soil, and grit in the resulting wastewater.
- Identify the wastewater disposal option that will be used. Whether you are discharging to landscaping or sanitary sewer, make sure that the requirements will be met and/or the necessary contacts have been made, as discussed below.
- Inventory spill cleanup equipment to ensure that it is available for immediate use, if needed.
- Conduct surface cleaning in accordance with all operating instructions provided by the equipment supplier. Maintain equipment in good working order and routinely check and test all safety features.

What methods can be used to collect wastewater at a site?

There is no specific containment method that must be used for wastewater collection/diversion. However, the system must be adequately designed so that the wastewater does not flow into an on-site or off-site storm drain inlet or into the street. All mobile businesses should use one of the following methods, regardless of the e type of cleaning operation to be performed:

- Portable containment areas can be made from waterproof tarps, heavy-duty plastic, or rubber matting equipped with berms to prevent wastewater from running into on-site or off-site storm drain inlets or into the street. Materials that have been used for berms include sand bags or water-filled tubing. Whatever containment material is used, it must seal tightly to the ground so that none of the wastewater can pass under or over the berms.
- When power washing smaller pieces of equipment, containment devices to use may include portable vinyl swimming pools, plastic 55-gallon drums on casters, and flat metal or plastic containment pads.
- Depending on the volume of wastewater generated, it may be necessary to use a pump system, which may range in size from a wet-dry vacuum to a sump pump. A basin from which to pump wastewater can also be created by establishing a slightly sloped containment area.
- Stationary or more permanent containment areas can be constructed with cement. Berms and pump systems may be used to contain wastewater and divert it to a holding tank.
- Commercial wastewater collection systems are also available for power washing. These systems can range from portable wash pits to self-contained water recycling systems. A list of companies selling this type of equipment can usually be found in the telephone book under “Pressure Washing Services and Equipment”.
- Storm drain covers can be made of an impermeable barrier such as a heavy-duty vinyl or plastic secured in place with materials such as concrete blocks, gravel bags, or sand bags. Storm drain covers may also be available though commercial vendors.

Note: Blocking storm drain inlets in the public right-of-way is prohibited as a method of containment, unless expressly permitted by the municipality, typically through an encroachment permit process. Wastewater should be contained on-site prior to entering the public right-of-way. Contact the local municipality for more information.

Wastewater Disposal Options

How can wastewater be safely disposed?

Wastewater generated by mobile businesses is not allowed in the storm drain or street. However, the wastewater may be discharged to a landscaped area, the sanitary sewer, or it may be picked up and disposed of by a waste hauler. Please note that laboratory chemical analysis of wastewater may be required to establish the proper disposal method. A wastewater disposal option should be selected based on the conditions outlined below:

Discharge Wastewater to a Landscaped Area

The wastewater must meet the following requirements if discharging to landscaping:

- The pH must be between 6.5 and 8.5. This can be checked quickly and easily through the use of pH paper test strips.
- The wastewater should not contain large volumes or concentrations of:
    - Toxic materials
    - Degreasers

    - Pollutants that may create a fire or explosion hazard (e.g., gasoline, diesel)
    - Solid or viscous pollutants in amounts sufficient to cause obstruction or blockage of flow
    - Petroleum oil, or other products of mineral oil origin
    - Paint
- Prior to surface washing, mobile businesses must exercise any reasonable means to eliminate large volumes or concentrations of the above listed pollutants. Common methods to eliminate standing pools of pollutants include the placement of absorbent to adsorb the pollutant, dry-sweeping the absorbent, and disposing of the absorbent properly.
- Wastewater from cleaning food-related vehicles or areas, vehicle exteriors or engines, and buildings with lead- or mercury-based paint should not be discharged to landscaping.
- Filter the wastewater if it contains debris, fibers, or other suspended solids.
- Ensure that the wastewater is fully contained within the landscaped area and will fully infiltrate into the ground prior to leaving the job site.

Sanitary Sewer

If discharging to the sanitary sewer, the following conditions apply:

- The wastewater temperature must be less than 140°F (60°C).
- The pH must be between 6.0 and 12.0. This can be checked quickly and easily through the use of pH paper test strips. Adjust the wastewater to a pH that is between 6.0 and 12.0. Dilution is not an effective or acceptable pretreatment method.
- The wastewater quality must comply with the sanitary sewer facility's local discharge limits and should not contain:
    - Pollutants that may create a fire or explosion hazard (e.g., gasoline, diesel).
    - Solid or viscous pollutants in amounts sufficient to cause obstruction or blockage of flow.
    - Petroleum oil, non-biodegradable cutting oil, or other products of mineral oil origin.
    - Oil based paint.
- No wastewater shall be discharged into any publicly owned manholes that directly or indirectly connect to the sanitary sewer system without express authorization from the appropriate agency.

When discharging to the sanitary sewer:

- Filter the wastewater if it contains debris, fibers, or other suspended solids.
- If chemicals (e.g., solvents or acids) are used during the cleaning process, additional precautions may be needed. Contact your local sanitation district to learn if wastewater containing these chemicals requires pretreatment before discharge to the sanitary sewer or if it needs to be treated as hazardous waste.
- Ensure that the wastewater is released at a flow rate and/or concentration that will not cause problems, pass through, or interference with the sanitary sewer facilities.
- Utilize an approved discharge point such as:
    - Privately owned cleanout (or sink, toilet or floor drain), oil/water separator, or below ground clarifier at the client's property where the wastewater is generated,
    - Privately owned industrial sewer connection at the client's property where the wastewater is generated,
    - Wastehauler station at sanitary sewer facility, and

- Any other disposal points approved by sanitary sewer facility.

- Maintain a logbook of all discharges.

Waste Hauler

If using a waste hauler, the following types of wastewater may be disposed if it:

- Is corrosive (as indicated by a pH value of less than 5.5) or caustic (as indicated by a pH value of greater than 10.0).
- Contains a pollutant that may create a fire or explosion hazard (e.g., gasoline, diesel).
- Contains solid or viscous pollutants in amounts sufficient to cause obstruction or blockage of flow.
- Contains petroleum oil, non-biodegradable cutting oil, or other products of mineral oil origin.

When using a waste hauler:

- Ensure that the waste hauler is certified by appropriate sanitary sewer and local health care agencies, is Hazardous Waste DOT certified, and complies with applicable discharge regulations, which may include obtaining necessary permits and conducting water quality monitoring requirements.
- Identify the wastes involved and determine if a hazardous waste has been generated.
- Maintain a logbook of all discharges and hazardous waste manifests, if applicable.

CITY OF LAGUNA NIGUEL

IC 24. SPECIAL EVENTS

The matrix below identifies required activity-specific Minimum Designated Best Management Practices (BMPs) and Pollution Prevention Methods (PPMs) for Special Events, based on priorities determined by site location and operational characteristics. Minimum Designated (required) BMPs shall be implemented to eliminate prohibited discharges and limit impact on stormwater surface water quality to the maximum extent practicable.

DESIGNATED MINIMUM BEST MANAGEMENT PRACTICES (BMPs)

1. Keep site free of trash & debris.
2. Provide employee & contractor training.

Suggested Implementation Strategies for Minimum Designated BMPs	
Trash/ Litter Management	• Ensure that an adequate number of receptacles are provided for use by vendors and guests. Any overflowing containers observed shall be managed and serviced in a timely manner. • Release of balloons (rubber, latex, mylar or other material) is not allowed. • All waste receptacles shall be leak tight and equipped with lids or covers. Dumpsters shall be closed when not in use. • Pick up litter at least once daily. Litter should not be allowed to be blown away by blowers or wind. • Hazardous and liquid waste shall not be disposed of in dumpsters or trash bins. Hazardous waste shall be disposed of properly at a hazardous waste facility. Liquid waste, such as cooking grease or other food related materials, shall be properly disposed of off-site by generator. Other non-hazardous liquids, such as left over beverages, ice bin residual, etc, should be disposed of in the sanitary sewer system through a sink or toilet, or poured on a pervious area, such as a landscaped or dirt/gravel area, where the liquids can be fully absorbed prior to leaving the site. • If commercial vendors/sales are involved, provide required recycling containers as set forth by City contract waste hauler. • After the event is over and any temporary event facilities are removed, inspect the site for litter or spills, and provide for prompt cleanup and disposal.
Portable Toilets	• Require the vendor to provide a secondary containment pan or storm drain inlet protection, if a spill could reach the storm drain. • Do not place portable toilets near or over a storm drain without secondary containment. • The contact information for the company responsible for the portable facilities must be clearly marked on or near the facilities. • Ensure adequate servicing to prevent overflows or leaks. • It is recommended that vendors be requested to stake down the portable toilets to prevent them from tipping over from wind or vandals, if appropriate.

Car Wash Fundraisers	• The use of an experienced car wash fundraiser vendor, with proper containment equipment such a Prontowash, or dry methods are encouraged. • All car wash water must be contained on site and not allowed to drain to adjacent property or storm drains without treatment BMPs. • If there is adequate on-site area, car wash water may be allowed to absorb into a pervious (i.e. landscaped or gravel/dirt) area. The event water must be fully absorbed prior to leaving site. • If draining to a vegetated area, a filtering device, such as sand or gravel bags shall be used to collect sediment and debris prior to draining to the vegetated area. The collected debris shall be removed and disposed of properly at the end of the event. • A high pressure hose nozzle is encouraged to minimize water use and runoff. An automatic shut off nozzle is required per water district regulations. • A non-toxic, biodegradable soap shall be used.
Pressure Washing / Wet Washing	• All water or wastewater discharges from any washing activities must be prevented from entering streets, storm drains and gutters and collected for proper disposal. • Storm drain inlets (or low points of the site) must be protected with a temporary berm where washwater is contained and then collected for proper disposal. • If contractors (such as powerwashers) are used for wet washing services, they must contain, collect and properly dispose of washwater (most likely offsite). Include this requirement in your contract. • Small amounts of water can be dumped into a sanitary sewer connection, such as a utility sink or toilet, if available, or could be diverted to a pervious (ie. landscaped or gravel/dirt) area, and allowed to soak into the ground. The water must be fully absorbed into the ground prior to leaving site.
Spill Clean Up & Reporting	• Prior to start of event, organizers & staff should assess the event location, and identify the nearby catch basins, that would receive any trash, debris or spills from the event. • Spills of drinks, food, and any other material on a paved area must be cleaned. Liquid spills can be cleaned by using absorbent materials such as paper towels, mops, or an absorbent material. Food or other solid materials may be swept up, and placed in the trash. • Regularly inspect storm drains during the event to assure that pollutants are not entering them. • If pollutants enter a storm drain or if a hazardous material spill occurs, please call Police Dispatch at 949-770-6011 immediately.
Post-Event Clean Up	• All streets, sidewalks, and public areas must be cleaned (sweeping, litter pickup, etc.) and returned to the pre-event condition. • Remove temporary public art (chalk, paint, charcoal, clay, etc). Any wet washing conducted should follow BMPs as noted above. • All storm drain inlet protection devices must be removed.
Contracts & Leases	• Provide adequate language in contracts with vendors to ensure compliance with these rules. • Discuss and distribute information about these water quality requirements during staff (including contractor) training and vendor registration.

R 1. Automobile Repair & Maintenance

The table below identifies activity-specific Best Management Practices (BMPs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs	
1.	Prevent materials, products and other pollutants associated with maintenance and repair activities from entering the streets, gutters, storm drains, or natural watercourses.
2.	Clean up leaks and spills immediately.
3.	Properly store and handle chemical materials.



Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Prevent materials, products and other pollutants associated with maintenance and repair activities from entering the streets, gutters, storm drains, or natural watercourses**

   A. Use sweeping and pick-up methods or vacuum to clean maintenance and repair areas. Do not wash materials into the street, gutters or storm drains.
   B. If pressure washing, use a collection device that enables collection of wash/rinse water and associated solids. Use a sump pump, wet vacuum or similarly effective device to collect runoff and loose materials. Dispose of collected liquids in a mop sink, toilet or other drain that is plumbed to the sanitary sewer. Dispose of collected solids in the trash. Do not dispose of in the street, gutter or storm drain.
   C. Inspect vehicles for leaks. Place vehicles on an impervious surface and install a drip pan under potential leak points.
   D. Clean oily spots with absorbent materials. Do not allow discharges to enter the street, gutters or storm drains.
   E. Properly dispose of chemicals and fluids as household hazardous waste at the Prima Deschecha HHW Collection Center. For details, visit their web site www.oclandfills.com or call (714) 834-6752 for recorded information.
   F. Properly dispose of used motor oil at a used oil recycling center or at the above mentioned HHW Collection Center.

2. **Clean up leaks and spills immediately.**

   A. Utilize dry cleaning methods to clean up spills to minimize the use of water. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste. Physical methods for the cleanup of dry chemicals include the use brooms, shovels, sweepers, or plows.
   B. Place a stockpile of spill cleanup materials where they will be readily accessible (e.g. near storage and maintenance areas).
   C. If pressure washing, use a collection device that enables collection of wash water and associated solids. Use a sump pump, wet vacuum or similarly effective device to collect runoff and loose materials. Dispose of collected runoff and solids properly. Never hose down or bury dry material spills.
   D. Clean up chemical materials with absorbents, gels, and foams. Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
   E. For larger spills, a private spill cleanup company or Hazmat team may be necessary.

3. **Properly store and handle chemical materials.**

   A. Store materials indoors or under cover to prevent exposure to rain or wind.
   B. Keep chemicals and vehicle fluids in their original containers, if feasible.
   C. Keep containers well labeled according to their contents (e.g., solvent, gasoline).
   D. Label hazardous substances regarding the potential hazard (corrosive, radioactive, flammable, explosive, poisonous).
   E. Prominently display required labels on transported hazardous and toxic materials (per US DOT regulations).

Other Beneficial Tips & Techniques

1. **Reduce exposure of maintenance and repair activities to rain.**

   A. Conduct maintenance and repair activities in the garages or in enclosed areas.

2. **Completely drain oil filters before recycling/disposal.**

3. **Remove all fluids from retired, wrecked, or salvaged vehicles.**

4. **Store cracked batteries in a non-leaking secondary container and dispose of properly at recycling or household hazardous waste facilities.**

5. **Pollution Prevention.**

   A. Keep site free of trash & debris. Properly dispose of any trash, litter and other debris that may have accumulated around the site to prevent them from entering the streets, gutters and storm drains.

   B. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

      The following pollution prevention principles apply to most industries:
      - Affirmative Procurement - Use alternative, safer, or recycled products.
      - Redirect storm water flows away from areas of concern.
      - Reduce use of water or use dry methods.
      - Reduce storm water flow across facility site.
      - Recycle and reuse waste products and waste flows.
      - Move or cover potential pollution from storm water contact.
      - Provide on-going employee training in pollution prevention.

   C. Eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous material:

- Use non-caustic detergents instead of caustic cleaning for parts cleaning.
- Use a water-based cleaning service and have tank cleaned. Use detergent-based or water-based cleaning systems in place of organic solvent degreasers.
- Replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check list of active ingredients to see whether it contains chlorinated solvents.
- Choose cleaning agents that can be recycled.

For more information, please contact:

City of Laguna Niguel
27801 La Paz Road
Laguna Niguel, CA 92677

Public Works Department 949.362.4337
Community Development Department 949.362.4360
Orange County 24 hr Water Quality Hotline: 714.567.6363
www.ocwatersheds.com www.ci.laguna-niguel.ca.us

R 2. Residential Automobile Washing

The table below identifies activity-specific Best Management Practices (BMPs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs	
1.	Minimize wash/rinse water from entering the streets, gutters, storm drains, or natural watercourses.
2.	Properly maintain vehicles.
3.	Properly store and handle chemical materials.



Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Minimize wash/rinse water from entering the streets, gutters, storm drains, or natural watercourses**

   A. When possible, use a commercial car wash facility where proper management practices and water recycling are utilized.
   B. Use sweeping and pick-up methods or vacuum to clean interior of vehicles. Do not wash materials into the street, gutters or storm drains.
   C. If pressure washing, use a collection device that enables collection of wash/rinse water and associated solids. Use a sump pump, wet vacuum or similarly effective device to collect runoff and loose materials. Dispose of collected liquids in a mop sink, toilet or other drain that is plumbed to the sanitary sewer. Dispose of collected solids in the trash. Do not dispose of in the street, gutter or storm drain.
   D. Turn off hose when not actively washing down vehicle. Rinse in small sections to allow rinse water to be absorbed on site or evaporate before leaving the site.

2. **Properly maintain vehicles.**

   A. Conduct regular inspections of vehicles for fluid leaks and malfunctions.
   B. Ensure all vehicles are in good working order.
   C. Promptly repair and clean up any fluid leaks from vehicles and equipment..

3. **Properly store and handle chemical materials.**

   A. Store materials indoors or under cover to prevent exposure to rain or wind.
   B. Keep chemicals and vehicle fluids in their original containers, if feasible.
   C. Keep containers well labeled according to their contents (e.g., solvent, gasoline).
   D. Label hazardous substances regarding the potential hazard (corrosive, radioactive, flammable, explosive, poisonous).
   E. Prominently display required labels on transported hazardous and toxic materials (per US DOT regulations).

Other Beneficial Tips & Techniques

1. **Pollution Prevention.**

   A. Keep site free of trash & debris. Properly dispose of any trash, litter and other debris that may have accumulated around the site to prevent them from entering the streets, gutters and storm drains.

B. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

The following pollution prevention principles apply to most industries:

- Affirmative Procurement - Use alternative, safer, or recycled products.
- Redirect storm water flows away from areas of concern.
- Reduce use of water or use dry methods.
- Reduce storm water flow across facility site.
- Recycle and reuse waste products and waste flows.
- Move or cover potential pollution from storm water contact.
- Provide on-going employee training in pollution prevention.

For more information, please contact:

City of Laguna Niguel
27801 La Paz Road
Laguna Niguel, CA 92677

Public Works Department 949.362.4337
Community Development Department 949.362.4360
Orange County 24 hr Water Quality Hotline: 714.567.6363
www.ocwatersheds.com www.ci.laguna-niguel.ca.us

R 3. Residential Automobile Parking

The table below identifies activity-specific Best Management Practices (BMPs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs	
1.	Adhere to applicable parking regulations, including parking restrictions to allow for street sweeping.
2.	Properly maintain vehicles.
3.	Properly store and handle chemical materials.



Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Adhere to applicable parking regulations, including parking restrictions to allow for street sweeping.**

   A. Park vehicles in garages and driveways where possible. Park vehicles only in designated parking areas.
   B. Observe all parking regulations.
   C. Remove vehicles from the street during posted street sweeping times.

2. **Properly maintain vehicles.**

   A. Conduct regular inspections of vehicles for fluid leaks and malfunctions.
   B. Ensure all vehicles are in good working order.
   C. Promptly repair and clean up any fluid leaks from vehicles and equipment..

3. **Properly store and handle chemical materials.**

   A. Store materials indoors or under cover to prevent exposure to rain or wind.
   B. Keep chemicals and vehicle fluids in their original containers, if feasible.
   C. Keep containers well labeled according to their contents (e.g., solvent, gasoline).
   D. Label hazardous substances regarding the potential hazard (corrosive, radioactive, flammable, explosive, poisonous).
   E. Prominently display required labels on transported hazardous and toxic materials (per US DOT regulations).

Other Beneficial Tips & Techniques

1. Pollution Prevention.

A. Keep site free of trash & debris. Properly dispose of any trash, litter and other debris that may have accumulated around the site to prevent them from entering the streets, gutters and storm drains.

B. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

The following pollution prevention principles apply to most industries:

- Affirmative Procurement - Use alternative, safer, or recycled products.
- Redirect storm water flows away from areas of concern.
- Reduce use of water or use dry methods.
- Reduce storm water flow across facility site.
- Recycle and reuse waste products and waste flows.
- Move or cover potential pollution from storm water contact.
- Provide on-going employee training in pollution prevention.

R 4. Home & Garden Care Activities

The table below identifies activity-specific Best Management Practices (BMPs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs
1. Do not dispose of wash or wastewater in the streets, gutters, storm drains, or natural watercourses.
2. Provide contractor training.
3. Use extra precautions when applying pesticides, herbicides, fungicides, fertilizers and soil amendments.

Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Do not dispose of wash or wastewater in the streets, gutters, storm drains, or natural watercourses.**

   A. Use sweeping and pick-up methods or vacuum to clean hardscape areas, including streets & gutters. Do not wash materials into the street, gutters or storm drains.
   B. If pressure washing, use a collection device that enables collection of wash water and associated solids. Use a sump pump, wet vacuum or similarly effective device to collect runoff and loose materials. Dispose of collected runoff and solids properly.
   C. Clean paint brushes and tools in sinks connected to sanitary sewers or in portable containers that can be dumped into a sink, toilet, or other drain that is plumbed to the sanitary sewer.
   D. Paint brushes and tools covered with non-water based materials must be cleaned in a manner that enables collection of uses solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.
   E. Dispose of mop and wash water from cleaning in a mop sink, toilet or other drain that is plumbed to the sanitary sewer.

2. **Provide contractor training.**

   A. If you hire a contractors or employees to do work or clean in your house, educate and inform them of the required BMPs, storm water discharge prohibitions, and wastewater requirements.
   B. Educate and train contractors and employees on site-specific drainage facilities such as locations of streets, gutters, storm drain inlets, v-ditches and other drainage courses.
   C. Educate contractors and employees on proper spill containment and cleanup methods.

3. **Use extra precautions when applying pesticides, herbicides, fungicides, fertilizers and soil amendments.**

   A. Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of pesticides and herbicides and training of applicators and pest control advisors.
   B. Follow manufacturers' recommendations and label directions.
   C. Do not apply pesticides if rain is expected or if wind speeds are above 5 mph.
   D. Do not mix or prepare pesticides for application near storm drains. Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the targeted pest.
   E. Whenever possible, use mechanical methods of vegetation removal rather than applying herbicides. Use hand weeding where practical.
   F. Do not apply any chemicals directly to surface waters, unless the application is approved and permitted by the state. Do not spray pesticides within 100 feet of open waters.
   G. Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.

H. Clean pavement and sidewalk if chemicals are spilled on these surfaces before applying irrigation water.
I. Implement storage requirements for pesticide products with guidance from the local fire department and/or County Agricultural Commissioner.
J. Dispose of empty containers according to the instructions on the container label.
K. When applying or supplementing plant material, soil or soil amendments, place temporary stockpiled material in existing planters or turf area away from watercourses, gutters and storm drain inlets.
L. Use sweeping and pick-up methods or vacuum all hardscape areas, including streets & gutters of all excess materials and debris. Do not wash these materials into the street, gutters or storm drains.

Other Beneficial Tips & Techniques

1. Pollution Prevention.

A. Keep site free of trash & debris. When doing routine landscape maintenance, pick-up and properly dispose of any trash, litter and other debris that may have accumulated in planters or other parts of the site to prevent them from entering the streets, gutters and storm drains.
B. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

The following pollution prevention principles apply to most industries:

- Affirmative Procurement - Use alternative, safer, or recycled products.
- Redirect storm water flows away from areas of concern.
- Reduce use of water or use dry methods.
- Reduce storm water flow across facility site.
- Recycle and reuse waste products and waste flows.
- Move or cover potential pollution from storm water contact.
- Provide on-going employee training in pollution prevention.

For more information, please contact:

City of Laguna Niguel
27801 La Paz Road
Laguna Niguel, CA 92677

Public Works Department 949.362.4337
Community Development Department 949.362.4360
Orange County 24 hr Water Quality Hotline: 714.567.6363
www.ocwatersheds.com www.ci.laguna-niguel.ca.us

R 5. Disposal of Pet Waste

The table below identifies activity-specific Best Management Practices (BMPs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs
1. Do not dispose of animal waste, animal food, or any other byproducts in the streets, gutters, storm drains, natural watercourses, or landscaping areas.
2. Pick up and dispose of animal waste regularly.
3. Prevent wash/rinse water from interior and exterior areas from entering the streets, gutters, storm drains, and natural watercourses.



Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Do not dispose of animal waste, animal food, or any other byproducts in the streets, gutters, storm drains, natural watercourses, or landscaped areas.**

   A. Use sweeping and pick-up methods or vacuum all hardscape areas, including streets & gutters of all animal waste, food, and other byproducts. Do not wash these materials into the street, gutters or storm drains.
   B. Dispose of animal waste, food products and other byproducts as garbage in appropriate trash containers for disposal to the landfill.

2. **Prevent wash/rinse water from interior and exterior areas from entering the streets, gutters, storm drains, and natural watercourses.**

   A. Wash pets in bathtubs, showers or other areas where the drains are plumbed to the sanitary sewer. Sweep or mop, rather than hose kennel and animal areas.
   B. Dispose of mop water from cleaning in a mop sink, toilet or other drain that is plumbed to the sanitary sewer.
   C. When possible, have pets groomed at a commercial facility.

3. **Pick up and dispose of animal waste regularly.**

   A. Pick-up on a regular basis and properly dispose of any animal waste in the planters or other parts of the site to prevent them from entering the streets, gutters and storm drains.
   B. While walking pets, carry bags, pooper-scoopers, or equivalent to safely pick up pet waste. Dispose of collected wastes properly in the trash or in a toilet.

Other Beneficial Tips & Techniques

1. Animal Care Products.

A. Consider using less toxic shampoos.
B. Properly use and dispose of flea control products, including collars, sprays and liquids.

2. Pollution Prevention Methods

A. Keep site free of trash & debris. Pick-up on a regular basis and properly dispose of any trash, litter, and other debris that may have accumulated in the planters, parking lot or other parts of the site to prevent them from entering the streets, gutters and storm drains.

For more information, please contact:

City of Laguna Niguel
27801 La Paz Road
Laguna Niguel, CA 92677

Public Works Department 949.362.4337
Community Development Department 949.362.4360
Orange County 24 hr Water Quality Hotline: 714.567.6363
www.ocwatersheds.com www.ci.laguna-niguel.ca.us

R 6. Disposal of Green Waste

The table below identifies activity-specific Best Management Practices (BMPs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs
1. Do not dispose of gardening waste (green waste) in the streets, gutters, storm drains, or natural watercourses.
2. Provide landscape contractor and gardener training.
3. Remove on a regular basis, any accumulated dead or dying vegetation and debris from on-site drainage devices, v-ditches and natural watercourses.



Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Do not dispose of gardening waste (green waste) in the streets, gutters, storm drains, or natural watercourses.**

   A. Use sweeping and pick-up methods or vacuum all hardscape areas, including streets & gutters of all grass clippings, leaves, sticks, and other collected vegetation. Do not wash these materials into the street, gutters or storm drains.
   B. Dispose of grass clippings, leaves, sticks, and other collected vegetation as garbage in appropriate trash containers, at the landfill or by using appropriate composting methods.
   C. Place temporary stockpiled material away from watercourses, gutters and storm drain inlets.

2. **Provide landscape contractor and gardener training.**

   A. If you hire a landscape contractor or gardener to take care of your landscaping, educate and inform them of the required BMPs, storm water discharge prohibitions, and wastewater requirements.
   B. Educate and train landscape contractors and gardeners on site-specific drainage facilities such as locations of streets, gutters, storm drain inlets, v-ditches and other drainage courses.
   C. Educate landscape contractors and gardeners on proper spill containment and cleanup methods.

3. **Remove on a regular basis, any accumulated dead or dying vegetation and debris from on-site drainage devices, v-ditches and natural watercourses.**

   A. Use sweeping and pick-up methods or vacuum all v-ditches, drainage swales and other hardscape drainage devices to remove grass clippings, leaves, sticks, and other collected vegetation. Do not wash these materials into the street, gutters or storm drains.
   B. Remove dead or dying vegetation from natural watercourses.

Other Beneficial Tips & Techniques

1. **Properly manage irrigation systems.**

   A. Irrigate slowly or pulse irrigate so the infiltration rate of the soil is not exceeded.
   B. Inspect irrigation system regularly for leaks and to ensure that excessive runoff is not occurring.
   C. If re-claimed water is used for irrigation, ensure that there is no runoff from the landscaped area(s).
   D. If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.

E. Use automatic timers to minimize runoff.
F. Use popup sprinkler heads in areas with a lot of activity or where pipes may be broken. Consider the use of mechanisms that reduce water flow to broken sprinkler heads.

2. Reduce landscape maintenance requirements.

A. Where feasible, retain and/or plant native vegetation with features that are determined to be beneficial. Native vegetation usually requires less maintenance than planting new vegetation.
B. When planting or replanting consider using low water use flowers, trees, shrubs, and groundcovers.

3. Use mulch or other erosion control measures on exposed soils.

4. Pollution Prevention.

A. Keep site free of trash & debris. When doing routine landscape maintenance, pick-up and properly dispose of any trash, litter and other debris that may have accumulated in planters or other parts of the site to prevent them from entering the streets, gutters and storm drains.

B. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

The following pollution prevention principles apply to most industries:

- Affirmative Procurement - Use alternative, safer, or recycled products.
- Redirect storm water flows away from areas of concern.
- Reduce use of water or use dry methods.
- Reduce storm water flow across facility site.
- Recycle and reuse waste products and waste flows.
- Move or cover potential pollution from storm water contact.
- Provide on-going employee training in pollution prevention.

R 7. Household Hazardous Waste

The table below identifies activity-specific Best Management Practices (BMPs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are the minimum designated BMPs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs	
1.	Do not dispose of household hazardous waste in the streets, gutters, storm drains, or natural watercourses.
2.	Clean up leaks and spills immediately.
3.	Properly store and handle chemical materials.



Only Rain in the Storm Drain.
The Ocean begins at your front door.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. **Do not dispose of household hazardous waste in the streets, gutters, storm drains, or natural watercourses.**

   A. Properly dispose of household hazardous waste at the Prima Deschecha HHW Collection Center. For details, visit their web site www.oclandfills.com or call (714) 834-6752 for recorded information.
   B. Properly dispose of used motor oil at a used oil recycling center or at the above mentioned HHW Collection Center.
   C. Clean paint brushes and tools in sinks connected to sanitary sewers or in portable containers that can be dumped into a sink, toilet, or other drain that is plumbed to the sanitary sewer.
   D. Paint brushes and tools covered with non-water based materials must be cleaned in a manner that enables collection of uses solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.

2. **Clean up leaks and spills immediately.**

   A. Utilize dry cleaning methods to clean up spills to minimize the use of water. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste. Physical methods for the cleanup of dry chemicals include the use brooms, shovels, sweepers, or plows.
   B. Place a stockpile of spill cleanup materials where they will be readily accessible (e.g. near storage and maintenance areas).
   C. If pressure washing, use a collection device that enables collection of wash water and associated solids. Use a sump pump, wet vacuum or similarly effective device to collect runoff and loose materials. Dispose of collected runoff and solids properly. Never hose down or bury dry material spills.
   D. Clean up chemical materials with absorbents, gels, and foams. Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
   E. For larger spills, a private spill cleanup company or Hazmat team may be necessary.

3. **Properly store and handle household chemicals.**

   A. Store materials indoors or under cover to prevent exposure to rain or wind.
   B. Keep household chemicals in their original containers, if feasible.
   C. Keep containers well labeled according to their contents (e.g., solvent, gasoline).
   D. Label hazardous substances regarding the potential hazard (corrosive, radioactive, flammable, explosive, poisonous).
   E. Prominently display required labels on transported hazardous and toxic materials (per US DOT regulations).

Other Beneficial Tips & Techniques

1. Reporting

A. Report spills that pose an immediate threat to human health or the environment to local agencies. Emergencies related to HHW, call 911.

B. Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour).

2. Pollution Prevention.

A. Keep storage areas free of trash & debris. Properly dispose of any trash, litter and other debris that may have accumulated around the processing area, parking lot, landscape planters or other parts of the site to prevent them from entering the streets, gutters and storm drains.

B. Consider pollution prevention measures at all times for improving pollution control. Implementation of pollution prevention measures may reduce or eliminate the need to implement other more costly or complicated procedures.

The following pollution prevention principles apply to most industries:

- Affirmative Procurement - Use alternative, safer, or recycled products.
- Redirect storm water flows away from areas of concern.
- Reduce use of water or use dry methods.
- Reduce storm water flow across facility site.
- Recycle and reuse waste products and waste flows.
- Move or cover potential pollution from storm water contact.
- Provide on-going employee training in pollution prevention.

B. Eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous material:

- Use non-caustic detergents instead of caustic cleaning for parts cleaning.
- Use a water-based cleaning service and have tank cleaned. Use detergent-based or water-based cleaning systems in place of organic solvent degreasers.
- Replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check list of active ingredients to see whether it contains chlorinated solvents.
- Choose cleaning agents that can be recycled.

For more information, please contact:

City of Laguna Niguel
27801 La Paz Road
Laguna Niguel, CA 92677

Public Works Department 949.362.4337
Community Development Department 949.362.4360
Orange County 24 hr Water Quality Hotline: 714.567.6363
www.ocwatersheds.com www.ci.laguna-niguel.ca.us

R 8. Irrigation Runoff

The table below identifies activity-specific Best Management Practices (BMPs) that are appropriate to prevent or mitigate pollution generated from the subject activity. These are minimum designated BMPs that must be implemented to eliminate prohibited discharges and limit impact on water quality to the maximum extent practicable. Below the matrix and following each BMP, is a listing of suggested implementation strategies to consider that may help achieve compliance with the minimum designated BMPs. However, please be aware that satisfaction of these strategies by themselves does not necessarily guarantee compliance with the minimum designated BMPs. Additional actions and efforts may be needed to fully achieve compliance with the minimum designated BMPs. The "Other Tips & Techniques" Section provides additional items to consider that promote pollution prevention, conservation and good house keeping ideas that ultimately benefit water quality and our environment.

Minimum Designated Best Management Practices BMPs	
1.	Implement all feasible measures to reduce and eliminate surface runoff of irrigation water.
2.	Comply with water conservation, drought response and waste prohibition regulations of the water district.

Suggested Implementation Strategies for Minimum Designated Best Management Practices (BMPs)

1. <u>Implement all feasible measures to reduce and eliminate surface runoff of irrigation water.</u>

A. Ensure that persons responsible for landscape maintenance are aware of irrigation management techniques for pollution prevention.
B. Replace irrigation controller batteries in the spring and fall.
C. Inspect the irrigation system regularly, while it is operating, to identify leaks and to determine if runoff is occurring.
D. Promptly repair any leaks or breaks. If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.
E. Adjust sprinkler heads and nozzles to avoid over-spray onto pavement and/or other impervious areas.
F. Irrigate slowly or pulse irrigate so the infiltration rate of the soil is not exceeded. This can occur in less than 2 minutes depending on landscaping, soil type and topography.

G. Adjust the watering schedule seasonally to reflect reduced winter water demand.
H. Do not water when rain is predicted, or when the ground is already moist from rainfall.

2. <u>Comply with water conservation, drought response and waste prohibition regulations of the water district.</u>

A. Adhere to the watering schedule restrictions designated by the water district, as appropriate to drought conditions. For more information on water district requirements contact Moulton Niguel Water District at (949) 831-2500 or visit their website at www.mnwd.com.

Other Beneficial Tips & Techniques

1. <u>Consider upgrading irrigation system components to increase irrigation efficiency and reduce runoff.</u>

A. Replace old timer-based irrigation controllers with new evapotranspiration-driven self-adjusting controllers.
B. Install sprinkler heads with a low precipitation rate and/or a more adjustable spray pattern or radius as needed.
C. Install popup sprinkler heads in areas with a lot of activity and/or where risers may be broken.
D. Install water-efficient drip irrigation systems for trees, shrubs and flowers.
E. Install a sensor that will reduce flow in case of breakages in the system.
F. Install an automatic rain shut-off sensor.
G. Install check valves for sprinkler heads at the bottom of slopes to eliminate low-head drainage.

2. <u>Consider reducing the need for irrigation.</u>

A. Add 2-3 inches of mulch around trees and plants to minimize runoff and reduce evaporation.
B. Replace turf areas adjacent to pavement and/or other impervious areas with drought tolerant shrubs and groundcover.



Only Rain in the Storm Drain.
The Ocean begins at your front door.

For more information, please contact:

City of Laguna Niguel
27801 La Paz Road
Laguna Niguel, CA 92677

Public Works Department 949.362.4337
Community Development Department 949.362.4360
Orange County 24 hr Water Quality Hotline: 714.567.6363
www.ocwatersheds.com www.ci.laguna-niguel.ca.us

EXHIBIT 9.II

INSPECTION FORM

EXHIBIT 9.III

COMMERCIAL AND INDUSTRIAL FACILITIES INVENTORY MAP

Commercial Areas

Watershed Boundary

J - Aliso Creek

Pacific Park Dr

Aliso Creek Rd

Moulton Pkwy

La Paz Rd

Alicia Pkwy

Cabot Rd

73

5

Paseo De Colinas

Crown Valley Pkwy

Camino Los Padres

Marina Hills Dr

Niguel Rd

Pacific Island Dr

K - Dana Point

Camino Del Avion

L - San Juan Creek

EXHIBIT 9.III

COMMERCIAL INVENTORY AREAS*

* No Industrial Inventory

City of Laguna Niguel GIS Geographic Information System

03/15/2017

Document Path: Q:\GISDATA\NPDES\permit\2017\ex.9III.ComINV.mxd

EXHIBIT 9.IV

RESIDENTIAL MANAGEMENT AREAS MAP

Residential Areas
Residential Management Areas (RMA)
Watershed Boundary

J - Aliso Creek

Pacific Park Dr
J01
J02
J03
Aliso Creek Rd
Moulton Pkwy
La Paz Rd
Alicia Pkwy
J04
J05
J09
J11
J06
J12
Golden Lantern
Paseo De Colinas
Cabot Rd
L03
5
73
J08
Crown Valley Pkwy
J10
L02
Camino Los Padres
J07
J13
K06
K03
Marina Hills Dr
Niguel Rd
K05
K07
Pacific Island Dr
K02
K01
K04
K08
K09
K10
L01
K11
K - Dana Point
Camino Del Avion
L - San Juan Creek

EXHIBIT 9.IV

RESIDENTIAL MANAGEMENT AREAS

03/16/2017

Document Path: Q:\GISDATA\NPDES\permit\2017\ex.9IV-RMA.mxd

10.0 ILLEGAL DISCHARGES/ILLICIT CONNECTIONS

10.1 INTRODUCTION

This section describes the City's process through which illegal discharges and illicit connections to the MS4 are actively detected and eliminated, in compliance with Provision E.2 of the Fifth Term Permit. The program addresses all types of illegal discharges and illicit connections, excluding non-stormwater discharges not prohibited by the City in accordance with the Permit, and those discharges that are authorized and regulated by a separate NPDES permit. Section 10 of the Countywide DAMP is used as a key reference for this program.

In order to ensure that this program is comprehensive and effective, it is integrated with the municipal, residential, commercial, industrial, and construction inspection programs (LIP Sections 5, 8, and 9); public education program (LIP Section 6); new development and significant redevelopment program (LIP Section 7); and, the Jurisdictional Work Plan (LIP Section 3). Illegal discharges and illicit connections that are discovered as a result of integrated efforts will be addressed pursuant to this Section. Relevant legal authorities pursuant are detailed in Section 4 of this LIP. Relevant training of City staff and contractors is also discussed in Section 6.

10.1.1 Overall Program Structure

The City's Public Works and Community Development Departments are responsible for implementing and enforcing this Section, under the direction of the City's NPDES Program Manager. An organization chart is included in Section 2.

Authorized Inspectors

Authorized inspectors are City employees, including Code Enforcement, Building Inspectors and Public Works staff and inspectors, including contracted staff, assigned to duties involving permits and other City approvals, inspections, investigations, and enforcement related to this Section.

Spill Responders

Spill Responders are designated by the City Manager on immediate response to accidental spills, leaks, or prohibited discharge of pollutants requiring clean-up. The City's street maintenance and emergency response contractor supports this function in the City, under the direction of and in coordination with the Program Manager and Authorized Inspectors. Spill response activities by the City's contractor are coordinated with the Orange County Fire Authority and/or the separate water, sewer, or power utilities where necessary for public safety.

Enforcing Attorney

The City Attorney functions as legal counsel for the City as described in Section 4 of this LIP. For the purpose of criminal prosecution, the Orange County District Attorney or designee will

act as the Enforcing Attorney pursuant to the duly executed Agreement for Prosecution Services between the City and the County of Orange.

OC Hazardous Materials Strike Force

The Strike Force is a multi-jurisdictional committee that provides tactical, logistical, and training support for the investigation and enforcement of environmental regulations through the Orange County District Attorney's office. The City utilizes this network of support for assistance in investigations and enforcement proceedings when necessary.

Water Quality Ordinance Implementation Agreement
The City has entered into a Water Quality Ordinance Implementation Agreement with the County of Orange and the Orange County Flood Control District (OCFCD), which allows the City to utilize the OCFCD Authorized Inspectors to provide high-end scientific, technical, enforcement and remediation/clean-up that the City may be unable to provide. Under the agreement, the City can request responses after or during normal business hours to hazardous waste and highly technical incidences through the County's Water Pollution Reporting number at 1(877)89-SPILL .

10.2 PREVENTION AND DETECTION

On-going activities that assist in the prevention and detection of illegal discharges and illicit connections include:

- Maintenance of necessary legal authorities, including enforcement mechanisms and prohibitions of illegal discharges and illicit connections (LIP Section 4).
- Application of development guidance, processes, standards, and requirements to prevent illegal discharges and illicit connections (LIP Section 7).
- Inspection of municipal, residential, commercial, and industrial facilities, as well as construction projects (LIP Sections 5, 8, and 9).
- Water quality monitoring, including dry weather field screening and analytical monitoring to detect illegal discharges and illicit connections (Chapter B.4 of WQIP).
- GIS mapping of the MS4, including drains and corresponding drainage areas, in order to help facilitate preventative and response efforts. A basic map is included in Section 5 as Exhibit 5.V.
- Training of City field operations staff and contractors to appropriately report suspected illegal discharges and illicit connections. (LIP Section 6)
- Promotion of the countywide water pollution reporting hotline: 1-(877)-89-SPILL (LIP Section 6). The hotline is capable of receiving reports in both English and Spanish, 24 hours per day, and seven days per week.

- Implementation of education, public information and other activities to facilitate the proper management and disposal of used oil and toxic materials, as well as awareness of discharge/connection prohibitions (LIP Section 6).

- Coordination with the Moulton Niguel Water District (MNWD) to publicize water conservation regulations and penalties and City ordinances prohibiting landscape irrigation runoff;

- Promotion of the City's public reporting mechanisms via phone and email, and tracking via the City's Complaint Response System for observed illicit discharges, including observed irrigation runoff incidents (LIP Sections 6 and 9). Callers to the City are referred to the Authorized Inspector or Code Enforcement Officers for follow-up during business hours, or after hours to Police Services, whose dispatcher notifies the appropriate responder (i.e. the City's spill response contractor, Orange County Fire Authority, or MNWD).

- Participation, as applicable, in the OC Hazardous Materials Strike Force.

10.3 INVESTIGATION

Suspected illegal discharges and illicit connections are investigated in accordance with the City's Enforcement Response Plan in Exhibit 4.IV.

10.3.1 Source Investigations

The City's Authorized Inspectors conduct source investigations when illegal discharges or illicit connections are detected or suspected and sources are not readily identifiable. The purpose of source investigations is to locate the cause and place of origin of illegal discharges or illicit connections so that enforcement and elimination measures can be implemented.

Once an Authorized Inspector is notified of a potential problem and determines that a source investigation is warranted, the approach used for tracking a pollutant source upstream or identifying an illicit connection will primarily involve the steps as outlined in Section 10.4.2 of the DAMP, including:

- Step One – Initial Screening
- Step Two – Source Evaluations and Inspections
- Step Three – Monitoring
- Step Four – Document, Notify and Report

10.3.2 Documentation

Thorough and accurate documentation will be maintained by the Authorized Inspector throughout the investigation process to ensure that an accurate record is maintained and legal/evidentiary requirements are met. Documentation is also intended to ensure that the required regulatory reporting is completed, enforcement and cost recovery actions can be justified, repeat offenders and other areas of concern can be identified, program improvements can be made, and program effectiveness assessments can be prepared.

Investigative documentation includes:

- Initial notification or investigation/response request
- The location and specific details about the complaint
- Information about the alleged responsible party
- The results of the investigation
- The actions that were taken as a result

Additional documentation may include interviews, photographs, samples, observation notes, and other information relevant to the investigation.

10.4 ELIMINATION AND ENFORCEMENT

Enforcement is undertaken in order to compel the elimination of illegal discharges and illicit connections, and to penalize offending parties. Enforcement actions are conducted in accordance with the City's Water Quality Ordinance and the City's Enforcement Response Plan (Exhibit 4.IV). Violations may be handled administratively or as criminal cases.

10.4.1 Choosing the Type of Enforcement

The City's Enforcement Response Plan (Exhibit 4.III) establishes a framework for selecting the type of enforcement action that should be pursued. Some of the factors that influence this decision include the duration and significance of the violation, the cooperativeness and willingness of the responsible party(ies) to remedy the violation, whether the violation is isolated or recurring, and whether the violation will affect or harm human health or the environment. Although the discussion in subsequent sections provides some guidelines on the use of enforcement tools, the City's Enforcement Response Plan is the primary tool for enforcement procedures and processes and is consulted when enforcement options are being considered or appeals of enforcement remedies have occurred.

10.4.2 Verbal Warnings and Educational Letters

A verbal waring or an educational letter may be used in appropriate situations, including:

- When an Authorized Inspector believes that the water pollution complaint may be valid, but does not have evidence to substantiate it;

- When a first complaint is received by the City in regard to landscape irrigation runoff; and/or

- When a second party, or resident, hires a contractor who causes an incident. In this case the contractor may receive the administrative remedy, while the resident may receive a warning or educational letter.

Authorized Inspectors are authorized to draft letters tailored to specific incidents and will include educational materials or brochures, as appropriate. The Authorized Inspector may also include a Notice of Noncompliance/Notice of Violation as described in Section 10.4.3.

10.4.3 Administrative Remedies

Notice of Noncompliance/Notice of Violation

Notice of Noncompliance/Notices of Violation (NNC/NOVs) are issued pursuant to the Laguna Niguel Municipal Code in instances where a party did not personally cause the violation, and/or is unaware that the violation is occurring in a manner or place which would render the party responsible; and for second or subsequent documented complaints of landscape irrigation runoff. NNC/NOVs do not include civil fines. For landscape irrigation runoff violations, the NNC/NOV may include a self-certification affidavit to be returned to City, confirming correction of the problem.

Notices of violation are also issued by the MNWD, pursuant to the District's water waste prohibition regulations, when irrigation runoff complaints are received by the MNWD, or if they are referred to the MNWD by the City for follow-up as documented landscape irrigation runoff violations. Follow-up by MNWD may include consultation with the landowner and offering of recommendations for corrective actions; imposition of fines for subsequent violations; or misdemeanor action. Fines are charged on the violator's regular water bill.

Administrative Compliance Orders

Administrative compliance orders are issued pursuant to the Laguna Niguel Municipal Code in instances where a violation exists, but the condition cannot be remedied within a relatively short period of time; the owner of the property or facility operator has indicated willingness to comply by meeting milestones established in a reasonable schedule; and, the violation does not pose an immediate threat. An Administrative Compliance Order is a progressively more severe enforcement in those instances where a previously issued Verbal Warning, Education Letter or Notice of Noncompliance has failed to achieve compliance.

Cease and Desist Orders

Cease and desist orders are issued pursuant to the Laguna Niguel Municipal Code when immediate action of the responsible party is necessary to stop a violation of the Runoff Water Quality Ordinance and/or as a first step in ordering the removal of nuisance conditions, which threaten to cause an unauthorized discharge of pollutants if exposed to rain or surface water runoff.

Administrative Nuisance Abatement

Any condition in violation of the Runoff Water Quality Ordinance, including the maintenance or use of any illicit connection or the occurrence of any illegal discharge, constitutes a threat to public health, safety, and welfare, and may be declared and deemed a nuisance pursuant to

Government Code Section 38771. Nuisances are addressed as described in the Laguna Niguel Municipal Code.

Invoice for Costs

The City's Water Quality Ordinance authorizes an Authorized Inspector to deliver an Invoice for Costs to any responsible party for the actual costs incurred by the City in issuing and enforcing any Notice of Noncompliance, Administrative Compliance Order, Cease and Desist Order, or Administrative Abatement order.

Stop Work Orders

Similar to a Cease and Desist Order and typically used for active construction projects, the City may stop work by written notice whenever any work is being done contrary to applicable City permit requirements or codes.

Permit Revocation or Denial

The City may revoke permits (e.g. building or grading) that a responsible party is working under or deny future permits.

Enforcement of Contracts

If a contractor is performing work for the City, then the City may use the provisions within the contract for enforcement of noncompliance.

Administrative Citations

Administrative citations carrying civil fines are issued pursuant to Section 1.06 of the Laguna Niguel Municipal Code in instances where a party is violating, causing and/or maintaining a violation of the Runoff Water Quality Ordinance.

Other Administrative Remedies

When a violation is related to the City's issuance of a local permit in accordance with the Water Quality Ordinance, administrative proceedings to suspend, revoke, or modify the permit may occur pursuant to City policy and ordinance, as applicable.

Other Civil Actions

Authorized Inspectors will consult with the Enforcing Attorney in matters of continuing or emergency nuisance and, at the discretion of the City Manager and/or Enforcing Attorney, a civil injunction may be sought or other civil proceeding may be brought in accordance with the Water Quality Ordinance.

10.4.4 Criminal Remedies

Criminal enforcement is appropriate when evidence indicates that the violator has acted willfully with intent to cause, allow to continue, or conceal an illegal discharge or illicit connection in violation of the Water Quality Ordinance.

Prosecutor

The Enforcing Attorney may act on the request of the City Manager to pursue criminal enforcement in accordance with City policy and code.

Infractions

At his/her discretion, the Enforcing Attorney may treat misdemeanor acts as infractions. Factors that may be considered, include:

- The duration of the violation or threatened violation
- The compliance history of the person, business or entity
- The effort made to comply with an established compliance schedule
- The existence of prior enforcement actions
- The actual harm to human health or the environment from the violation

Misdemeanors

The Enforcing Attorney may treat acts involving negligently or knowingly violating the Water Quality Ordinance, undertaking to conceal a violation, continuing a violation after notice thereof, or violating the terms, conditions and/or requirements of any local permit issued pursuant to the Water Quality Ordinance, as misdemeanors.
Criminal Citations

Where criminal enforcement is indicated, the Orange County Sheriff's Department may cause issuance of a criminal citation to the offending party pursuant to California Penal Code Sections 853.5, 853.6, and/or 853.9.

10.5 NON-SEWAGE SPILL INCIDENT RESPONSE

In addition to the prevention and detection of illegal discharges and illicit connections, this program provides a framework for responses to spills and active water pollution incidents. Sewage spills/incidents are discussed separately in Section 10.6 due to the heightened regulatory environment and specialized efforts often required.

10.5.1 Incident Response

Diagrams depicting the general response to spills/incidents are attached to this Section as Exhibit 10.I through 10.X. The exhibits provide concepts of operations beginning with the discovery or notification of an incident through clean-up and enforcement actions. After receiving notification of a non-sewage spill/incident within the City's jurisdiction, it is referred to an Authorized Inspector or Spill Responder, as appropriate. After hours reports of non-sewage spills/incidents can be made to the Orange County Sheriff's Department, Control 1 (1-

714-628-7008), for dispatch to the City and the Orange County Fire Authority, as appropriate. Response efforts are conducted as soon as possible and in accordance with DAMP Section 10 and the DAMP Investigative Guidance Manual. Response generally includes the following elements:

- On-Scene Assessment
- Field Notifications and Requests for Assistance
- Control and Containment
- Investigation
- Clean-Up

On-Scene Assessment

Upon arriving at the scene of the non-sewage spill/incident, the Authorized Inspector or Spill Responder will conduct an assessment to determine jurisdiction, potential impacts, type of response required, assignment of responsibilities, and observable violations.

Field Notifications and Requests for Assistance

Based on the on-scene assessment, field notifications and requests for assistance will be made, as necessary, including:

- *Agency notifications* – Government agencies, special districts, and other entities (e.g., property owners) with response jurisdiction.
- *Requests for assistance* – In the event that the non-sewage spill/incident requires resources beyond the City's, it may be necessary to request outside assistance.

Regulatory reporting (e.g., regional water quality control boards) is discussed in Section 10.5.2 and typically occurs after field notifications and requests for assistance.

Control and Containment

The City contracts with outside agencies, including OC Public Works and the Orange County Fire Authority, for control and containment services. The MNWD responds to non-sewage spills/incidents related to potable and recycled water service facilities. Outside agencies employ control, containment, and documentation procedures described in greater detail in their individual spill/incident response plans.

Investigation

The Authorized Inspector will conduct an investigation of non-sewage spills/incidents in order to facilitate future prevention and enforcement activities. Investigations will be conducted as outlined in the DAMP Investigative Guidance Manual, which includes specific information on interviewing, photographs, and sample collection, and more. Thorough and accurate documentation will be maintained by the Authorized Inspector throughout the investigation process to ensure that an accurate record is maintained and legal/evidentiary requirements are met. Documentation is also intended to ensure that the required regulatory reporting is

completed, enforcement and cost recovery actions can be justified, repeat offenders and other areas of concern can be identified, program improvements can be made, and program effectiveness assessments can be prepared. Investigation documentation includes:

- Information on how the City was notified
- Agency notifications and requests for assistance made
- The location and specific details about the spill/incident
- Information about the alleged responsible party
- The results of the investigation
- The actions that were taken as a result

Additional documentation may include interviews, photographs, samples, observation notes, and other information relevant to the investigation.

Clean-Up

In preparation for the clean-up phase of the response, the Authorized Inspector or Spill Responder will evaluate the resources necessary to perform the clean-up and initiate mobilization of the necessary resources. Clean-up actions will be taken to restore the impacted area back to its original state (to the maximum extent practicable) and prevent further environmental degradation in the surrounding areas. Trauma scene waste (e.g., blood and human tissue) that is encountered at non-sewage spills/incidents will be dealt with as outlined in Section 10.3.5.1 of the DAMP.

10.5.2 Regulatory Reporting

Regulatory reporting for non-sewage spills/incidents is the responsibility of the City's Authorized Inspector as described in Exhibit 10.II attached to this Section. A sample Pollution Notification/Investigation Request (PNIR) Form is included in the DAMP and may be used as a guideline for regulatory reporting.

10.6 SEWAGE SPILL INCIDENT RESPONSE

The Statewide General Waste Discharge Requirements for Sanitary Sewer Systems (State Water Resources Control Board, Order No. 2006-0003 and amending by Order No. 2013-0058-EXEC) and other orders promulgated by the State Water Resources Control Board and Regional Water Quality Control Boards assign responsibilities relative to sanitary sewer overflows to the owners and operators of sanitary sewer systems. These orders influence sewage spill/incident response.

10.6.1 Program Responsibilities

MNWD (an independent special district) operates and maintains the public wastewater and sanitary sewer system within the City. The District is responsible for monitoring, inspection, maintenance, operation, and cleaning of their wastewater and sanitary sewer systems. The MNWD is also responsible for activities necessary to prevent, respond to, contain, and clean-up sewage spills/incidents originating from their wastewater and sanitary systems, including

systems that collect and convey wastewater to publicly owned treatment facilities. It is the MNWD's standard operating policy to respond to all sewage spills/incidents from private systems, as well. The City cooperates with the MNWD in order to maximize water quality protection.

10.6.2 Management Measures

The City and MNWD maintain a cooperative partnership and a shared commitment to water quality protection. Management measures implemented by the City that relate to sewage spills/incidents, include:

- The MNWD's sewage spill/incident response procedures include promptly notifying the City's Code & Water Quality Enforcement of sewage spills (including from private laterals and failing septic systems) that occur in the City. City staff and/or subcontractors are available for on-scene coordination and prevention of discharge to the MS4, as necessary.
- Provision of the MNWD with 24-hour contact information for the City Manager, Public Works Director, City Emergency personnel and NPDES Authorized Inspector.
- The City conditions approval of projects that involve sanitary sewer facilities on conformance with plumbing codes and approval by the MNWD.
- The City conditions approval of food service establishment projects on compliance with the District's Fats, Oils, and Grease Regulations, which are intended to prevent blockages of sewer lines resulting from discharges of fats, oils, and grease into the sewer system.
- The City publishes articles on pollution prevention in its quarterly newsletters to residents. Content includes public education information that may help prevent and facilitate proactive identification of sewage spills/incidents.

10.6.3 Response

Pursuant to the Statewide General Waste Discharge Requirements for Sanitary Sewer Systems, the MNWD is responsible for responding to, containing, and cleaning up sewage spills/incidents originating from their wastewater and sanitary systems, including systems that collect and convey wastewater to publicly owned treatment facilities. It is the District's standard operating policy to respond to all sewage spills/incidents from private systems, as well. The District has implemented an overflow emergency response plan that is used during sewage spills/incidents.

In the event that notification of a sewage spill/incident within the City's boundaries is received by the City, staff will notify the MNWD immediately via their 24-hour hotline at (949) 837-0660.

Regulatory reporting for sewage spills/incidents is the responsibility of the MNWD as owner and operator of the sanitary sewer system. California Health and Safety Code Section 5411.5 requires that all sewage spills be immediately reported to the Orange County Health Care Agency, at (714) 433-6000 during working hours, or after hours through the County Communications number (714) 628-7008. RWQCB Order No. 96-50 further requires that sewage

dischargers report spills of at least 1,000 gallons, or to surface waters (all, of any volume), within 24-hours by FAX or telephone.

10.7 REPORTING

If a spill, leak or illegal dumping is determined to pose a threat to human or environmental health, the City reports this information to the RWQCB by phone or e-mail within 24 hours of the discovery followed by a written report within 5 days.

Proposition 65 Notification – Health and Safety Code 25180.7 provides that any illegal discharge of a hazardous waste likely to cause substantial injury to public health or safety, must within 72 hours be reported to the local health officer, or the Proposition 65 Hotline at (714) 433-6401 or fax (714) 754-1768.

The City submits an Annual Report each year to the Principal Permittee and RWQCB, including information detailing the City's efforts in prevention, elimination and enforcement of illegal discharges and illicit connections (ID/IC). The Annual Report includes:

- Summaries of any changes or updates to the City's legal authority to implement ID/IC activities, the established investigation procedures, the public reporting mechanisms, or the MS4 GIS mapping layers;
- The numbers of IC/ID inspections, detections by City or monitoring staff or the public, IC/ID eliminations, violations, and types of enforcement actions taken;
- Summaries of how each significant IC/ID case was resolved; and
- A description of the effectiveness of enforcement measures taken in response to IC/ID investigations.

EXHIBIT 10.I THROUGH EXHIBIT 10.VIII

INCIDENT RESPONSE

10.I	Notification and Response Procedures
10.II	Agency Notification List
10.III	Recommended Field Investigation Equipment and Supplies
10.IV	Water Quality Problems and Illicit Discharge Investigations
10.V	Authorized Inspectors Field Spill Response Procedures
10.VI	MS4 Permittee Sewage Spill Response Procedure
10.VII	Pollution Notification/Investigation Request Form
10.VIII	Enforcement Flow Chart

Exhibit 10.I

City of Laguna Niguel

NOTIFCATION/RESPONSE PROCEDURES

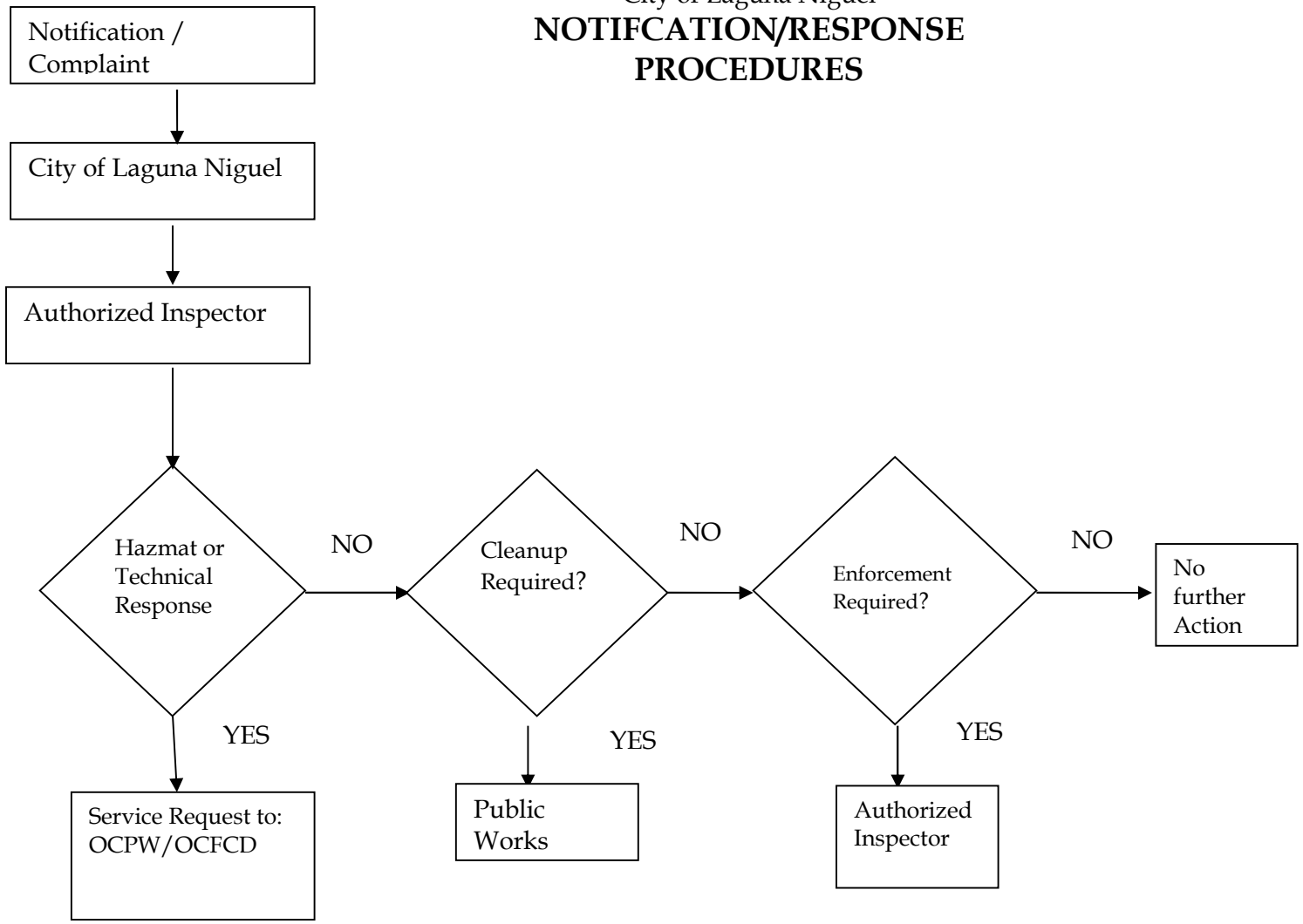


Exhibit 10.II Agency Notification List	
Situation	**Notify**
Emergency	Local Fire Dept. – 911 State OES: Sacramento - (800) 852-7550 Control One – (714) 628-7000 National Response Center – (800) 424-8802
Water	RWQCB: San Diego - (858) 467-2952
Stormdrain/Flood channels	Orange County Public Works – (877) 89-SPILL
Creeks & streams	California Department of Fish and Wildlife - (858) 467-4201
Bay, harbor, ocean	United States Coast Guard - (562) 980-4444
Hazardous waste	Orange County Health Care Agency (HCA) - (714) 667-3700
Private property	Certified Unified Program Agency (CUPA) Prop. 65 HCA - (714) 667-3765
Air	Air Quality Management District (AQMD) - (909) 396-2360
Soil	Department of Toxic Substance Control (DTSC) - (714) 484-5396
Sewage Local Sanitary District	South Orange County Wastewater Authority (SOCWA) – (949) 234-5400 Moulton Niguel Water District (MNWD) – (949) 831-2500
Criminal offense	District Attorney - (714) 347-8716

(2 Pages)

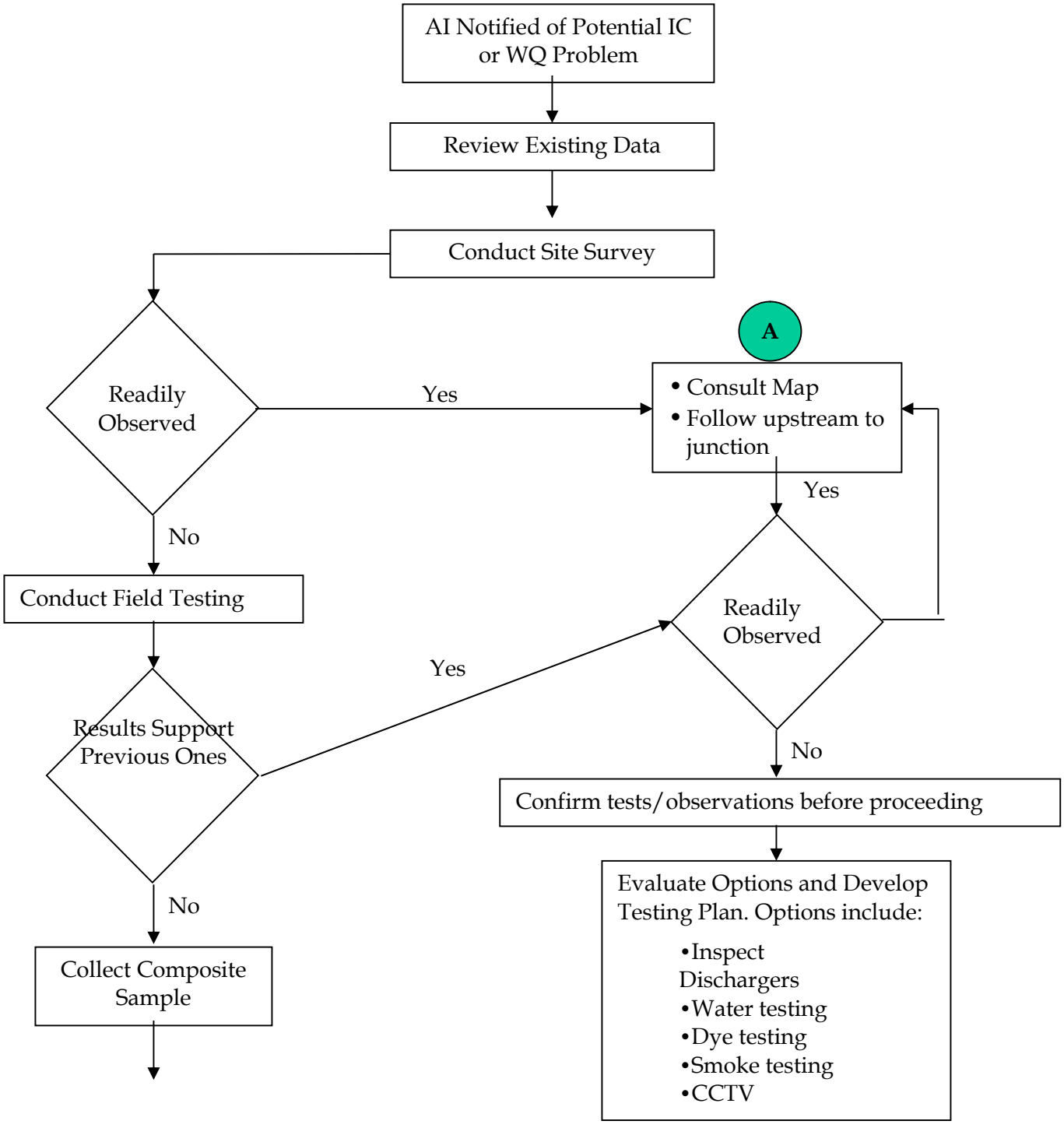
Exhibit 10.III Recommended Field Investigation Equipment and Supplies			
Activity	**Equipment/Supplies**	**# of Items**	**Location**
Safety	Latex gloves Leather gloves Protective eyeglasses or goggles Rubber boots Elbow length nitrite gloves Gas monitor (optional and dependent on investigation) First aid kit Steel toed boots Drinking water Hat		
Field Equipment	Measuring tape (measure pipe diameter) Cell phone/radio Paper towels Duct tape Bungee cords Folding ruler (measure flow depth) Styrofoam peanuts (measure flow velocity) Plastic bucket and rope Sampling rod to collect samples Extra batteries for all meters Manhole cover puller		
Field Screening Analysis	Portable field kits-colorimeters, and all reagents kit (optional) Storm water pollutant screening pH paper Sample bottles Multi-parameter or individual probes for temperature, conductivity, and pH Deionized water Waste disposal bottles		
Laboratory Analysis	Sample bottles with labels and preservatives Cooler with ice or cold packs		
	Chain of custody forms Sample collection equipment described above		
Documentation	Camera (digital preferred) Field notebook Pens- pencils		

(2 Pages)

Exhibit 10.III Recommended Field Investigation Equipment and Supplies			
Activity	**Equipment/Supplies**	**# of Items**	**Location**
	Notice of Violation forms Educational materials Clipboard Inspection forms		
Reference Materials	MS4 map Street map Emergency contact phone numbers		

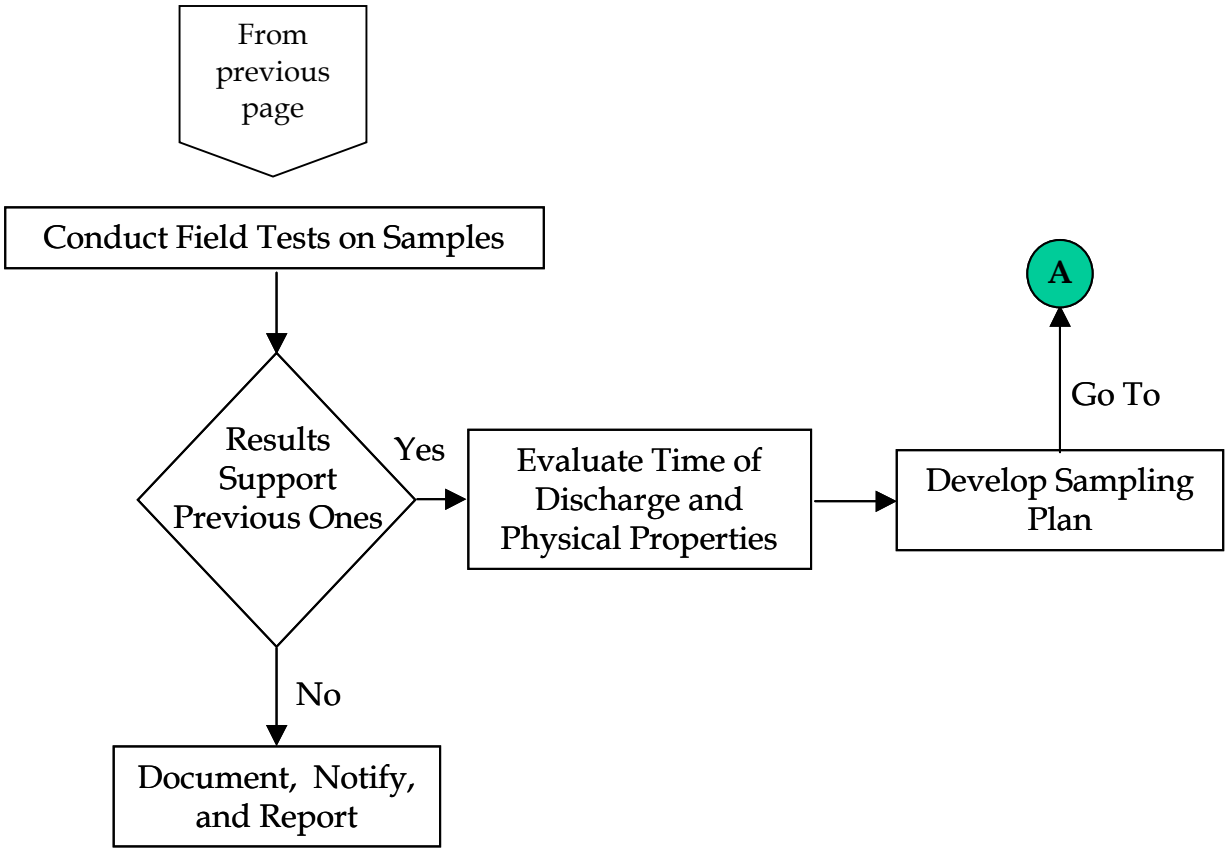
(2 pages)

Exhibit 10.IV
Water Quality Problems and Illicit Discharge Investigations



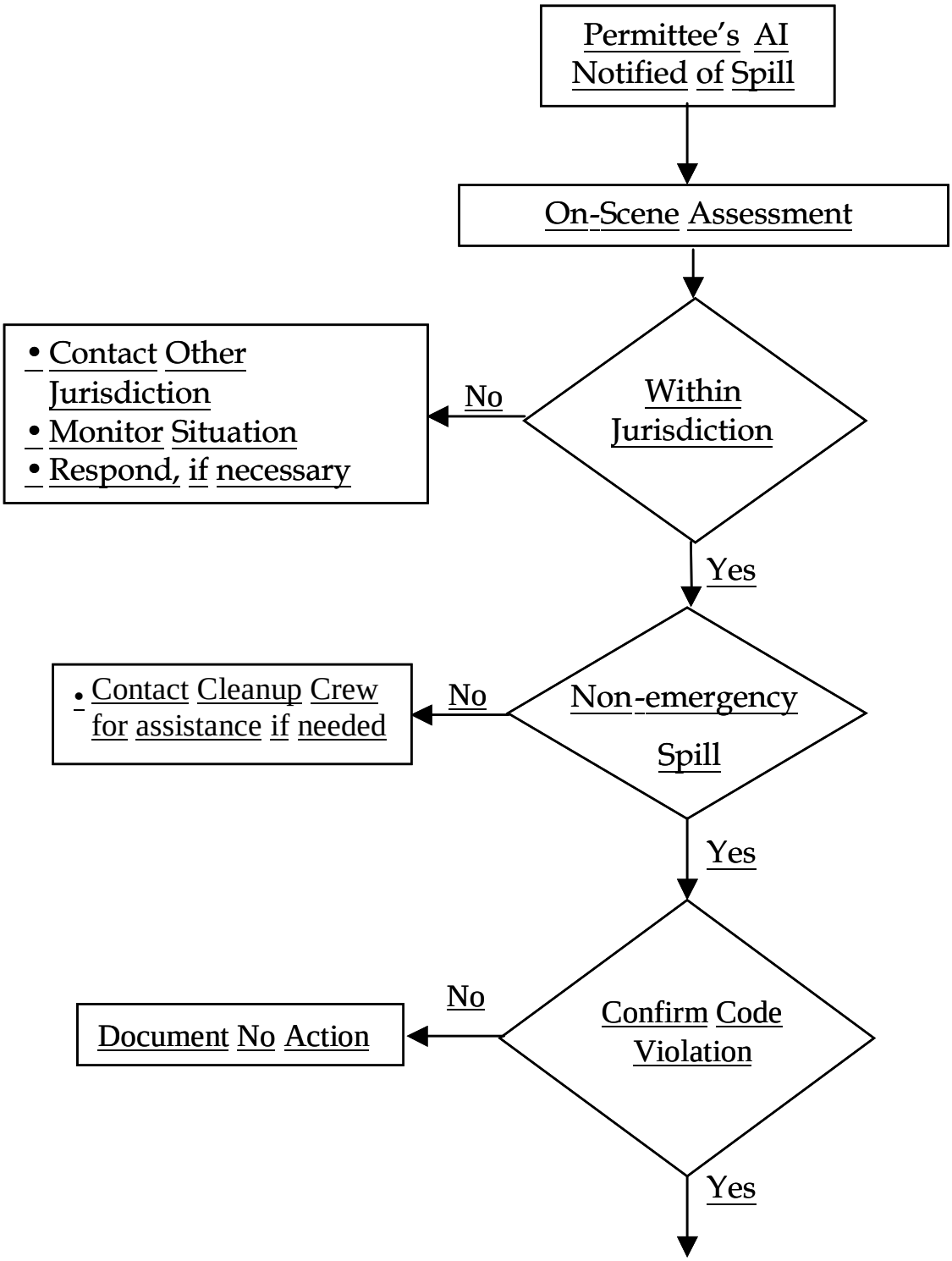
(2 pages)

Water Quality Problems and Illicit Discharge Investigations (continued)



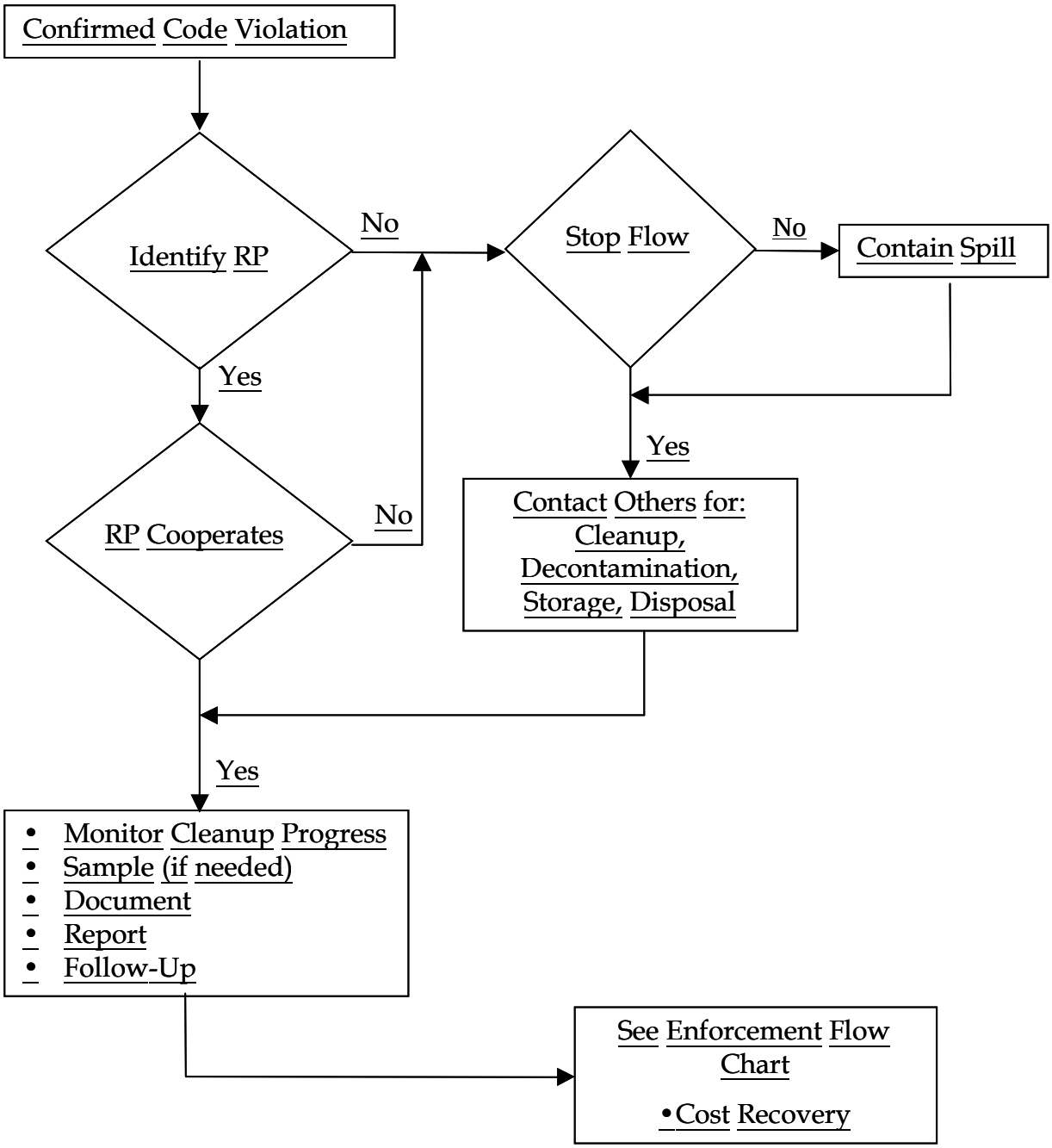
(2 pages)

Exhibit 10.V
Authorized Inspectors
Field Spill Response Procedures



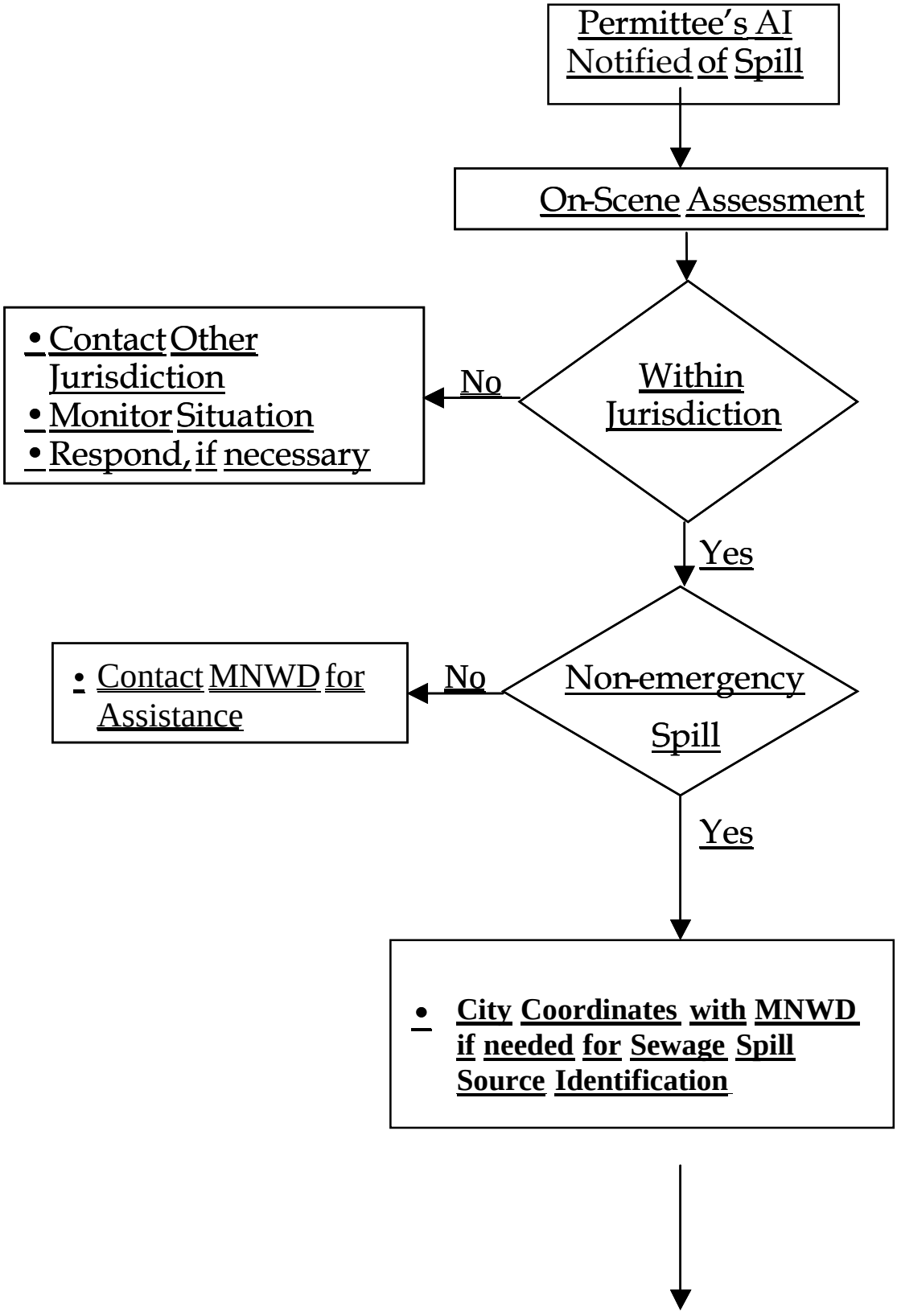
(2 pages)

Authorized Inspectors
Field Spill Response Procedures
(Continued)



(2 pages)

Exhibit 10.VI
MS4 Permittee
Sewage Spill Response Procedures



(2 pages)

MS4 Permittee
Sewage Spill Response Procedures
(Continued)

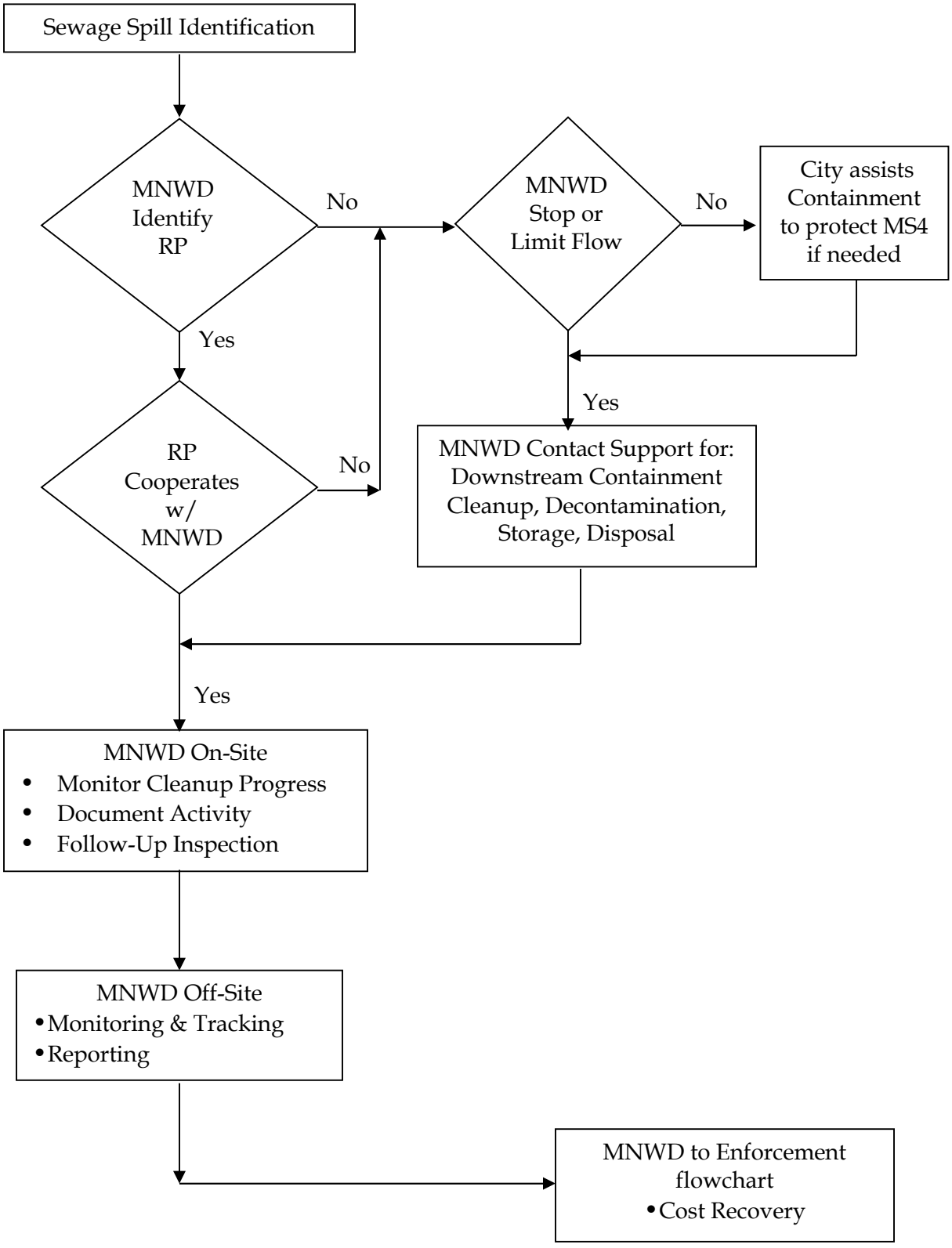


Exhibit 10.VII

City of Laguna Niguel
Engineering Department
27791 La Paz Road
Laguna Niguel CA 92677

Incident Date: ___/___/_____
Time: _____:____ A.M. - P.M.

POLLUTION NOTIFICATION / INVESTIGATION REQUEST FORM

Notification/Request: **Category:** G Notification G Compliant G Response Request G Reconnaissance

From:_____(G Agency / G Department / G Public / G Private Company)
Contact: _____ Phone: (___)_____
Contact Address: _____
City: _____ State _____ Zip:_____
Comments :_____ Phone: (___)_____

Location:
Affected Address: _____
City: _____ State _____ Zip:_____
Extent of Impact_____ Map Page/Grid _____
Reference: _____

Complaint:
Complaint/Incident: _____

Notification / Request received by: _____ Date: _____

Responsible Party:
Suspect / RP: _____ Phone:(___)___
Contact: _____ Phone:(___)___
Contact Address: _____
City: _____ State _____ Zip:_____

Investigation Results:
Investigated by: _____ Date:____/____/____ Time: ___:___ A.M. - P.M.
Material/Waste Involved: _____ Estimated Volume/Quantity: _____
Investigation results : _____

Hours spent on investigation: _____ \ _____ \ _____ Job Code : _____ G **OC** G **RH**
Complainant/Requester Contacted: G In Person G By Telephone Date: _____

Action:
G Referred to County
G Hazardous Materials Incident - HMI Report _____
G Enforcement action G Enforcement letter G Prosecution case Date: _____
G Correction required: _____

G Non-**ER** Responsibility - Referred to: _____
Contact: _____ Phone: (___)_____
Date: _____ Time: ___:___ A.M. - P.M.
G No action - Reason: _____

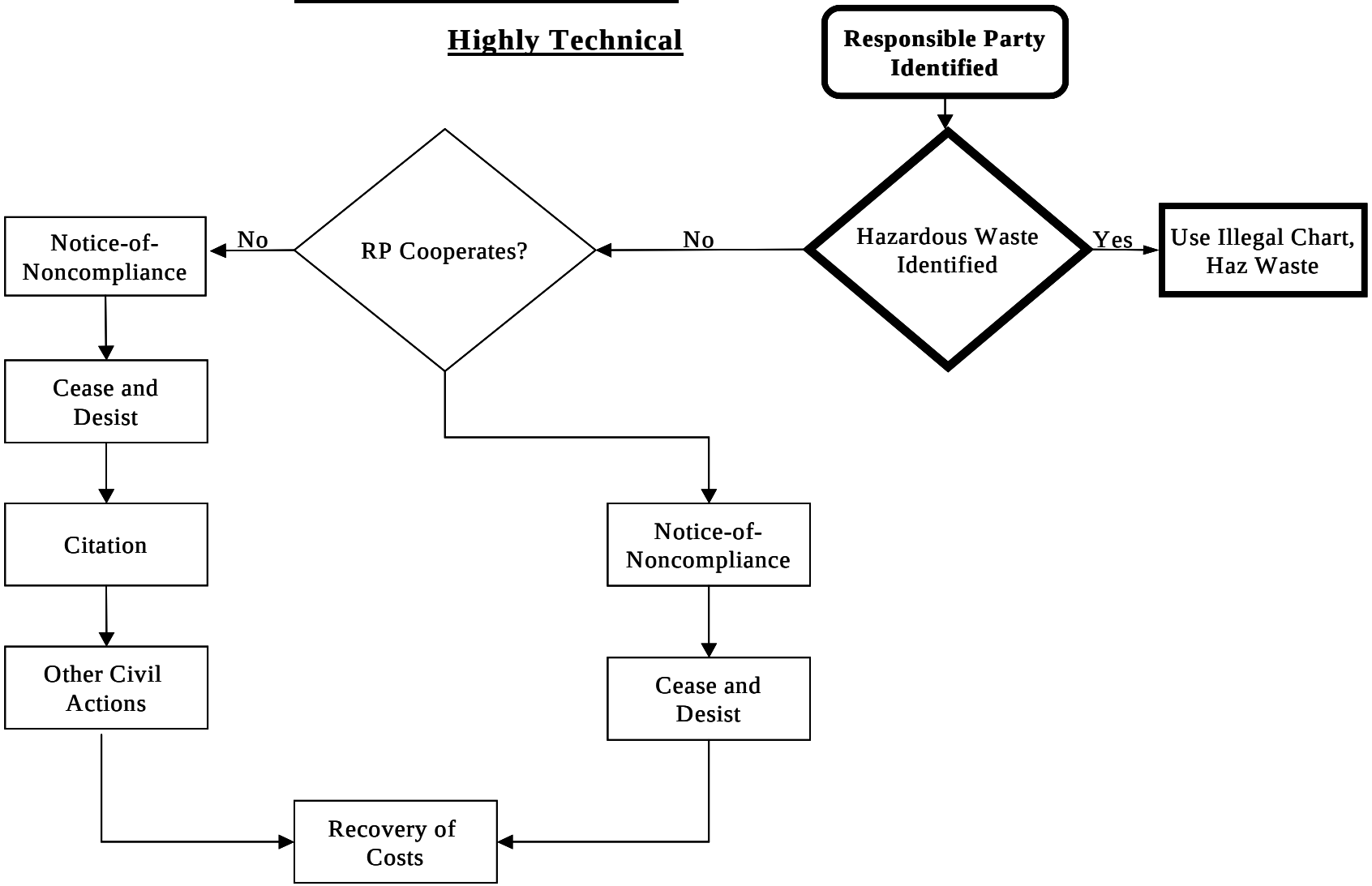
(4 pages)

Exhibit 10.VIII
ENFORCEMENT FLOW CHART

Attachment 10-G

Emergency Illegal Discharge Flow Chart

Highly Technical



Costs for investigations, monitoring, mitigation, and enforcement should be recovered in all applicable cases.

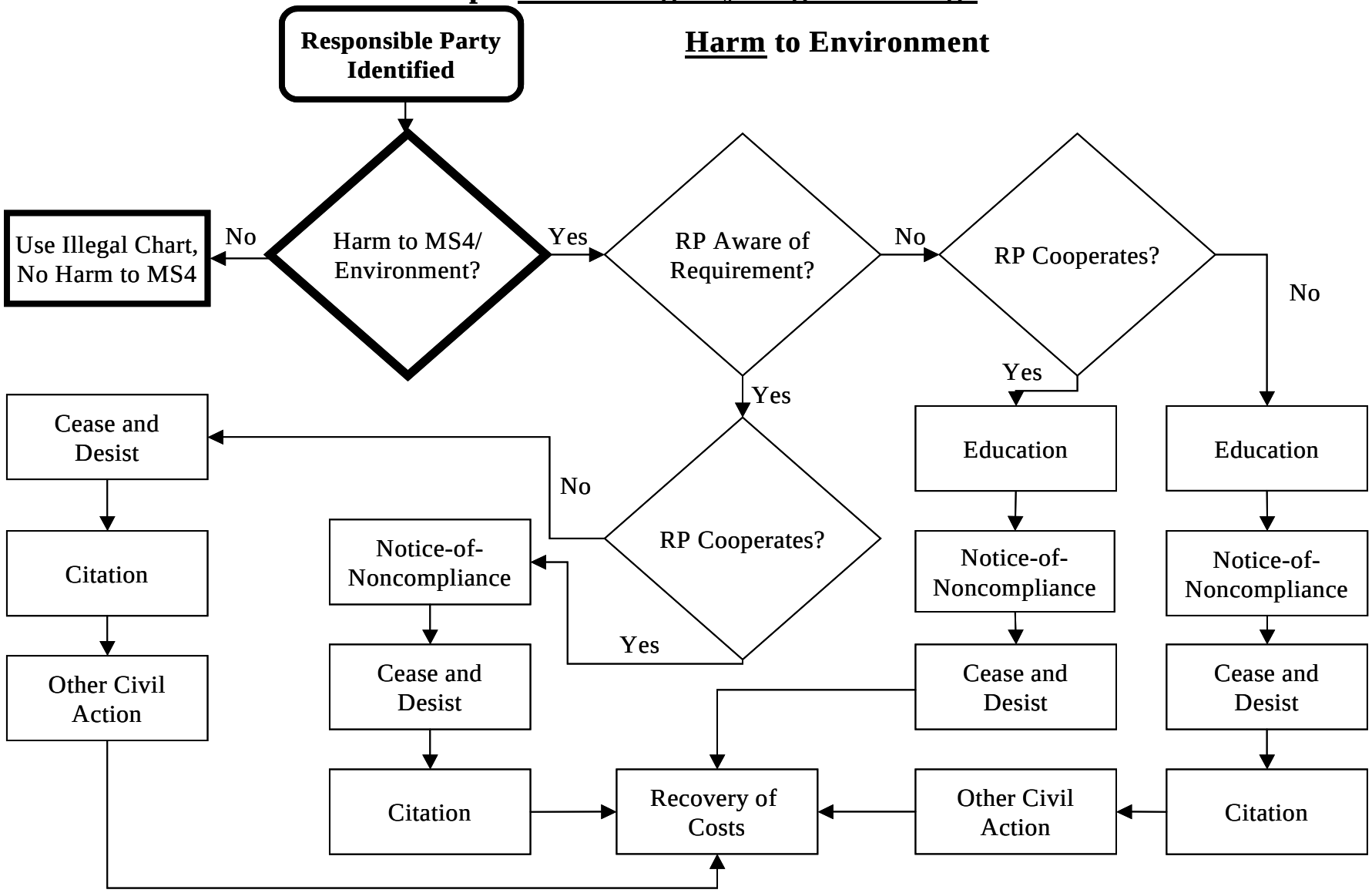
(4 pages)

ENFORCEMENT FLOW CHART

Attachment 10-G

Example Non-Emergency Illegal Discharge Flow Chart

Harm to Environment



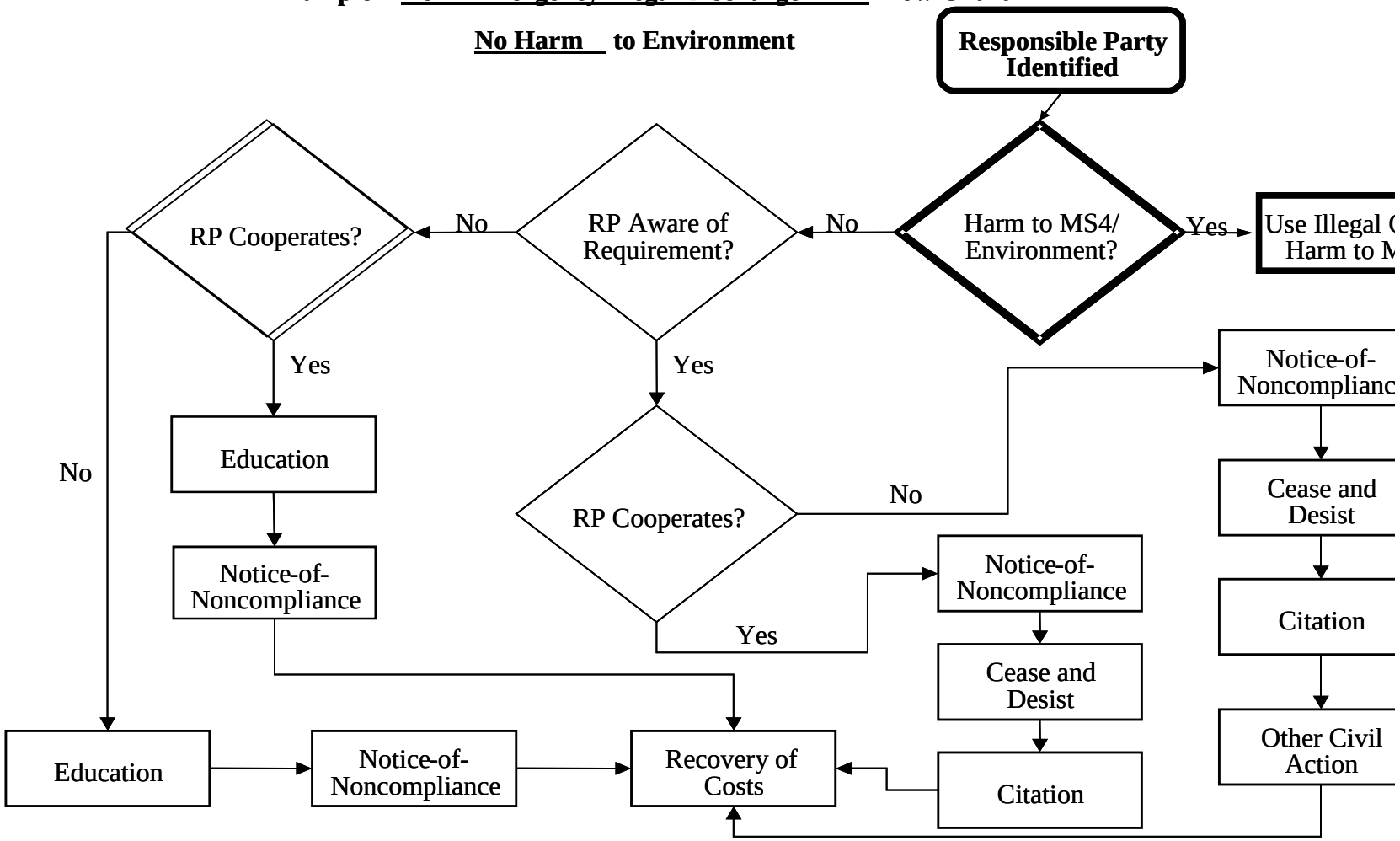
(4 pages)

ENFORCEMENT FLOW CHART

Attachment 10 -G

Example Non -Emergency Illegal Discharge Flow Chart

No Harm to Environment



Costs for investigations, monitoring, mitigation, and enforcement should be recovered in all applicable cases.

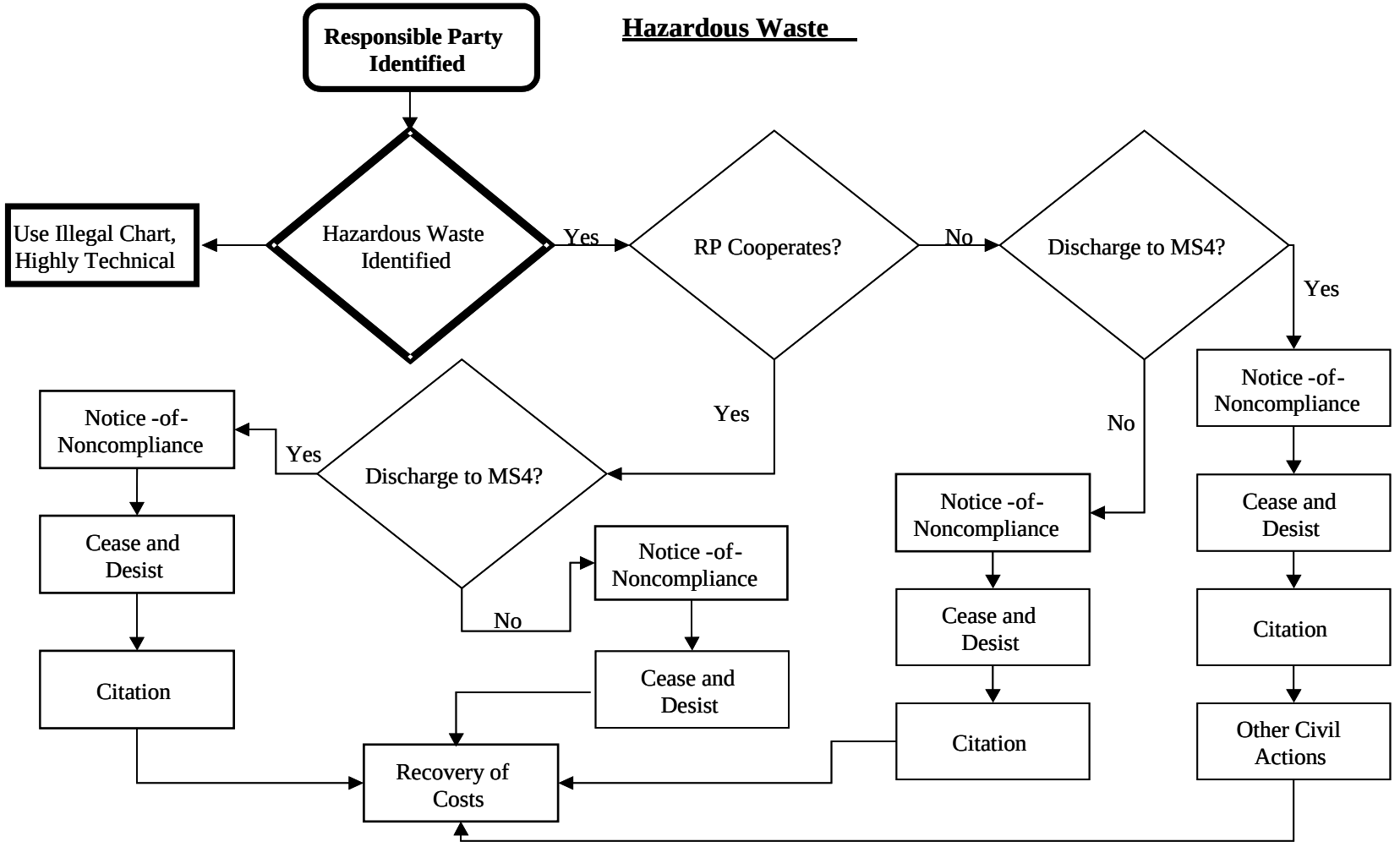
(4 pages)

ENFORCEMENT FLOW CHART

Attachment 10 -G

Example Emergency Illegal Discharge Flow Chart

Hazardous Waste



Costs for investigations, monitoring, mitigation, and enforcement should be recovered in all applicable cases.