

***Nevada Department
of Transportation***



Storm Water Quality Manuals

Construction Site Best Management Practices (BMPs) Manual

January 2006





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The content was developed from a variety of sources, written and unwritten. A Steering and a Technical Committee provided review of the document throughout its development. Special thanks are due to the committee members who spent many long sessions reviewing the material.

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It has been our pleasure to develop this document for NDOT. We believe it will provide a valuable source of information to help NDOT minimize short and long-term water quality impacts from water and air-borne sediment and other constituents of concern, and to provide NDOT with assistance in compliance with applicable Federal, State, and local storm water regulatory requirements.



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NEVADA DEPARTMENT OF TRANSPORTATION

STORM WATER QUALITY HANDBOOKS CONSTRUCTION SITE BEST MANAGEMENT PRACTICES (BMPs) MANUAL

PREFACE

This manual is to provide employees and other users with general information relevant to the storm water activities and responsibilities of the Nevada Department of Transportation. It is intended to provide guidance and reasonably uniform procedures and guidelines to affect an efficient and standardized application of storm water Best Management Practices (BMPs) for construction activities on the State's highway system. Since conditions may vary dramatically throughout the state, it may be appropriate to modify procedures in the field.

Construction managers are encouraged to make the manual available to all employees so they may familiarize themselves with construction site BMPs. A thorough understanding of policies and procedures will greatly assist the Department in meeting its objectives, and enable employees seeking advancement to enhance these opportunities.

Many state and NDOT manuals govern the operation of the Department. In some cases these documents are described; in others only a reference is made to the information and where it may be located.

This manual is not intended to establish a legal standard of care of conduct. It is a guide subject to modification and revision as conditions warrant.

Hard copies of this manual are available for purchase from NDOT Administrative Services. The manual will also be available for download from the NDOT website.

NEVADA DEPARTMENT OF TRANSPORTATION

STORM WATER QUALITY HANDBOOKS

CONSTRUCTION SITE

BEST MANAGEMENT PRACTICES (BMPs) MANUAL

PROCEDURE FOR MANUAL REVISIONS

This manual was developed to reflect current policies, procedures, and practices. It is intended that the manual be periodically revised. Two procedures are included. For edits or updates, contact Thresa Zylstra, NDOT Hydraulics Administrative Assistant, at 775-888-7619. All updates will be available on the NDOT website which should be visited regularly for updated information.

Temporary Revisions

As new policies, procedures, and directives are developed, it is sometimes necessary to provide this information to field personnel prior to a scheduled revision. To expedite distribution of revisions, the Water Quality, Erosion and Sediment Control (WQESC) Implementation Team will issue "Temporary Revisions" as needs arise. The "Temporary Revision" should be inserted in the manual prior to the page it modifies.

Scheduled Revisions

In October of each year, the Implementation Team will review the manual to determine if revisions are required. The Implementation Team is comprised of staff from design, construction, maintenance, environmental services, materials, and FHWA and NDEP if necessary.

Revisions affecting department policies and procedures proposed by the Implementation Team will be reviewed by a Steering Committee. Results of the Steering Committee Meeting will be provided to the Implementation Team. After revisions have been approved, the Implementation Team will initiate the changes and distribute them to all holders of the manual. Revisions will be transmitted under a cover memorandum. Each page of the revision will contain a revision date. It will be the manual holders' responsibility to insert the new material in the manual.

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Section 1

Construction Site Best Management Practices (BMPs)

1.1 Introduction

The State of Nevada Department of Transportation (NDOT) has a comprehensive statewide effort to prevent pollution in storm water runoff from NDOT construction projects. Contractors are required to prepare and implement a plan to control water pollution effectively during the construction of all projects within or in the vicinity of Waters of the United States (WOUS) - see Standard Specifications Section 637, Water Pollution.

Projects resulting in one acre (ac) or more of soil disturbance and that discharge to a WOUS are subject to the State of Nevada Stormwater General Permit ("General Permit") and are required to prepare a Storm Water Pollution Prevention Plan (SWPPP). When a SWPPP is required for a project, it shall satisfy the requirements of Standard Specifications Section 637, in addition to meeting other permit requirements.

Projects in the Lake Tahoe area fall under the jurisdiction of the Tahoe Regional Planning Agency (TRPA). Construction permits are issued by TRPA for all projects and include specific water quality control and other environmental requirements that are often more stringent than those mandated under the General Permit.

1.2 Organization of this Manual

This *Storm Water Quality Handbooks, Construction Site Best Management Practices Manual* (Manual) is intended to provide contractors and NDOT staff with detailed information on how to comply with the "Water Pollution Control" requirements contained in NDOT's construction contract documents, and in the State of Nevada Division of Environmental Protection (NDEP) permit requirements through the implementation of construction site best management practices (BMPs). This manual is organized as follows:

- **Section 1** introduces the construction site best management practices (BMPs) Manual.
- **Section 2** provides minimum requirements for the selection and implementation of construction site BMPs
- **Section 3** provides listing and working details for NDOT construction site BMPs for temporary soil stabilization.
- **Section 4** provides listing and working details for NDOT construction site BMPs for temporary sediment control.

- **Section 5** provides listing and working details for NDOT construction site BMPs for tracking control
- **Section 6** provides listing and working details for NDOT construction site BMPs for non-storm water management.
- **Section 7** provides listing and working details for NDOT construction site BMPs for waste management and materials pollution control.
- **Appendix A** provides a listing of frequently used abbreviations, acronyms, and definitions of terms used throughout this Manual.
- **Appendix B** provides a SWPPP Template that may be used to prepare SWPPPs.

1.3 Requirements for General Permit Sites

1.3.1 Nevada General Construction Permit

On September 16, 2002, NDEP adopted the *General Permit for Storm Water Discharges Associated with Construction Activity NVR100000*, hereby called "General Permit". The General Permit complies with provisions of the Federal Clean Water Act as amended (33 U.S.C. 1251 et. set: the "Act") and Chapter 445A of the Nevada Revised Statutes (NRS).

Under these regulations, owners or operators (contractors) of all proposed private and public construction sites that disturb a total of one or more acres of land are required to obtain coverage under the General Permit when the site discharges to a WOUS. Additionally, the following specific cases require coverage under the General Permit:

- Any land disturbance that is part of a larger common plan of development or sale with a planned disturbance of one acre or greater,
- All temporary plants or operations set up to produce concrete, asphalt or other materials for a permitted construction project (these are permitted with the project but require a separate SWPPP),
- Any repaving operation of one or more acres that creates fine-grained sediments that are not immediately removed from the site and properly disposed of at an acceptable facility, and
- Any construction activity, including sites disturbing less than one acre that are designated by NDEP or the U.S. Environmental Protection Agency (EPA) to have a potential for contribution to a violation of a water quality standard or may significantly contribute pollutants to waters of the United States.

Disturbance is defined as clearing, grading, or excavating underlying and/or surrounding soil as part of a repaving operation. NDEP may also require general permit coverage if repaving operations create loose fine-grained material (e.g. asphalt millings) that is not immediately disposed of and/or is stockpiled on the site. If the

material is immediately overlaid or hauled off-site, a permit may not be required depending on site-specific conditions.

BMP implementation must be appropriate for the sensitivity of the adjacent area. Geographically, portions of some NDOT projects are located in closed basin areas where storm water runoff ultimately flows to valleys and playas that have no standards for water quality and associated criteria for designated beneficial use. Typically, this will occur on linear projects where only a portion of the project discharges to a jurisdictional WOUS and/or environmentally sensitive area, but the entire project will require General Permit coverage. Only those topographically low discharge points to identified WOUS and/or environmentally sensitive areas along the length of the job require water pollution controls.

Under the General Permit, eligible discharger(s) who have submitted a Notice of Intent (NOI), paid an annual filling fee, and developed and implemented a SWPPP, are authorized to discharge stormwater associated with:

- (1) Construction activity
- (2) Small construction activity
- (3) Industrial activity from temporary concrete, asphalt, and material plants or operations dedicated to the permitted construction project.

The NOI must be filed at least 48 hours before construction begins and the SWPPP must be prepared prior to submittal of the NOI. NDEP has the authority to waive General Permit requirements, such as preparing and implementing a SWPPP for small construction projects that will not have adverse impacts to water quality. Sites between one and five acres that have a rainfall erosivity factor less than five (5) during the period of construction may also be able to obtain a waiver. NDEP has the option not to allow waivers for small construction activity based on other criteria. A worksheet for the small construction site activity waiver may be obtained from the NDEP Bureau of Water Pollution Control Website (Stormwater Discharge Permits section) and submitted to NDEP for review. Other useful documents such as the NOI form and sample SWPPP can also be found at the website.

1.3.1.1 Storm Water Pollution Prevention Plan (SWPPP)

To comply with the General Permit, a SWPPP must be prepared prior to submittal of the NOI and must remain on the project site at all times. The SWPPP must be prepared in accordance with good engineering practices and must consist of the components listed in the General Permit, Part IB, and listed below:

- Project information and description including: site location; type of project; contact information; estimated soil disturbance; and a description of potential receiving waters;
- Description of all proposed and implemented major land disturbing activities;

- Description and sequencing of construction activities;
- Estimates of total area of the construction site and the area that will be disturbed;
- Estimates of pre- and post-construction runoff coefficients (refer to Appendix B for values);
- A general location map and detailed site map(s) including drainage patterns, areas of soil disturbance, location of BMPs, borrow and equipment storage areas, and potential receiving waters;
- Description of proposed and implemented erosion, sediment, and waste control practices to be used on the site;
- Description of permanent stormwater management practices that will be installed during the construction process to control pollutants in stormwater discharges after completion of construction operations;
- Documentation of self-inspections, maintenance of BMPs, and corrective actions that will be implemented throughout construction;
- Location and description of any non-stormwater discharges and stormwater discharges from dedicated asphalt and concrete plants located off-site;
- Copy of approved state or local plans, including a copy of the General Permit requirements; and
- Certification by the owner/operator or authorized representative and all contractors who work on the construction site.

A SWPPP template is available on the NDEP website. A copy of the template can be found in Appendix B; it is the contractor's responsibility to ensure that the most current version is used. Other SWPPP templates acceptable to NDEP may be used.

1.3.2 TRPA Construction Permit

As a regulatory agency, the TRPA reviews and permits construction projects, and seeks to minimize environmental impacts of new projects. Permits issued include Standard Conditions of Approval and Special Conditions for individual projects. Permanent and temporary erosion control BMPs are required for applicable projects.

There are numerous differences between typical TRPA construction permit conditions and those in the General Permit. The TRPA permits are issued individually and are generally more stringent. Contractors are subject to the following requirements for all TRPA approved projects:

- Comply with all conditions of the TRPA permit and the General Permit.

- The contractor's engineer must attend the pre-grade meeting with TRPA and their contract compliance officer to identify all other BMP items required by TRPA.
- Include any additional BMP requirements in the contractor's SWPPP.

1.3.3 NDOT Contract Requirements

All NDOT contracts require contractors to comply with Section 637 of the Standard Specifications and may include Special Provisions for pollution control. These specifications and provisions require contractors to comply with the General Permit for all projects greater than one acre. For projects that require General Permit coverage and are within or near WOUS, contractors shall prepare and effectively implement a SWPPP that fulfills both the General Permit requirements and those in Section 637 for a Temporary Working in Waterways / Discharge Permit. NDEP may require turbidity monitoring as a condition of the Temporary Working in Waterways / Discharge Permit. Contact NDEP's Bureau of Water Pollution Control for specific monitoring criteria.

If revisions to the SWPPP are required by site conditions, impending weather, or regulatory officials, the contractor shall incorporate the revisions. No construction activity having the potential to cause water pollution, as determined by the Engineer, shall be performed until the SWPPP has been completed in accordance with General Permit requirements. Construction activities such as traffic control, which will not threaten water quality, may proceed without a SWPPP, if allowed by the Engineer. Furnish a copy of the initial SWPPP to the Engineer as evidence of completion; the SWPPP may be reviewed for permit compliance but not formally approved by NDOT. The contractor is responsible for all regulatory compliance issues and will be responsible for any penalties or fines imposed by the NDEP for regulatory non-compliance.

For sites covered by the General Permit, the contractor is responsible for filing the NOI, and is the responsible permittee with NDEP. This includes being responsible for any fees associated with permit procurement, and for executing the permit requirements, as well as being responsible for any fines levied by a regulatory agency for water management violations.

1.3.3.1 Project Categorization and Temporary Erosion Control Plans

NDOT has adopted a policy of categorizing all construction projects as having no, low, medium or high potential for water quality impacts. The general definitions of each project category are as follows:

- **No impact:** Projects with ground/soil disturbance less than one acre or no potential discharge into WOUS.
- **Low Impact:** Projects with little ground/soil disturbance and low potential for discharge of sediment into WOUS.

- **Medium Impact:** New construction or reconstruction projects with potential discharge of sediments into a WOUS. Ground/soil disturbance is not excessive, construction phasing is simple, and construction duration is usually less than two years.
- **High Impact:** Projects with major ground/soil disturbance; high potential of sediment discharge; complex construction staging; and construction duration is longer than two years. All projects in the Lake Tahoe Basin are also classified in this category.

For projects categorized as having low or medium potential impacts, the contractor is responsible for SWPPP development including design of temporary BMPs and temporary erosion control plans.

For projects categorized as having a high potential for water quality impacts, NDOT may develop temporary erosion control plans for temporary BMPs for one construction phase of an assumed phasing sequence and include bid items in the final project plans and specifications. For these projects, the contractor is then required to employ a Professional Engineer (P.E.) to develop the SWPPP in compliance with the General Permit. Additionally, a P.E. must be responsible for the design of temporary BMPs, as specified within the BMP Fact Sheets included in this manual.

NDOT will include specific temporary BMPs in the design under any of the following conditions:

- The project is categorized as having high potential for water quality impacts,
- Specific construction site (temporary) BMPs are prescribed by the NDEP, TRPA or other environmental permits or certifications,
- The National Environmental Policy Act (NEPA) process has identified sensitive receiving waters or valuable habitats requiring special protection.
- There are site-specific conditions or sources of pollution that would not be adequately addressed by “typical” SWPPP deployment strategies.

1.3.4 Sites not Covered by the General Permit

Sites that disturb less than one acre of soil do not require General Permit coverage unless they are designated by NDEP or EPA to have a potential for contribution to violation of a water quality standard or may significantly contribute pollutants to WOUS. The special provisions will identify such projects.

Geographically, some NDOT projects are located in closed basin areas where storm water runoff ultimately flows to valleys and playas that have no standards for water quality and associated criteria for designated beneficial use. Typically, these projects will not require General Permit coverage (therefore SWPPP development and

implementation) as these areas in Nevada are not considered to be jurisdictional WOUS thereby alleviating the need for structural water pollution controls.

1.4 Temporary Working in Waterways / Discharge Permit

A Temporary Working in Waterways/Discharge Permit is required by NDEP for work within or immediately adjacent to, live streams or water bodies. NDEP issues individual temporary permits valid for no longer than six months. NDEP reviews and approves the submitted Temporary Working in Waterways/Discharge Permit application before work can start. For projects that require General Permit coverage in addition to this permit, the SWPPP may be submitted to the NDEP as part of the Temporary Working in Waterways/Discharge Permit application. For NDOT projects the contractor is responsible for obtaining this permit, where applicable, and the NDOT Water Quality Specialist provides oversight of the process if necessary.

The Temporary Working in Waterways/Discharge Permit application must include a detailed description of the BMPs to be implemented during the disturbance and/or work activities proposed in and along the stated water body for: erosion control; sediment control; riparian stream zone protection and restoration; streambank stabilization/protection/rehabilitation, water pollution control/prevention, dewatering controls, etc. Water quality monitoring may also be a permit requirement to verify compliance with the applicable receiving water standards.

1.5 Air Quality Regulations

NDOT projects may also require coverage under various Air Quality or Dust Control Permits. NDOT contractors are responsible for obtaining these permits from the appropriate agency. In Nevada, air quality is regulated by the NDEP or, within Washoe and Clark Counties, by each county's Air Quality Management Divisions. Permit requirements for the different jurisdictions are discussed in Section 2.6.2.

Air quality permits will also typically require some type of permanent soil stabilization after construction is complete. This stabilization may or may not be sufficient to satisfy the final stabilization requirements of the General Permit. The following methods shall be used to satisfy the final soil stabilization requirement of air quality permits for NDOT Projects:

- In the North areas of the state, seeding, slope paving and application of millings to the shoulders will be the methods of stabilization.
- In southern urban areas, where re-vegetation is not successful, slope paving or rock mulch will be the methods of stabilization for cut and fill slopes. For aesthetic reasons, in an area contained within the landscape master plan, millings are not appropriate.
- In southern rural areas, soil stabilizers, slope paving, or application of millings will be the methods of soil stabilization.

Section 2

Selecting and Implementing Construction Site Best Management Practices

2.1 Introduction

This section provides instructions for the selection and implementation of construction site best management practices (BMPs). It is important to note that the requirements of this Section are NDOT minimum requirements, and that the contractor must implement additional construction site BMPs if deemed necessary to meet permit requirements or control pollutant discharges. Additional requirements may be included in the project's Special Provisions. Working details of the construction site BMPs listed in this Section are presented in Sections 3 through 7 of this Manual.

2.2 NDOT Construction Site BMPs

This section lists those BMPs to be considered during the construction of NDOT projects. Construction site BMPs, also called temporary control practices, are best conventional technology/best available technology (BCT/BAT) based BMPs that are consistent with the BMPs and control practices required under the General Permit. NDOT construction site BMPs are divided into categories (see Table 2-1).

2.2.1 Minimum Requirements

NDOT has selected some BMPs as *Minimum Requirements* that must be implemented on all highway construction projects statewide to protect WOUS and environmentally sensitive areas. Implementation is dependent on conditions and applicability of deployment described as part of the BMP. These BMPs are typically implemented as applicable in all NDOT construction projects; they include practices for soil stabilization, sediment control, wind erosion control, tracking control, non-storm water management, and waste management.

There are other construction site BMPs that may be implemented, on a project by project basis, in addition to the minimum required BMPs, and when determined necessary and feasible by NDOT or by the contractor. NDOT may, on a project-by-project basis, specify or require contractors to implement some of these construction site BMPs. Additionally, NDOT will consider a contractor's recommendation to implement some of these or other construction site BMPs on a project, subject to NDOT's approval.

Construction site BMPs within each of the categories are described throughout Sections 3 through 7 of this Manual. Table 2-1 lists the minimum required construction site BMPs. Note that some BMPs are grouped in order to show that a combination of those BMPs will enhance protection over the use of only one BMP, or to show that one BMP can be selected from multiple equivalent choices.

Table 2-1 CONSTRUCTION SITE BMPs MINIMUM REQUIREMENTS ⁽¹⁾				
SEDIMENT CONTROL In addition to all of the required BMPs employ at least one BMP option				
Sheet No.	Best Management Practice	Required	Option	Section
SS-1	Scheduling	X		3
SS-2	Preservation of Existing Vegetation	X		3
SC-2	Sediment Basin ⁽³⁾		X	4
SC-3	Sediment Trap ⁽³⁾		X	4
SC-4	Check Dam		X	4
SC-7	Street Sweeping and Vacuuming	X		4
SC-8	Storm Drain Inlet Protection	X		4
SEDIMENT BARRIER Employ at least one BMP option ⁽³⁾				
SC-1	Silt Fence		X	4
SC-5	Sediment Logs		X	4
SC-6	Gravel Bag Berm		X	4
NON-STORM WATER MANAGEMENT				
NS-1 thru NS-16	All NS BMPs	X		6
WASTE MANAGEMENT AND MATERIAL CONTROL				
TC-1	Stabilized Construction Entrance/Exit	X		5
WM-1 Thru WM-8	All WM BMPs	X		7
SLOPE PROTECTION Employ at least one BMP option ⁽³⁾				
SS-7	Geotextiles and Erosion Control Blankets		X	3
SS-9	Earth Dikes/ Drainage Swales & Lined Ditches		X	3
SS-11	Slope Drains		X	3
SC-5	Sediment Logs		X	4
SC-6	Gravel Bag Berm		X	4
SOIL STABILIZATION (DISTURBED AREAS) Employ at least one BMP option ⁽³⁾				
SS-13	Wind Erosion Control	X		3
SS-5	Soil Stabilizers		X	3
SS-3/SS-6/SS-8	Hydraulic/ Straw/ Wood Mulch		X	3
SS-7	Geotextiles and Erosion Control Blankets		X	3
SS-7	Hydroseeding	X ⁽²⁾	X ⁽²⁾	3

⁽¹⁾ See also Section 2.2.1. Not all minimum requirements may be applicable to every project. Applicability to a specific project shall be verified by the contractor. See Section 2.5 for Implementation Guidance.

⁽²⁾ When specified.

⁽³⁾ See Tables 2-4 and 2-5 for implementation guidelines.

2.3 Definitions

2.3.1 Disturbed Soil Area (DSA)

Disturbed soil areas (DSAs) are areas of exposed, erodible soil that are within the construction limits and that result from construction activities. The following are not considered DSAs:

- Areas where permanent soil stabilization, highway planting, or slope protection are applied and associated drainage facilities are in place and functional.
- Roadways, construction roads, access roads or contractor's yards that have been stabilized by the placement of compacted sub-base or base material or paved surfacing.
- Areas where construction has been completed in conformance with the contract plans and permanent erosion control is in place and functional.
- Erosion control is considered functional when a uniform vegetative cover equivalent to 70 percent of the native background vegetation coverage has been established or equivalent stabilization measures have been employed.

2.3.2 Active Areas and Non-Active Areas

Active Areas are construction areas where soil-disturbing activities occur or where soil-disturbing activities will be resumed within 21 days from when they were temporarily ceased.

Non-Active Areas are construction areas where soil-disturbing activities have ceased for 14 days and will not resume within 21 days. Stabilization measures shall be initiated as soon as possible in portions of the site where soil-disturbing activities have temporarily or permanently ceased, but in no case more than 14 days after soil-disturbing activities in that portion of the site have temporarily or permanently ceased.

The Contractor shall conduct a review of the existing active areas on a regular basis to determine if a non-active status should be applied to some DSAs.

2.3.3 Slope Length and Benches

Slope length is measured or calculated along the continuous inclined surface. Each discrete slope is between one of the following: top to toe, top to bench, bench to bench, and bench to toe.

Benches are drainage facilities that intercept surface flow and convey the resulting concentrated flow away from a slope. For the purpose of determining slope lengths, sediment logs or other appropriate BMPs (used for temporary sediment control) can be considered equivalent to a bench.

2.3.4 Rainy Season

The average rainfall in Nevada varies greatly from region to region. To account for the various rainfall patterns (time frame, intensities, and amounts) the State is separated into several rainy seasons. Shown in Figure 2-1 is a map identifying the rainy seasons throughout the State. These rainy seasons are used to identify the appropriate level of soil stabilization and sediment control protection.

Area 1 is usually subject to major floods in the late fall and winter because of “spillover” from the rain and snowstorms in the western Sierras; this area also includes high elevations and is prone to snow storms. Area 2 is affected by winter storms and snowmelt runoff while Area 3 is subject to influence by rainstorms from the Gulf of Mexico or the Pacific Ocean. The major flood season in Area 3 is during the summer months of thunderstorm activity.

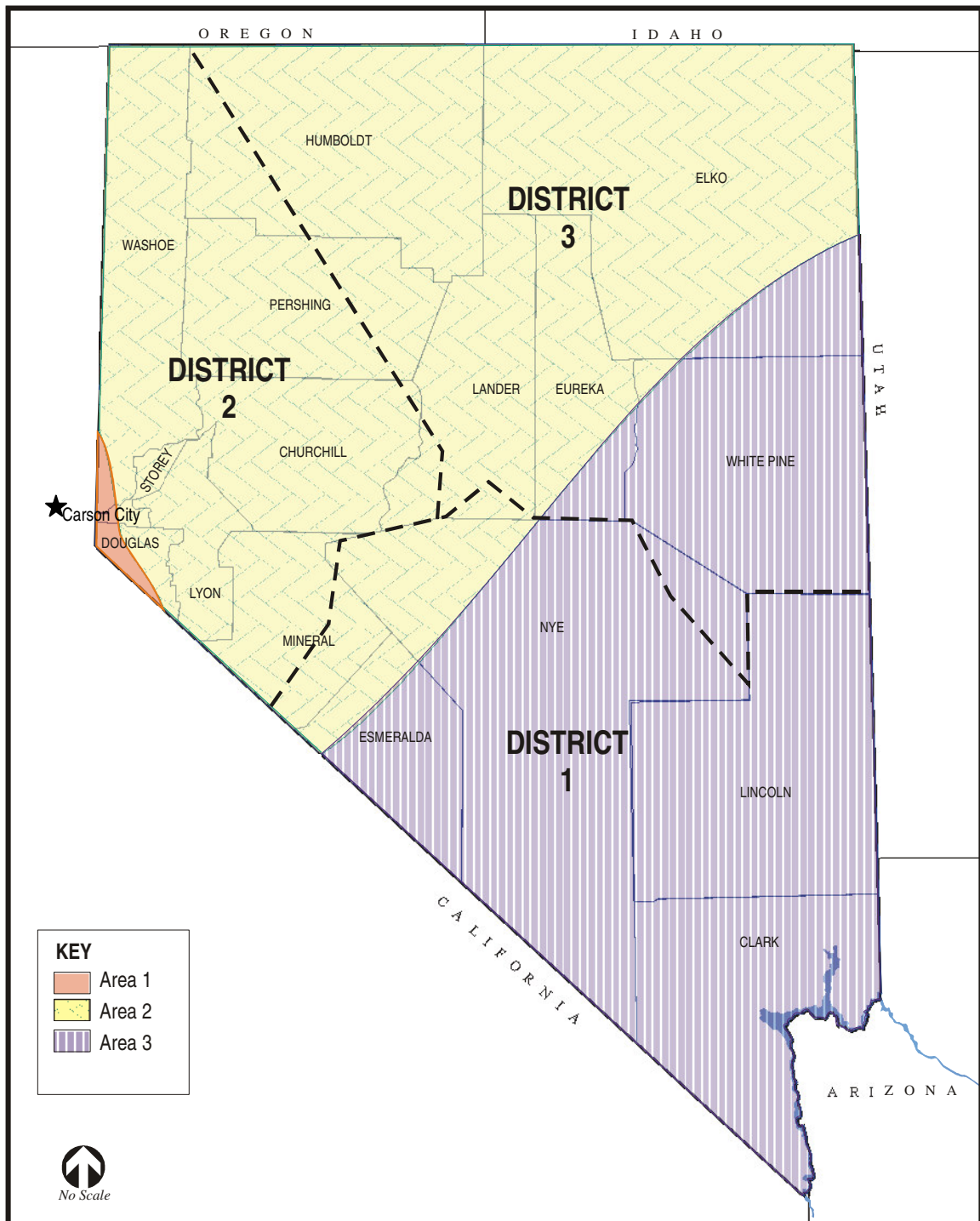


Figure 2-1
Designation of Homogeneous Rainfall Areas

2.4 Selection of Temporary Soil Stabilization Controls

There are many methods available to provide soil stabilization. Criteria were developed to allow for comparison and differentiation among the product types that are available. These criteria include installed cost, erosion control effectiveness, drying time, and others.

For some criteria, values have been assigned by characteristics: an example would be mode of application (e.g., hydraulic seeder, water truck, and hand labor). For other criteria, actual numeric values should be considered based on available data, such as drying time in hours. Refer to Table 2-2 for a summary of selection criteria information and ratings for temporary soil stabilization BMPs.

2.4.1 Antecedent Moisture

This criterion relates to the effect of existing soil moisture on the effectiveness of a soil stabilization method. While antecedent soil moisture conditions can have an effect on the performance of some methods, (e.g., hydraulic soil stabilizers, temporary seeding) other methods, such as erosion control blankets or impervious covers, are not affected, except perhaps in their ease of installation.

Suppliers of manufactured soil stabilization products affected by antecedent soil moisture specify the conditions under which their products are to be applied. For example, some products clearly benefit from having the soil “pre-wetted” before application of the hydraulic soil stabilizer and as a result, some manufacturers recommend application of water by itself as a first step. Conversely, the binding action of some adhesives on soil particles (and thereby their erosion control effectiveness) can be affected by excessive soil moisture. Therefore, some manufacturers recommend that their products not be applied when the soil is visibly saturated or when standing water is present.

2.4.2 Availability

A critical aspect of product specification and use is whether or not a soil stabilization product is readily available. While local sources may be preferable, the seasonal nature of soil stabilization work can create localized shortages of materials. In these cases, usually the material that can be delivered to the job most quickly is the material that is selected for application.

**Table 2-2
Temporary Soil Stabilization Criteria Matrix**

CLASS	TYPE	Antecedent Moisture	Availability	Ease of Clean-Up	Installed Cost per acre (ac)	Erosion Control Effectiveness (%)	Degradability	Length of Drying Time (hrs)	Time to Effectiveness (days)	Longevity	Mode of Application	Residual Impact	Native	Runoff Effect
Straw Mulch	Wheat Straw	D	S	H	\$2,100	90-95	B	0	1	M	L/M	M		+
	Rice Straw	D	S	H	\$2,100	90-95	B	0	1	M	L/M	M		+
Wood Fiber Mulch	Wood Fiber	D	S	H	\$900	50-60	B	0-4	1	M	H	L		+
Recycled Paper Mulch	Cellulose Fiber	D	S	H	\$850	50-60	B	0-4	1	S	H	L		+
Bonded Fiber Matrix	Biodegradable	D	S	H	\$5,500	90-95	B	12-18	1	M	H	M		+
Biodegradable	Jute Mesh	D	S	H	\$6,500	65-70	B		1	M	L	M		+
	Curled Wood Fiber	D	S	H	\$10,500	85-90	P/B		1	M	L	M		+
	Straw	D	S	H	\$9,000	85-90	P/B		1	M	L	M		+
	Wood Fiber	D	S	H	\$9,000	85-90	P/B		1	M	L	M		+
	Coconut Fiber	D	S	H	\$13,000	90-95	P/B		1	L	L	M		+
	Coconut Fiber Mesh	D	S	H	\$31,000	85-90	B		1	L	L	M		+
	Straw Coconut Fiber	D	S	H	\$11,000	90-95	P/B		1	L	L	M		+
Non-Biodegradable	Plastic Netting	D	M	H	\$2,000	<50	P		1	L	L	H		+
	Plastic Mesh	D	M	H	\$3,250	75-80	P		1	L	L	H		+
	Synthetic Fiber with Netting	D	M	H	\$35,000	90-95	P		1	L	L	H		+
	Bonded Synthetic Fibers	D	M	H	\$50,000	90-95	P		1	L	L	H		+
Combination with Biodegradable	D	M	H	\$32,000	85-90	P		1	L	L	H		+	
High-Density	Ornamentals		S-M	H	\$400 - \$1,600	50-60			28	M-L	H	L-M	N/E	+
	Turf species		S	H	\$350	50-60			28	L	H	M-H	N/E	+
	Bunch grasses		S-M	H	\$300 - \$1,300	50-60			28	L	H	L-M	N	+
Fast-Growing	Annual		S	H	\$350 - \$650	50-60			28	L	H	L-H	N/E	+
	Perennial		S	H	\$325 - \$800	50-60			28	L	H	M	N/E	+
Non-Competing	Native		S-M	H	\$300 - \$1,600	50-60			28	L	H	L-M	N	+
	Non-Native		S-M	H	\$400 - \$500	50-60			28	L	H	L-H	E	+
Sterile	Cereal Grain		S	H	\$500	50-60			28	L	H	L	E	+
Plastic	Rolled Plastic Sheeting		S		\$7,000	100	P		1	M	L	H		-
	Geotextile (Woven)		S		\$6,000	90-95	P		1	M	L	H		-
(PBS) Plant Material Based- Short Lived	Guar	D	S	H	\$400	80-85	B	12-18	Same as Length of Drying Time.	S	B	L		0/+
	Psyllium	P	S	H	\$400	25-35	B	12-18		M	B	L		0
	Starches	D	S	H	\$400	25-30	B	9-12		S	H	L		0
(PBL) Plant Material Based- Long Lived	Pitch/ Rosin Emulsion	D	S	M	\$1,200	60-75	B	19-24		M	B	M		-
(PEB) Polymeric	Acrylic polymers and copolymers	D	S	M	\$1,200	35-70	P/C	19-24		L	B	M		+/-
	Methacrylates and acrylates	D	M	M	\$400	35-40	P/C	12-18		S	W	L		0/+
	Sodium acrylates and acrylamides	D	M	M	\$400	20-70	P/C	12-18		S	H	L		+/-
	Polyacrylamide	D	M	M	\$400	55-65	P/C	4-8		M	H	L		0/+
	Hydro-colloid polymers	D	M	H	\$400	25-40	P/C	0-4		M	H	L		0/+
(PRB) Petroleum/ Resin-Based Emulsions	Emulsified Petroleum Resin	D	M	L	\$1,200	10-50	P/C	0-4		M	B	M		0/-
(CBB) Cementitious Based Binders	Gypsum	D	S	M	\$800	75-85	P/C	4-8		M	H	L		-
= not applicable for category, class or type														

Section 2
Selecting and Implementing Construction Site Best Management Practices

Table 2-2 (continued)
Temporary Soil Stabilization Criteria Matrix

Antecedent Moisture	D	Soil should be relatively dry before application
	P	Soil should be pre-wetted before application
Availability	S	A short turn-around time between order and delivery, usually 3-5 days
	M	A moderate turnaround time, between 1-2 weeks
Ease of Clean-Up	L	Require pressure washing, a strong alkali solution, or solvent to clean up
	M	Requires cleanup with water while wet; more difficult to clean up once dry
	H	May be easily removed from equipment and overspray areas by a strong stream of water
Installed Cost		Dollars per acre
Erosion Control Effectiveness		Percent reduction in soil loss over bare soil condition.
Degradability	C	Chemically degradable
	P	Photodegradable
	B	Biodegradable
Length of Drying Time		Estimated hours
Time to Effectiveness		Estimated days
Longevity	S	1 - 3 months
	M	3 – 12 months
	L	Greater than 12 months
Application Mode	L	Applied by hand labor
	W	Applied by water truck
	H	Applied by hydraulic mulcher
	B	Applied by either water truck or hydraulic mulcher
	M	Applied by a mechanical method other than those listed above (e.g., straw blower)
Residual Impact	L	Projected to have a low impact on future construction activities
	M	Projected to have a moderate impact on future construction activities
	H	Projected to have a significant impact on future construction activities
Native	N	Plant or plant material native to the State of Nevada
	E	Exotic plant not native to the State of Nevada
Runoff Effect	+	Runoff is decreased over baseline (bare soil)
	0	No change in runoff from baseline
	-	Runoff is increased over baseline

Source: California Department of Transportation (CALTRANS) Storm Water Quality Handbooks, Construction Site Best Management Practices Manual, Appendix B, August 2002.

2.4.3 Ease of Clean-Up

This criterion applies primarily to the hydraulically applied soil stabilization materials, but there may be clean-up issues associated with some of the other categories as well (e.g., packaging materials, disposal of excess product, etc).

All of the approved hydraulic soil stabilization products are typically applied using water as a carrier, and to varying degrees, these products can be removed from application machinery and overspray areas with the application of clean water as well. However, cleaning must occur before the material sets or dries, otherwise stronger cleaning solutions of detergent, a strong alkali solution, or a petrochemical solvent must be used.

A prudent contractor will take precautions when working with hydraulic products that have some clean-up limitations, and must follow the BMPs in the SWPPP for cleaning of equipment on site. Regardless of which approach is used for temporary soil stabilization, site clean up can be problematic due to the following:

- Added time to dispose of waste materials
- Added time to clean hydraulic equipment before the material sets or dries
- Additional quantities of water needed for cleaning operations
- Impact of quick-setting materials on overspray areas such as sidewalks, roads, vehicles
- Contractor resistance to products that require excessive clean-up
- Additional operation and maintenance costs included in contractor's bid.

2.4.4 Installed Cost

The estimated installed cost (the cost of the material itself, plus the cost associated with its installation) has a value that corresponds to cost in dollars per acre, which is used for estimating and bidding. This approach allows for the direct comparison of approaches.

2.4.5 Erosion Control Effectiveness

This criterion measures the ability of a particular product to reduce soil erosion relative to the amount of erosion measured for bare soil. Erosion control effectiveness is described as a percentage reduction in erosion as compared to an untreated or control condition.

2.4.6 Degradability

Degradability relates to the method by which the chemical components of a soil stabilization product are degraded over time. As might be expected, the way in which a product degrades is related to longevity, which is another selection criterion.

Both degradability and longevity are sometimes key issues in temporary soil stabilization and long-term erosion and sediment control planning.

Soil properties, climate, existing vegetation as well as slope aspect contribute to the degradation of soil stabilization materials. Knowing something about the physical and chemical properties of a product and how these characteristics might interact with site conditions is important when selecting a particular material.

2.4.7 Length of Drying Time

Not all materials require drying time, and the drying criterion may be used to differentiate categorical approaches as well as a final screen for the various types of materials within a class of approaches.

Determining when a soil stabilization material is dry or completely cured is a subjective exercise that relies a great deal on manufacturer-published information. In setting standards for this criterion, where drying or curing time is necessary for a particular method to become erosion control effective, manufacturers' recommendations have been followed.

2.4.8 Time to Effectiveness

Not all soil stabilization products are immediately effective in controlling erosion: some take time to dry (e.g., hydraulic soil stabilizers) and others take time to grow (e.g., temporary seeding). However, when some treatments are applied (e.g., rolled erosion control products, plastic sheeting, and straw mulch) they are immediately effective.

2.4.9 Longevity

This criterion simply considers the time that a soil stabilization product maintains its erosion control effectiveness.

2.4.10 Mode of Application

The mode of application criterion refers to the type of labor or equipment that is required to install the product or technique.

2.4.11 Residual Impact

This criterion relates to the impact that a particular practice might have on construction activities once they are resumed on the area that was temporarily stabilized. Some examples include:

- Temporary vegetation covers or standard biodegradable mulches might create problems with achieving final slope stability or compaction due to their organic content, and therefore would require removal and disposal.
- Applications of straw or hay fibers might keep soil from drying out as quickly as it might if it was bare.

- Plastic sheeting, netting or materials used in a soil stabilization product might last longer than needed on or in the soil.

2.4.12 Native

This criterion relates primarily to selection of plant materials and is important from the standpoint of environmental compatibility and competitiveness.

2.4.13 Runoff Effect

This criterion measures the effect that a particular soil stabilization product has on the production of storm water runoff. Similar to the erosion control effectiveness criterion, runoff from an area protected by a particular product may be compared to the amount of runoff measured for bare soil and is presented in the matrix as a percentage of the runoff that would occur in an untreated, or control condition.

2.5 Temporary Soil Stabilization and Sediment Control Implementation Guidance

Storm water pollution control requirements are intended to be implemented on a year-round basis at an appropriate level. The requirements must be implemented in a proactive manner during all seasons while construction is ongoing.

Nevada has varied rainfall patterns throughout the state; therefore, the appropriate level of BMP implementation will also vary throughout the state. The guidance for temporary sediment controls and soil stabilization BMPs specified in this section is based on rainfall patterns (time frames, intensities, and amounts), general soil types, seasons, slope inclinations and slope lengths.

Appropriate storm water pollution control includes the implementation of an effective combination of both soil stabilization and sediment controls. This section describes both general principles and specific guidance for selecting and implementing temporary soil stabilization and sediment control BMPs.

Sections 2.5.1, 2.5.2, and 2.5.3 provide key principles for preventing erosion on construction sites. Sections 2.5.4 and 2.5.5 provide the specific guidance for selecting and implementing temporary soil stabilization and sediment control BMPs to manage disturbed soil areas.

2.5.1 Scheduling

Construction scheduling must consider the amount and duration of soil exposed to erosion by wind, rainfall, runoff, and vehicle tracking, and must seek to minimize disturbed soil area in the rainy season. A schedule must be prepared that shows the sequencing of construction activities with the installation and maintenance of soil stabilization and sediment control BMPs. See Section 3, BMP SS-1, in this manual for BMP details.

2.5.2 Preservation of Existing Vegetation

Preserving existing vegetation to the maximum extent possible and for as long as possible on a construction site reduces or eliminates erosion in those areas. To facilitate this practice, on a year-round basis, temporary fencing must be provided prior to commencement of clearing and grubbing operations or other soil-disturbing activities in areas where no construction activity is planned or construction will occur at a later date. See BMP SS-2, Preservation of Existing Vegetation, for BMP details.

2.5.3 Storm Water Run-on and Concentrated Flows

The diversion of storm water run-on and conveyance of concentrated flows must be considered in determining the appropriateness of the BMPs chosen. BMPs to divert or manage concentrated flows in a non-erodible fashion may be required on a project-by-project basis to divert off-site drainage through or around the construction site or to properly manage construction site storm water runoff. See BMPs SS-9, Earth Dikes, Drainage Swales and Lined Ditches; SS-10, Outlet Protection/Velocity Dissipation Devices; and SS-11, Slope Drains for BMP details.

2.5.4 Disturbed Soil Area Management

The DSA management guidelines are based on rainfall patterns (time frames, intensities, and amounts), general soil types, seasons, slope inclinations, and slope lengths. All of these factors are considered in developing the appropriate levels of soil stabilization and sediment control, and must be considered by the contractor when selecting specific site-by-site actions.

2.5.4.1 Disturbed Soil Area Size Limitations

Limiting the amount of disturbed soil is a critical component in conducting an effective storm water management program. Contract Special Provisions may specify limits of DSA. The Engineer has the option of increasing the limit of the total DSA during the rainy season beyond five (5) acres if appropriate construction BMPs and an implementation plan are included in an accepted SWPPP.

2.5.4.2 Disturbed Soil Area Protection by Temporary Soil Stabilization and Temporary Sediment Controls

To account for rainfall patterns (time frames, intensities, and amounts) and to a lesser extent general soil type differences, the State has been divided into three areas requiring common protection requirements. These rainfall areas are described in Table 2-3. The specific temporary soil stabilization and sediment control BMPs for DSA protection in each area are determined from Tables 2-4 and 2-5 (for non-active disturbed soil areas and active disturbed soil areas, respectively). The slope length and slope inclination are the most important criteria for soil stabilization and sediment control requirements, as these factors have the largest potential impact on the erosion rate. As indicated on these tables, the temporary soil stabilization and sediment controls at a construction site will increase with increasing slope length and slope inclination combination.

DSAs shall be protected as follows:

- Temporary BMPs (as required in Table 2-4) shall be implemented on non-active DSAs within 14 days from the cessation of soil-disturbing activities or one day prior to the onset of precipitation, whichever occurs first.
- Temporary BMPs for active DSAs (as required in Table 2-5) shall be implemented prior to the onset of precipitation and throughout each day for which precipitation is forecasted.
- For non-active DSAs, limit the erosive effects of storm water flow on slopes by implementing BMPs such as sediment logs or gravel bag berms to break up the slope lengths as follows:
 - Slope inclination 4:1 and flatter: BMPs shall be placed on slopes at intervals no greater than 20 ft.
 - Slope inclination between 4:1 and 2:1: BMPs shall be placed on slopes at intervals no greater than 15 ft.
 - Slope inclination 2:1 or greater: BMPs shall be placed on slopes at intervals no greater than 10 ft.
- For non-active DSAs, permanent erosion control shall be applied to areas deemed substantially complete during the project's defined seeding window.
- Provide construction site BMPs in addition to those specified in Tables 2-4 and 2-5 to convey concentrated flows in a non-erodible fashion.

Table 2-3 AREA DEFINITIONS	
AREA	DESCRIPTION
1	District 2 in the following areas: Along the Sierra Nevada from the westerly edge of Reno south through Douglas County
2	District 1, 2, and 3 (except within Area 1) North of line running from western edge of Esmeralda County northeasterly above Tonopah, south of Eureka to the eastern state line near Wendover.
3	District 1 and 3 (except within Area 2) South of line running from western edge of Esmeralda County northeasterly above Tonopah, south of Eureka to the eastern state line near Wendover.

Table 2-4 Required Combination of Temporary Slope Protection and Temporary Sediment Barriers ^{(5) (6)} NON-ACTIVE DISTURBED SOIL AREAS						
SEASON	AREA	TEMPORARY BMP	SLOPE ⁽¹⁾			
			≤ 20:1	> 20:1 ≤ 4:1	> 4:1 ≤ 2:1	> 2:1
RAINY	1	SLOPE PROTECTION ⁽⁴⁾	X	X	X	X
		SEDIMENT BARRIER ⁽⁴⁾	X	X	X	X
		SEDIMENT BASIN OR TRAP ⁽²⁾		X	X	X
	2	SLOPE PROTECTION ⁽⁴⁾	X ⁽⁷⁾	X	X	X
		SEDIMENT BARRIER	X ⁽⁷⁾	X	X	X
		SEDIMENT BASIN OR TRAP				X
	3	SLOPE PROTECTION ⁽⁴⁾	X	X	X	X
		SEDIMENT BARRIER	X	X	X	X
		SEDIMENT BASIN OR TRAP				X
NON - RAINY	1	SLOPE PROTECTION ⁽⁴⁾	X ⁽³⁾	X ⁽³⁾	X	X
		SEDIMENT BARRIER		X ⁽³⁾	X	X
		SEDIMENT BASIN OR TRAP				
	2	SLOPE PROTECTION		X ⁽³⁾⁽⁷⁾	X ⁽⁷⁾	X
		SEDIMENT BARRIER		X ⁽³⁾⁽⁷⁾	X ⁽⁷⁾	X
		SEDIMENT BASIN OR TRAP				
	3	SLOPE PROTECTION				
		SEDIMENT BARRIER			X	X
		SEDIMENT BASIN OR TRAP				

⁽¹⁾ Unless otherwise noted, the temporary BMP is required for the slope inclinations indicated on slope lengths greater than 10 ft. The maximum slope length is 100 ft. for slope inclinations between 20:1 and 2:1 and 50 ft. for steeper slopes.

⁽²⁾ Required in addition to the temporary sediment barrier, where feasible. Feasibility will depend on site-specific factors such as available right-of-way within the project limits, topography, soil type, disturbed soil area within watershed, and climate conditions.

⁽³⁾ Implementation of controls not required except at least 24 hours prior to all predicted rain events.

⁽⁴⁾ The indicated temporary BMP is required on all slope lengths.

⁽⁵⁾ Temporary sediment barrier BMPs are equivalent to what are sometimes referred to as perimeter systems. Provide a barrier to the transport of sediment at the downslope edge of disturbed soil areas.

⁽⁶⁾ Permanent erosion control seeding shall be applied to all non-active areas deemed substantially complete. Comply with seeding window in specifications or special provisions.

⁽⁷⁾ Implement Slope Protection or Sediment Barrier

Table 2-5 Required Combination of Temporary Slope Protection Temporary Sediment Barriers ACTIVE DISTURBED SOIL AREAS ^{(3) (6)}					
SEASON	AREA	TEMPORARY BMP	SLOPE ⁽¹⁾		
			≤ 20:1	> 20:1 ≤ 2:1	> 2:1
RAINY	1	SLOPE PROTECTION		X	X
		SEDIMENT BARRIER ⁽⁴⁾	X	X	X
		SEDIMENT BASIN OR TRAP ⁽²⁾		X	X
	2	SLOPE PROTECTION			X ⁽⁵⁾
		SEDIMENT BARRIER		X	X
		SEDIMENT BASIN OR TRAP ⁽²⁾			X ⁽⁵⁾
	3	SLOPE PROTECTION			X ⁽⁵⁾
		SEDIMENT BARRIER		X	X
		SEDIMENT BASIN OR TRAP ⁽²⁾			X ⁽⁵⁾
NON-RAINY	1	SLOPE PROTECTION			
		SEDIMENT BARRIER		X	X
		SEDIMENT BASIN OR TRAP ⁽²⁾			X ⁽⁵⁾
	2	SLOPE PROTECTION			
		SEDIMENT BARRIER			
		SEDIMENT BASIN OR TRAP			
	3	SLOPE PROTECTION			
		SEDIMENT BARRIER			
		SEDIMENT BASIN OR TRAP			

⁽¹⁾ Unless otherwise noted, the BMP is required for the slope inclinations indicated on slope lengths greater than 10 ft.

⁽²⁾ Required in addition to the temporary sediment barrier, where feasible. Feasibility will depend on site-specific factors such as available right-of-way within the project limits, topography, soil type, disturbed soil area within watershed, and climate conditions.

⁽³⁾ Implementation of soil stabilization controls not required except prior to predicted rain.

⁽⁴⁾ The indicated temporary BMP required on all slope lengths.

⁽⁵⁾ The indicated temporary BMP required on slope lengths greater than 50 feet.

⁽⁶⁾ Temporary sediment barrier BMPs are equivalent to what are sometimes referred to as perimeter systems. Provide a barrier to the transport of sediment at the downslope edge of disturbed soil areas.

2.5.5 Basins

The practices described herein are typical of those that will be implemented on a project-by-project basis. However, it is important to note that there will be instances where project and site conditions require deviation from the BMPs and the descriptions provided in this manual.

For instance, the proposed implementation of sediment basins (see BMP SC-2, Sediment Basin) is a new commitment that has not been incorporated into existing designs. In addition, the nature of linear projects and constrained rights-of-way inherent to NDOT work may prohibit the use of sediment basins at some locations on certain projects and on some projects altogether.

Implementation of sediment basins will be considered on a project-by-project basis. NDOT is committed to refining the sediment basin implementation criteria during the term of the General Permit while implementing the sediment basins on projects as practicable.

2.5.6 Stockpile Management

Soil stabilization and sediment control requirements, as they apply to stockpiles of various materials, are presented in BMP WM-3, Stockpile Management.

2.6 Guidance for Implementation of Other BMPs

2.6.1 Mobile Operations

Mobile operations common to the construction of a project include asphalt recycling, concrete mixing, crushing and the storage of materials. BMPs shall be implemented year-round, as appropriate, to control the individual situations these mobile operations can create.

2.6.2 Wind Erosion Controls

Wind erosion controls shall be implemented year-round for all disturbed soils on the project site that are subject to wind erosion and when significant wind and dry conditions are anticipated during construction of the project. See BMP SS-13, Wind Erosion, for BMP details.

The Special Provisions may also require issuance of Air Quality Permits. In Nevada, air quality is regulated by the NDEP or, within Washoe and Clark Counties, by each county's Air Quality Management Divisions. The Contractor is responsible for obtaining any air quality-related permits and developing any plans that may be required by the regulatory agencies.

2.6.2.1 NDEP

NDEP requires a Surface Area Disturbance Permit if land disturbance equals or exceeds five (5) acres. If the disturbed soil area exceeds twenty (20) acres, a dust control plan must also be submitted.

2.6.2.2 Clark County Department of Air Quality Management (AQMD)

In Clark County, the following construction activities require a Dust Control Permit:

- Soil disturbing or construction activity greater than or equal to one-quarter acre;
- Mechanized trenching greater than or equal to 100 feet in length; or
- Mechanical demolition of any structure larger than or equal to 1,000 ft².

A Dust Mitigation Plan is required for all projects and a Site Specific Dust Mitigation Plan is required for sites greater than 10 acres. Construction site superintendent(s), foremen and other designated on-site representatives, as well as the water truck/pull drivers are required to complete the Clark County Dust Control Class.

Clark County Dust Control Permits require explicit payment for temporary and permanent dust control in contract estimates. To comply with this requirement NDOT has created standard line items for these controls to be included in the cost estimates for every project that would disturb the soil.

2.6.2.3 Washoe County District Health Department Air Quality Management Agency (AQMA)

In Washoe County a Dust Control Plan is required for projects disturbing more than one acre of soil.

2.6.3 Tracking Controls

Tracking controls shall be implemented year-round, as needed, to reduce the tracking of sediment and debris from the construction site. At a minimum, entrances and exits shall be inspected daily, and controls implemented as needed. See Section 5 of this manual for BMP details.

2.6.4 Non-Storm Water and Waste Management and Materials Pollution Controls

The objective of the non-storm water and waste management and materials pollution controls is to reduce the discharge of materials other than storm water to the storm water drainage system or to receiving waters. These controls shall be implemented year-round for all applicable activities, material usage, and site conditions. Sections 6 and 7 of this manual provide guidance on implementation of BMPs related to the specific activity being conducted.

2.7 BMP Inspections

Construction site BMPs shall be inspected by the contractor in accordance with General Permit criteria as follows:

- Within 24 hours of the end of a storm event of 0.5 in. or greater;
- At least once every seven (7) calendar days;

- As specified in the project Special Provisions and/or SWPPP; and/or
- As directed by the Engineer.

NDOT personnel also perform construction site BMP inspections in accordance with the above criteria. A *Weekly Construction Site Discharge Inspection Checklist* is filled out by NDOT inspectors and signed by the contractor. The checklist provides assistance with inspection criteria and the proper course of action once the inspection is completed. The RE works with the contractor to correct any problems immediately or schedules an approved alternative time, but no later than the onset of subsequent rain events. This Manual may be employed during inspections because it provides details for installation, application, and maintenance for each temporary BMP.

In general, repairs and/or placement of temporary pollution control BMPs shall begin within 24 hours of notification of a deficiency and shall be completed within 7 days. Should this restriction be exceeded, work may be immediately suspended and no other items of work shall be performed until the repairs are completed. Working days will continue to be assessed during the suspension period and partial payments as set forth under Subsection 109.06 may not be forthcoming until said repairs are completed.

Section 3

Temporary Soil Stabilization Best Management Practices

3.1 Temporary Soil Stabilization

Temporary soil stabilization consists of preparing the soil surface and applying one of the best management practices (BMPs) shown in Table 3-1, or combination thereof, to disturbed soil areas. Temporary soil stabilization shall be applied to disturbed soil areas of construction projects in conformance with the criteria presented in Section 2, Selecting and Implementing Construction Site BMPs, of this Manual.

Table 3-1 TEMPORARY SOIL STABILIZATION BMPs	
ID	BMP NAME
SS-1	Scheduling
SS-2	Preservation of Existing Vegetation
SS-3	Hydraulic Mulch
SS-4	Hydroseeding
SS-5	Soil Stabilizer
SS-6	Straw Mulch
SS-7	Geotextiles, Plastic Covers, & Erosion Control Blankets/Mats
SS-8	Wood Mulching
SS-9	Earth Dikes/Drainage Swales & Lined Ditches
SS-10	Outlet Protection/Velocity Dissipation Devices
SS-11	Slope Drains
SS-12	Streambank Stabilization
SS-13	Wind Erosion Control

Temporary soil stabilization also includes concentrated flow conveyance controls, which consist of a system of measures or BMPs that are used alone or in combination to intercept, divert, convey and discharge concentrated flows with a minimum of soil erosion, both on-site and downstream (off-site). Temporary concentrated flow conveyance controls may be required to direct run-on around or through the project in a non-erodible fashion. Temporary concentrated flow conveyance controls include the following BMPs:

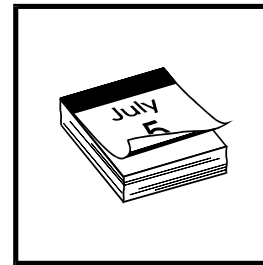
Section 3
Temporary Soil Stabilization Best Management Practices

- Earth Dikes/Drainage Swales & Lined Ditches
- Outlet Protection/Velocity Dissipation Devices
- Slope Drains

The remainder of this Section shows the working details for each of the temporary soil stabilization BMPs.

Adapted from Caltrans Construction Site BMPs

JANUARY				
MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
		1	2 NTP MOBILIZATION	3
			9	10 Grading
6 Install erosion & sediment control measures	7	8 Land clearing		16
12	13	14	15	23
			22	



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose This best management practice (BMP) involves developing, for every project, a schedule that includes sequencing of construction activities with the implementation of construction site BMPs such as temporary soil stabilization (erosion control) and temporary sediment controls measures. 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.

Appropriate Applications Construction sequencing shall be scheduled to minimize land disturbance for all projects during the rainy and non-rainy season. Appropriate BMPs shall be implemented during both rainy and non-rainy seasons. Section 2.3.4 provides a description of the Nevada rainy season.

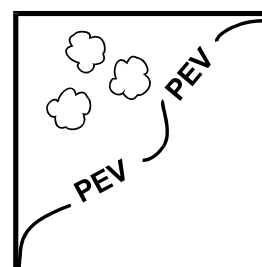
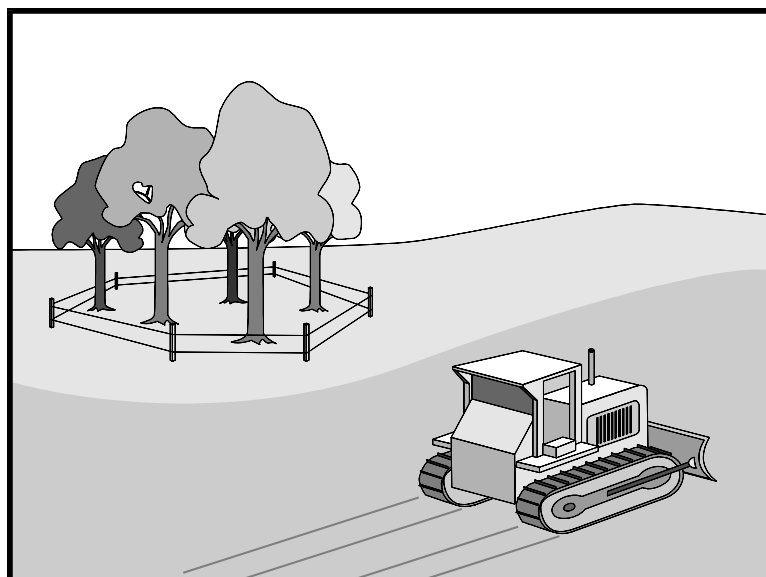
Limitations None identified.

- Standards and Specifications**
- Developing a schedule and planning the project are the very first steps in an effective storm water program. Plan the project and develop a schedule or to layout the construction plan. Refer to Standard Specifications Section 108. The schedule shall clearly show how the rainy season relates to soil-disturbing and re-stabilization activities. The construction schedule shall be incorporated into the Storm Water Pollution Prevention Plan (SWPPP) or WPCP.
 - The schedule shall include detail on the rainy season implementation and deployment of:
 - Temporary soil stabilization BMPs;

- Temporary sediment control BMPs;
 - Tracking control BMPs;
 - Wind erosion control BMPs;
 - Non-storm water BMPs; and
 - Waste management and materials pollution control BMPs.
- Schedule shall also include dates for significant long-term operations or activities that may have planned non-storm water discharges such as dewatering, sawcutting, grinding, drilling, boring, crushing, blasting, painting, hydro-demolition, mortar mixing, bridge cleaning, etc.
 - Schedule work to minimize soil-disturbing activities during the rainy season.
 - Work out the sequencing and timetable for the start and completion of each item such as site clearing and grubbing, grading, excavation, paving, pouring foundations, installing utilities, etc., to minimize the active construction area during the rainy season.
 - Schedule major grading operations for the non-rainy season when practical.
 - Temporarily stabilize non-active areas within 14 days from the cessation of soil-disturbing activities or one day prior to the onset of precipitation, whichever occurs first. See Standard Specification Section 107, "Protection and Restoration of Property and Landscape", Section 211, "Erosion Control" and General Permit section 1.B.b.2.
 - Monitor the weather forecast for rainfall.
 - When rainfall is predicted, adjust the construction schedule to allow the implementation of soil stabilization and sediment controls and sediment treatment controls on all disturbed areas prior to the onset of rain.
 - Be prepared year-round to deploy soil stabilization and sediment control and sediment treatment control practices as required by Section 2 of this Manual. Erosion may be caused during dry seasons by unseasonal rainfall, wind and vehicle tracking. Keep the site stabilized year-round, and retain and maintain rainy season sediment trapping devices in operational condition.
 - Sequence trenching activities so that most open portions are closed before new trenching begins.

- Consider scheduling when establishing permanent vegetation (appropriate planting time for specified vegetation).
 - Apply permanent erosion control to areas deemed substantially complete during the project's defined seeding window.
 - Seeding should generally take place in the fall for spring germination. This provides a cold treatment required by many native species to break dormancy. Seeds that are in place during spring thaw will also have more favorable soil moisture conditions from winter precipitation. As discussed in the UNR Ecosystem Mapping and Revegetation Specifications Manual (Tueller et al, 2002), the fall seeding windows for Nevada conditions would be October 1 to January 1 for southern Nevada and August 15 to November 15 for the northern part of the state.
 - See Section 2 of this manual for additional information on rainy season in Nevada and BMP implementation guidance for different seasons and geographical areas.
- Maintenance and Inspection
- Amend the schedule when changes are warranted.

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose Preservation of existing vegetation is the identification and protection of desirable vegetation that provides erosion and sediment control benefits.

- Appropriate Applications**
- Preserve existing vegetation at areas on a site where no construction activity is planned or will occur at a later date. Specifications for preservation of existing vegetation can be found in Standard Specifications, Sections 106 and 107 or plans or special provisions.
 - On a year-round basis, protection or flagging shall be provided prior to the commencement of clearing and grubbing operations or other soil-disturbing activities in areas.
 - No grading or disturbances shall occur in areas identified on the plans to be preserved, especially on areas designated on the plans as avoidance areas.

Limitations Protection of existing vegetation requires planning, and may limit the area available for construction activities.

Standards and Specifications **Timing**

- Preservation of existing vegetation shall be provided 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.
- Preservation of existing vegetation shall conform to scheduling requirements set forth in the special provisions.
- Replace destroyed trees with comparable quality.

Design and Layout

- Mark areas to be preserved with temporary flagging fencing made of orange polypropylene that is stabilized against ultraviolet light. The temporary fencing shall be at least 3 ft. wide and shall have openings not larger than 2 in. by 2 in.
- Minimize the disturbed areas by locating temporary roadways to avoid stands of trees and shrubs and to follow existing contours to reduce cutting and filling.
- Consider the impact of grade changes to existing vegetation and the root zone.
- Trees to be removed should be shown on plans. A general schematic is provided on first page of this BMP, but plans should provide a site-specific design and layout.

Installation

- Construction materials, equipment storage, and parking areas shall be located where they will not cause root compaction.
- Keep equipment away from trees to prevent trunk and root damage.
- Maintain existing irrigation systems.
- When heavy equipment is to be working directly adjacent to trees provide 2x4 tree wraps.
- Employees and subcontractors shall be instructed to honor protective devices. No heavy equipment, vehicular traffic, or storage piles of any construction materials shall be permitted within the drip line of any tree to be retained. The drip line is the 7' perimeter from outside the trunk of a tree. Removed trees shall not be felled, pushed, or pulled into any retained trees. Fires shall not be permitted within 100 ft. of the drip line of any retained trees. Any fires shall be of limited size, and shall be kept under continual surveillance. No toxic or construction materials - including paint, acid, nails, gypsum board, chemicals, fuels, and lubricants - shall be stored within 50 ft. of the drip line of any retained trees, nor disposed of in any way which would injure vegetation. No washout areas near trees/fenced areas.

Trenching and Tunneling

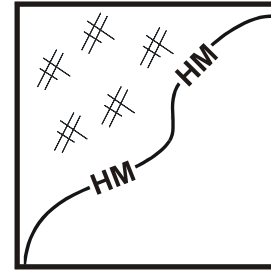
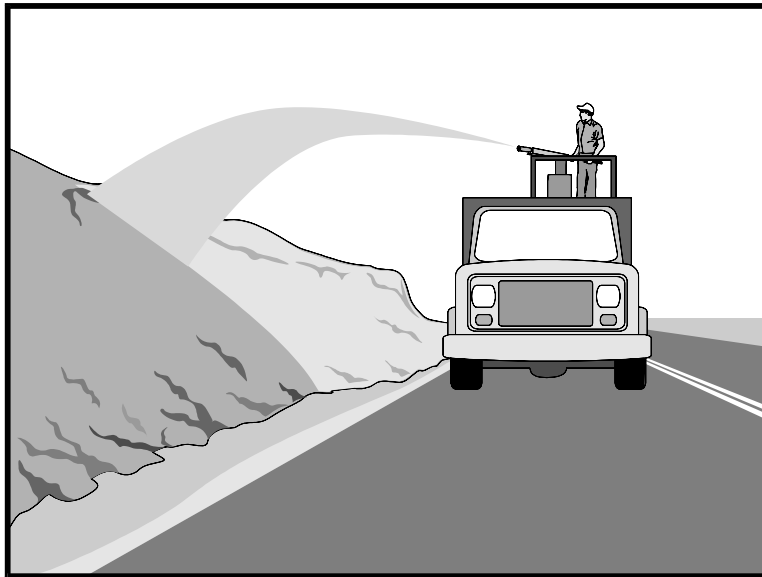
- Trenching shall be as far away from tree trunks as possible, usually outside of the tree drip line or canopy. Curve trenches around trees to avoid large roots or root concentrations. If roots are encountered, consider tunneling under them. When trenching and/or tunneling near or under trees to be retained, tunnels shall be at least 18 in. below the ground surface, and not below the tree center to minimize impact on the

roots.

- Tree roots shall not be left exposed to air; they shall be covered with soil as soon as possible, protected, and kept moistened with wet burlap or peat moss until the tunnel and/or trench can be completed.
- The ends of damaged or cut roots shall be pruned.
- Trenches and tunnels shall be filled as soon as possible. Careful filling and tamping will eliminate air spaces in the soil, which can damage roots.
- After all other work is complete, fences and barriers shall be removed last. This is because protected trees may be destroyed by carelessness during the final cleanup and landscaping.

Maintenance and Inspection During construction, the limits of disturbance shall remain clearly marked at all times. Irrigation or maintenance of existing vegetation shall conform to the requirements in the landscaping plan. If damage to protected trees still occurs, maintenance guidelines described below shall be followed:

- If necessary, as determined by the Resident Engineer, a certified arborist will be hired at the contractor's expense to attend to serious tree injuries.
- Any damage to the crown, trunk, or root system of a retained tree shall be repaired immediately.
- Damage roots shall be immediately root pruned.
- If bark damage occurs, all loosened bark shall be cut back into the undamaged area, with the cut tapered at the top and bottom, and drainage provided at the base of the wood. Cutting of the undamaged area shall be as limited as possible. Performed by ASCA certified arborist.
- Soil that has been compacted over a tree's root zone shall be aerated by punching holes 12 in. deep with water injection soil probes. Holes shall be placed 18 in. apart throughout the area of compacted soil under the tree crown.
- Trees shall be fertilized in the late fall or early spring. Stressed or damaged broadleaf trees shall be fertilized to aid recovery. Consult with NDOT Landscape Architect.
- Fertilizer shall be applied to the soil over the feeder roots and in accordance with label instructions, but never closer than 3 ft. to the trunk. The fertilized area shall be increased by one-fourth of the crown area for conifers that have extended root systems.
- During construction, the Environmental Division shall be contacted to ensure that avoidance areas are protected.



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose	Hydraulic mulch consists of applying a mixture of cut or shaved wood fiber or a bonded fiber matrix, and a stabilizing emulsion or tackifier with hydro-mulching equipment, which temporarily protects exposed soil from erosion by raindrop impact or wind. This is one of five temporary soil stabilization alternatives to consider.
Appropriate Applications	Hydraulic mulch is applied to disturbed areas requiring temporary protection until permanent vegetation is established or disturbed areas that must re-disturbed following an extended period of inactivity.
Limitations	<ul style="list-style-type: none"> ■ Wood fiber hydraulic mulches are generally short-lived (only last a part of a growing season) and need 24 hours to dry before rainfall occurs to be effective. ■ Avoid use in areas where the mulch would be incompatible with future earthwork activities and would have to be removed. ■ Paper mulches are not permitted.
Standards and Specifications	<ul style="list-style-type: none"> ■ Prior to application, roughen embankment and fill areas by rolling with a crimping or punching type roller or by track walking. Track walking shall only be used where other methods are impractical. ■ Hydraulic matrices require 24 hours to dry before rainfall occurs to be effective unless approved by the Resident Engineer (RE). ■ Avoid mulch over-spray onto the traveled way, sidewalks, lined drainage channels, and existing vegetation. ■ Materials for wood fiber based hydraulic mulches and hydraulic matrices shall conform to Standard Specifications Section 726. Paper

based hydraulic mulches alone shall not be used for temporary soil stabilization applications.

Hydraulic Mulches

- Wood fiber mulch is a component of hydraulic applications. It is typically applied at the rate of 2,000 to 4,000 lb/acre. This type of mulch is manufactured from wood or wood waste from lumber mills or from urban sources. Specifications for wood fiber mulch can be found in Standard Specifications Section 726.

Hydraulic Matrices

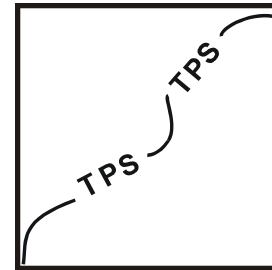
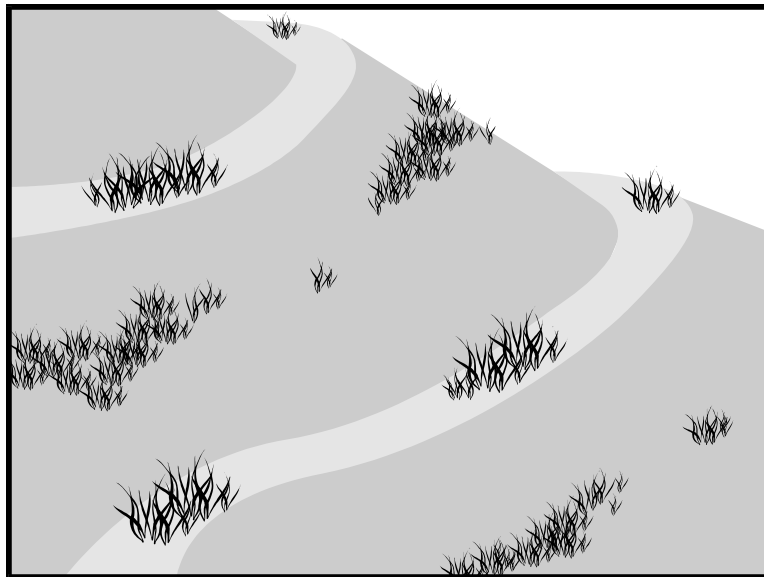
- Apply a wood fiber base layer mixed with acrylic polymers as binders. Apply as a liquid slurry using a hydraulic application machine (i.e., hydro-seeder) at the following minimum rates, or as specified by the special provisions, to achieve complete coverage of the target area: 750 lb/acre wood fiber mulch and 55 gal/acre of acrylic copolymer.

Bonded Fiber Matrix

- Bonded fiber matrix (BFM) is a hydraulically-applied system of fibers and adhesives that upon drying forms an erosion-resistant blanket that promotes vegetation, and prevents soil erosion. BFMs are typically applied at rates from 3,000 to 4,000 lb/acre based on manufacturer's recommendation (the biodegradable BFM is composed of materials that are 100% biodegradable. The binder in the BFM should also be biodegradable and should not dissolve or disperse upon re-wetting). Typically, biodegradable BFMs should not be applied immediately before, during, or immediately after rainfall if the soil is saturated. Depending on the product, BFMs typically require 12 to 24 hours to dry and become effective.

Maintenance and Inspections

- Maintain an unbroken, temporary mulched ground cover throughout the period of construction when the soils are not being reworked. Inspect before expected rainstorms and repair any damaged ground cover and re-mulch exposed areas of bare soil.
- After any rainfall event, the Contractor is responsible for maintaining all slopes to prevent erosion.



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose Hydroseeding typically consists of applying a mixture of wood fiber, seed, fertilizer, and stabilizing emulsion with hydro-mulch equipment, which temporarily protects exposed soils from erosion by water and wind. This is one of five temporary soil stabilization alternatives to consider. A list of additional soil stabilization BMPs can be found in Section 2 of this manual.

Appropriate Applications ■ Hydroseeding is applied on disturbed areas requiring temporary protection until permanent vegetation is established or disturbed areas that must be re-disturbed following an extended period of inactivity.

Limitations ■ Hydroseeding may be used alone only when there is sufficient time in the season to ensure adequate vegetation establishment and coverage to provide adequate erosion control. Otherwise, hydroseeding must be used in conjunction with a soil stabilizer or mulching, refer to BMP SS-5, Table 1 or other options.

■ Steep slopes are difficult to protect with temporary seeding.

Standards and Specifications ■ In order to select appropriate hydroseeding mixtures, an evaluation of site conditions shall be performed with respect to:

Soil conditions

Maintenance requirements

Site topography

Sensitive adjacent areas

Season and climate

Water availability

Vegetation types

Plans for permanent vegetation

- Selection of hydroseeding mixtures shall be approved by the Landscape Architect.
- For additional guidance seeding and revegetation in Nevada see *Mapping Ecosystems along Nevada Highways and the Development of Specifications for Vegetation Remediation* (UNR, 2002).

The following steps shall be followed for implementation:

- Seed mix shall comply with the Standard Specifications Section 726 and the project's special provisions.
- Hydroseeding can be accomplished using a multiple-step or one-step process; refer to the Special Provisions for specified process. The multiple-step process ensures maximum direct contact of the seeds to soil. When the one-step process is used to apply the mixture of fiber, seed, etc., the seed rate shall be increased to compensate for all seeds not having direct contact with the soil.
- Prior to application, roughen the slope, fill area, or area to be seeded with the furrows trending along the contours. See Standard Specifications Section 211, "Seeding and Fertilizing" and the "Slope Roughening/Terracing/Rounding" BMP (*NDOT Storm Water Quality Project Planning and Design Guide*).
- Apply a straw mulch to keep seeds in place and to moderate soil moisture and temperature until the seeds germinate and grow, refer to Standard Specifications Sections 211 and 726.
- All seeds shall be in conformance with the Standard Specifications Section 726. Each seed bag shall be delivered to the site sealed and clearly marked as to species, purity, percent germination, dealer's guarantee, and dates of test; provide the Resident Engineer with such documentation. The container shall be labeled to clearly reflect the amount of Pure Live Seed (PLS) contained. All legume seed shall be pellet-inoculated. Inoculant sources shall be species specific and shall be applied at a rate of 2 kg of inoculant per 100 kg of seed (2% inoculant by weight), refer to Standard Specifications Sections 211 and 726.
- Commercial fertilizer shall conform to the requirements of the Nevada Food and Agricultural Code. Fertilizer shall be pelleted or granular form.
- Follow-up applications shall be made as needed to cover weak spots, and to maintain adequate soil protection.

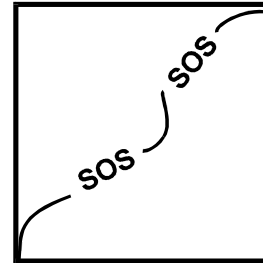
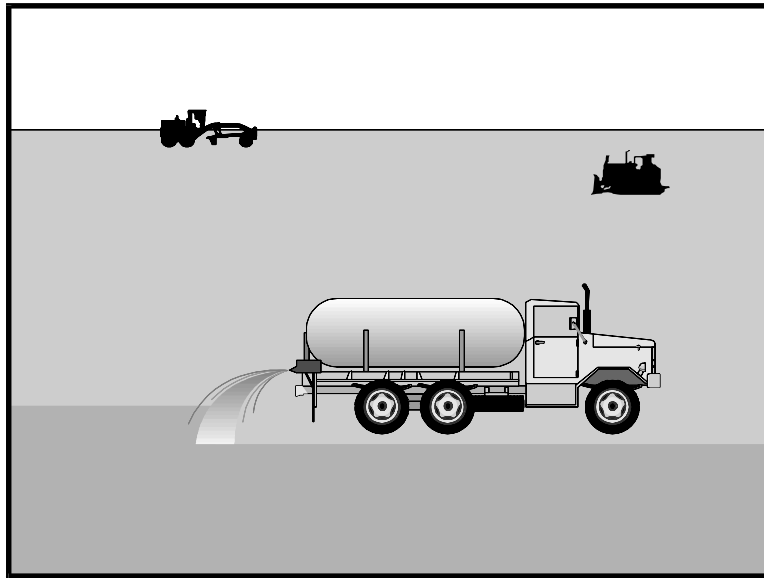
Maintenance and Inspection

- Avoid over-spray onto the travel way, sidewalks, lined drainage channels and existing vegetation.
- In the Tahoe Basin seed mixes shall use only the approved species as listed in TRPA's Native and Adapted Plant List.
- All seeded areas shall be inspected for failures and re-seeded, fertilized, and mulched within the planting season, using not less than half the original application rates. Any temporary revegetation efforts that do not provide adequate cover must be reapplied at a schedule recommended by the Landscape Architect.
- After any rainfall event, the Contractor is responsible for maintaining all slopes to prevent erosion.

Soil Stabilizers / Dust Palliatives

SS-5

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

Soil stabilizers are applied to exposed or disturbed soil to reduce wind and water erosion, typically as a final treatment when construction activity has ceased. **Dust palliatives** are used during construction to reduce dust emissions due to mechanical and wind forces, and typically do not have the longevity of soil stabilizers.

Appropriate Applications

Soil stabilizers are applied where specified in the contract plans or as directed by the engineer. Dust palliatives are typically applied at the contractor's discretion to disturbed areas requiring short-term temporary protection for erosion control/dust control and to comply with air quality standards. Because dust palliatives can often be incorporated into the work, they may be a good choice for areas where grading activities will soon resume. Apply on stockpiles to reduce water and wind erosion.

Limitations

- Soil stabilizers and dust palliatives are temporary in nature and may need reapplication.
- Soil stabilizers and dust palliatives require a minimum curing time until fully effective, as prescribed by the manufacturer, which may be 24 hours or longer. They may need reapplication after a storm event.
- Soil stabilizers and dust palliatives may need reapplication after a storm event, and will generally experience spot failures during heavy rainfall. If runoff penetrates the soil at the top of a treated slope, it is likely that the runoff will undercut the stabilized soil layer and discharge at a point further down slope.
- Some soil stabilizers and dust palliatives do not hold up to pedestrian or vehicular traffic across treated areas. For traffic areas, be sure to

select an appropriate product.

- Soil stabilizers and dust palliatives may not penetrate soil surfaces made up primarily of silt and clay, particularly when compacted.
- Some soil stabilizers and dust palliatives may have a deleterious effect on long-term landscaping. Use of soil stabilizers in areas to be landscaped should be coordinated with NDOT landscaping.
- Some soil stabilizers and dust palliatives may not perform well with low relative humidity. Refer to manufacturers' literature for humidity limitations. Under rainy conditions, some agents may become slippery or leach out of the soil.
- May not cure if low temperatures occur within 24 hours of application. Refer to manufacturers literature for temperature limitations.

Standards and Specifications

General Considerations

- Site-specific soil types will dictate appropriate soil stabilizers or dust palliatives to be used.
- Soil stabilizers and dust palliatives must be environmentally benign (non-toxic to plant and animal life), easy to apply, easy to maintain, economical, and shall not stain paved or painted surfaces, refer to Standard Specifications Section 211.03.09.
- Some products are compatible with existing vegetation.
- Performance of soil stabilizers and dust palliatives depends on temperature, humidity, and traffic across treated areas.
- Avoid over-spray onto the traveled way, sidewalks, lined drainage channels, and existing vegetation.

Selecting a Soil Stabilizer or Dust Palliative

Properties of common soil stabilizers and dust palliatives used for erosion control are provided in Tables 1 and 2. Use Table 1 to select a product for non-traffic applications, and Table 2 for traffic areas. Refer to Wind Erosion Control, SS-13, for more information about dust control. Factors to consider when selecting a product include the following:

- Suitability to situation - Consider where the product 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 stabilization will be needed, and if the product will be placed in an area where it will degrade rapidly.
- Soil types and surface materials - Fines and moisture content are key properties of surface materials. Consider a soil stabilizer or dust

palliative's ability to penetrate, likelihood of leaching, and ability to form a surface crust on the surface materials. Soil information can be obtained from the project's geotechnical report or from a Natural Resources Conservation District (NRCS) website.

- If working in Clark County, soil maps are available from the county.
- Frequency of application - The frequency of application 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 dust palliative has good penetration, low evaporation, and good longevity. Consider also that frequent application will require frequent equipment clean-up.

After considering the above factors, the soil stabilizers and dust palliatives in Tables 1 and 2 will be generally appropriate as follows:

Plant-Material Based (Short Lived)

Short lived products may only be used as dust palliatives.

Guar: Guar is a non-toxic, biodegradable, natural galactomannan-based hydrocolloid treated with dispersing agents for easy field mixing. It shall be applied at the rate of 10 to 15 lb per 1,000 gal (1.2 to 1.8 kg per 1,000 L) of water, depending on application machine capacity. Recommended minimum application rates are as follows:

Application Rates for Guar Soil Stabilizer

Slope (V:H):	Flat	1:4	1:3	1:2	1:1
lb/acre	40	45	50	60	70
kg/ha:	45	50	56	67	78

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 shall be applied at a rate of 80 to 200 lb/acre (90 to 225 kg/ha), 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 (170 kg/ha). Approximate drying time is 9 to 12 hours.

Plant-Material Based (Long Lived)

Tall Oil Pitch/Pitch and Rosin Emulsion: Generally, a non-ionic pitch and

rosin emulsion has a minimum solids content of 48%. The rosin shall be a minimum of 26% of the total solids content when included. The addition of rosin will strengthen the stabilizer, but also makes it more brittle and less UV resistant, decreasing its effective duration. The soil stabilizer shall be a non-corrosive, water-dilutable emulsion that upon application cures to a water insoluble binding and cementing agent. Application rate will be per the manufacturer's recommendations for the given situation and required duration.

Lignin Sulfonate: Byproduct of the kraft paper-making process, it is a natural adhesive that holds plant fibers together. It greatly increases the dry strength of the soil, is not humidity-dependant, lowers the freezing point of the road, and retains its effectiveness after reblading. High solubility results in leaching during heavy precipitation. Lignin products have a high BOD, and should not be used where runoff could contaminate a body of water. A neutralizing additive must be added to reduce its corrosive effects to aluminum alloys.

Application can be by water truck or hydraulic seeder with the emulsion/product mixture application rate as specified by the manufacturer.

Polymeric Emulsion Blends

Acrylic Copolymers and Polymers: Polymeric soil stabilizers shall consist of a liquid or solid polymer or copolymer with an acrylic base that contains a minimum of 55 percent solids. The polymeric compound shall be handled and mixed in a manner that will not cause foaming or shall contain an anti-foaming agent. The polymeric emulsion shall not exceed its shelf life or expiration date; manufacturers shall provide the expiration date. Polymeric soil stabilizer shall be readily miscible in water, non-injurious to seed or animal life, non-flammable, shall provide surface soil stabilization for various soil types without totally inhibiting water infiltration, and shall not re-emulsify when cured. The applied compound shall air cure within a maximum of 36 to 48 hours. Liquid copolymer shall be diluted at a rate of 10 parts water to 1 part polymer and applied to soil at a rate of 1,175 gal/acre (11,000 L/ha).

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 and applied with a hydraulic seeder at the rate of 20 gal/acre (190 L/ha). 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	kg/ha
Flat to 5:1	3.0 – 5.0	3.4 – 5.6
5:1 to 3:1	5.0 – 10.0	5.6 – 11.2
2:1 to 1:1	10.0 – 20.0	11.2 – 22.4

Poly-Acrylamide and Copolymer of Acrylamide: Linear copolymer polyacrylamide is packaged as a dry-flowable solid. When used as a stand-alone stabilizer, it is diluted at a rate of 10 lb/1,000 gal (1.2 kg/1,000 L) of water and applied at the rate of 5.0 lb/acre (5.6 kg/ha).

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 50 to 60 lb/acre (60 to 70 kg/ha). Drying times are 0 to 4 hours.

Cementitious-Based

Gypsum: This is a formulated gypsum-based product that readily mixes with water and sometimes 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 of 4,000 to 12, 000 lb/acre (4,500 to 13,500 kg/ha). Drying time is 4 to 8 hours.

Petroleum-Based

Petroleum Resin Emulsion: These products coat soil particles, increasing their mass and decreasing their likelihood of becoming airborne, but do not exhibit adhesive properties. They are water insoluble once cured, and hence provide a degree of surface waterproofing, and have good residual effectiveness. Used oils are prohibited as a soil stabilizers or dust palliatives because they contain toxic substances. Petroleum resin products should only be used for traffic areas such as haul roads, parking

and staging areas.

Applying Soil Stabilizers and Dust Palliatives

After selecting an appropriate product, the untreated soil surface must be prepared before applying the soil stabilizer. The untreated soil surface must contain sufficient moisture to assist the agent in achieving uniform distribution. In general, the following steps shall be followed:

- Follow manufacturer's recommendations for application rates and pre-wetting of application area.
- Prior to application, roughen embankment and fill areas. Track walking shall only be used where rolling is impractical.
- Consider the drying time for the selected product and apply with sufficient time before anticipated rainfall. Generally, soil stabilizers and dust palliatives require a minimum curing time of 24 hours before they are fully effective. Refer to manufacturer's instructions for specific cure times. Soil stabilizers and dust palliatives shall not be applied during or immediately before rainfall.
- Avoid over-spray onto the traveled way, sidewalks, lined drainage channels, sound walls, and existing vegetation.
- Soil stabilizers and dust palliatives shall not be applied to frozen soil, areas with standing water, under freezing or rainy conditions, or when the air temperature is below 4°C (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. Follow the manufacturer's application instructions.
- For liquid agents:
 - Crown or slope ground to avoid ponding.
 - Uniformly pre-wet ground at 0.03 to 0.3 gal/yd² (0.14 to 1.4 L/m²) or according to manufacturer's recommendations.
 - Apply solution under pressure. Overlap solution 6 to 12 in. (150 to 300 mm).
 - Allow treated area to cure for the time recommended by the manufacturer; typically, at least 24 hours.
 - In low humidities, reactivate chemicals by re-wetting with water at 0.1 to 0.2 gal/yd² (0.5 to 0.9 L/m²).

Soil Stabilizers / Dust Palliatives

SS-5

Adapted from Caltrans Construction Site BMPs

Maintenance and Inspection

- Reapplying the selected soil stabilizer may be needed for proper maintenance. High traffic areas shall be inspected on a daily basis, and lower traffic areas shall be inspected on a weekly basis.
- After any rainfall event, the Contractor is responsible for maintaining all slopes to prevent erosion.
- Maintain any unbroken, temporary mulched ground cover while DSAs are non-active. Repair any damaged ground cover and re-mulch exposed areas.
- Follow manufacturer's recommendations for maintaining and cleaning equipment after use.
- Maintenance and repair applications are included in the bid price. Additional payment will not be made.

Table 1
Properties of Soil Stabilizers for Erosion Control (Non-Traffic Areas)

Chemicals	Plant Material Based (Short Lived)	Plant Material Based (Long Lived)	Polymeric Emulsion Blends	Cementitious-Based Stabilizers
Relative Cost	Low	Low	Low	Low
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	Varies	Varies	4,500 to 13,500 L/Ha

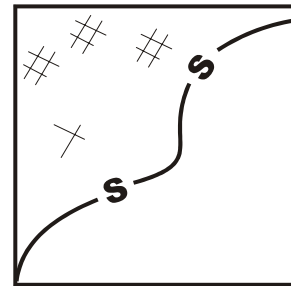
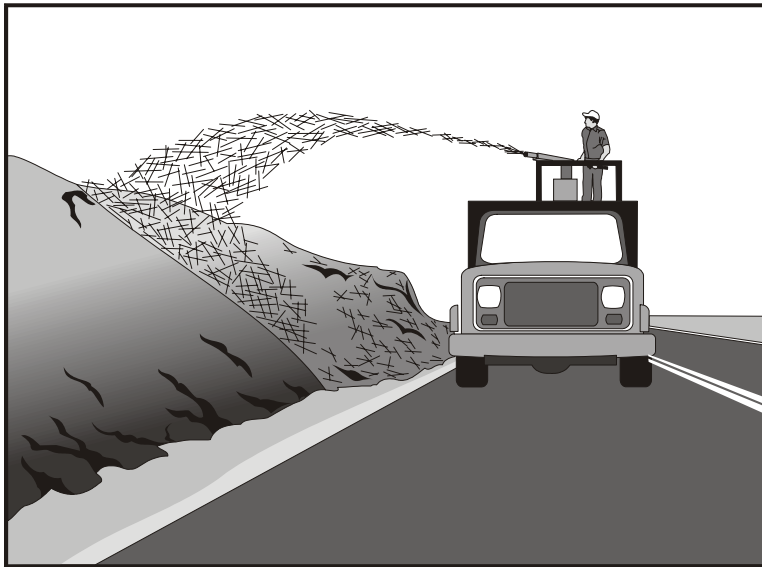
Table 2
Properties of Soil Stabilizers for Erosion Control (Traffic Areas)

Chemicals	Ligninosulfonate	Tall Oil Pitch Emulsion	Petroleum Resin Emulsion
Relative Cost	Moderate	Moderate	Moderate
Resistance to Leaching	Low	High	High
Longevity	Medium	Medium to Long	Medium
Minimum Curing Time before Rain	24 hours +	30-60 min (Prime Coat) 8-24 Hours (Mixed Into Base)	0-4 hours
Mode of Degradation	Biodegradable	Biodegradable	Photo/Chemically Degradable
Labor Intensive	No	No	No
Specialized Application Equipment	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher
Surface Crusting	Yes, but dissolves on rewetting	Yes	Yes
Clean-Up	Water	Water, before it dries	Water, before it cures

Straw Mulch

SS-6

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose Straw mulch consists of placing a uniform layer of straw and incorporating it into the soil with a studded roller or anchoring it with a tackifier stabilizing emulsion.

Appropriate Applications

- Straw mulch is typically used for soil stabilization as a temporary surface cover on disturbed areas until soils can be prepared for re-vegetation and permanent vegetation is established.
- Also typically used in combination with temporary and/or permanent seeding strategies to enhance plant establishment.

Limitations

- Availability of erosion control contractors and straw may be limited prior to the rainy season due to high demand.
- There is a potential for introduction of weed-seed and unwanted plant material.
- When straw blowers are used to apply straw mulch, the treatment areas must be within 150 ft. of a road or surface capable of supporting trucks.
- Straw mulch applied by hand is more time intensive and potentially costly.
- May have to be removed prior to permanent seeding or soil stabilization.
- Application of straw mulch should be performed in calm conditions with wind speeds below 8 mph.

- When working in sandy soils, pushing the straw into the soils with shovels, discs, or other equipment has limited effectiveness. Other methods, such as the use of tackifiers, should be considered to secure the mulch in place.
- Standards and Specifications
- Straw shall be derived from wheat, rice, or barley.
 - All materials shall conform to Standard Specifications Section 726.
 - A tackifier is the preferred method for anchoring 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 shall only be used where other methods are impractical.
 - Avoid placing straw onto the traveled way, sidewalks, lined drainage channels, sound walls, and existing vegetation.
 - Straw mulch with tackifier shall not be applied during or immediately before rainfall.

Application Procedures

- Generally, apply loose straw at a minimum rate of 4,000 lb/acre, or as indicated in the project's special provisions, manufacturer's recommendation, either by machine or by hand distribution. Application procedure should follow Standard Specifications Section 211. If stabilizing emulsion will be used to anchor the straw mulch in lieu of incorporation, 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 and shall be considered when applying duff.
- The straw mulch must be evenly distributed on the soil surface.
- Anchor the mulch in place by using a tackifier or by "punching" it into the soil mechanically (incorporating).
- A tackifier acts to glue the straw fibers together and to the soil surface. The tackifier shall 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.
- Methods for holding the straw mulch in place depend upon the slope steepness, accessibility, soil conditions and longevity. If the selected method is incorporation of straw mulch into the soil, then do as follows:

- Applying and incorporating straw shall follow the requirements in Standard Specifications Sections 726 and 211.
- On small areas, a spade or shovel can be used.
- 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 coultter, known commercially as a "crimper".
- On small areas and/or steep slopes, straw can also be held in place using plastic netting or jute. The netting shall be held in place using 11 gauge wire staples, geotextile pins or wooden stakes (as described in BMP SS-7, "Geotextiles, Plastic Covers and Erosion Control Blankets/Mats").

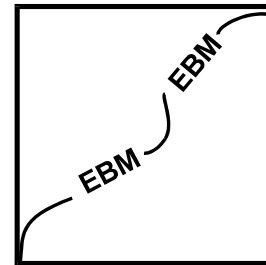
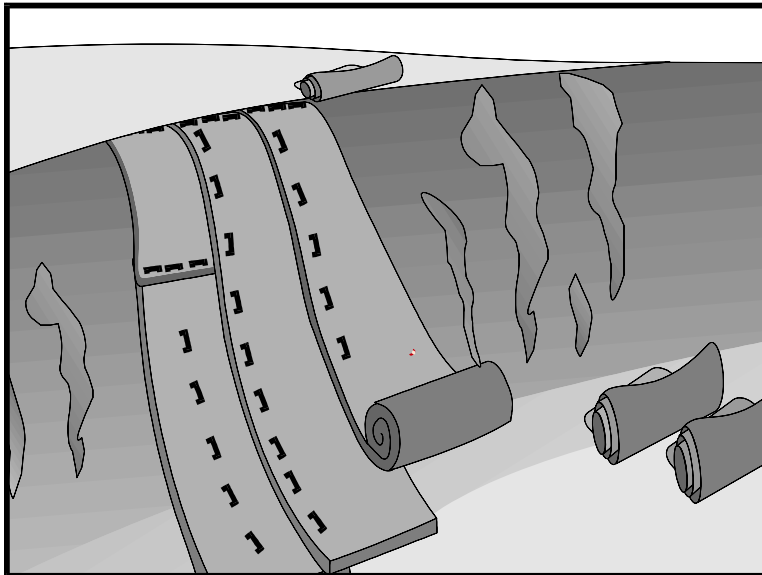
Maintenance and Inspections

- The key consideration in Maintenance and Inspection is that the straw needs to last long enough to achieve erosion control objectives.
- Maintain an unbroken, temporary mulched ground cover while disturbed soil areas are non-active. 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.
- After any rainfall event, the Contractor is responsible for maintaining all slopes to prevent erosion.

Geotextiles, Mats, Plastic Covers and Erosion Control Blankets

SS-7

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose This Best Management Practice (BMP) involves the placement of geotextiles, mats, plastic covers, or erosion control blankets to temporarily stabilize disturbed soil areas and protect soils from erosion by wind or water. Refer to the NDOT Qualified Products List (QPL) for pre-approved products.

Appropriate Applications These measures are used when disturbed soils may be particularly difficult to stabilize, including the following situations:

- Steep slopes, generally steeper than 3:1
- Slopes with loose soils or non-cohesive sandy and/or silty material.
- 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 of environmentally sensitive areas (ESAs).

Limitations

- Blankets and mats are more expensive than other erosion control measures, due to labor and material costs. This usually limits their application to areas inaccessible to hydraulic equipment, or where other measures are not applicable, such as channels.

Geotextiles, Mats, Plastic Covers and Erosion Control Blankets

Adapted from Caltrans Construction Site BMPs

- Blankets and mats 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).
- Plastic sheeting is easily vandalized, easily torn, photodegradable, and must be disposed of at a landfill in accordance with Standard Specifications section 107.
- Non-degradable fabrics must generally be removed when permanent stabilization measures are ready to be installed. Failure to move these materials creates trash that may be environmentally harmful and may result in littering fines.
- Plastic results in 100 percent runoff, which may cause serious erosion problems in the areas receiving the increased flow.
- 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 alternative measures, such as seeding and mulching, may be installed.
- Geotextiles, mats, plastic covers, and erosion control covers have maximum flow rate limitations; consult the manufacturer for proper selection.

Standards and Specifications

Material Selection

There are many types of erosion control blankets and mats, and selection of the appropriate type shall be based on the specific type of application and site conditions. Certification of compliance shall be in accordance with Standard Specifications Sections 211 and 726, the project's Special Provisions and the following sections.

Geotextiles

A wide variety of Geotextiles are available dependant on their intended uses which range from separation of different materials (such as road bedding and underlying soils) to lining ponds and landfills. For temporary erosion control, geotextile fabrics typically consist of woven or non-woven fabrics that are used to line channels or slopes and are usually used in combination with rock or other mulches or riprap.

Geomembranes are more impervious type of geotextile and can be used to cover stockpiles or bare soil areas, where a more durable material (as compared to plastic sheeting) is desired. The use of geomembranes for this application will likely be very limited due to their higher costs.

Geotextiles, Mats, Plastic Covers and Erosion Control Blankets

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Adapted from Caltrans Construction Site BMPs

- Geotextiles should be secured in place with wire staples or sandbags and by keying into tops of slopes and edges to prevent infiltration of surface waters under Geotextile. Staples shall be made of 0.12 in. steel wire and shall be U-shaped with 8 in. legs and 2 in. crown.
- Geotextiles may be reused if, in the opinion of the Engineer, they are suitable for the use intended.

Plastic Covers

- Plastic sheeting shall have a minimum thickness of 6 mil and shall be keyed in at the top of slope 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 shall be at least a 12 to 24 in. overlap of all seams. Edges shall be embedded a minimum of 6 in. in soil.
- All sheeting shall be inspected periodically after installation and after significant rainstorms to check for erosion, undermining, and anchorage failure. Any failures shall be repaired immediately. If washout or breakages occur, the material shall be re-installed after repairing the damage to the slope.

Erosion Control Blankets/Mats

- Biodegradable rolled erosion control products (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.
 - **Jute** is a natural fiber that is made into a yarn that is loosely woven into a biodegradable mesh. It is designed to be used in conjunction with vegetation and has longevity of approximately one year. The material is supplied in rolled strips, which shall be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.
 - **Excelsior (curled wood fiber)** blanket material shall consist of machine-produced mats of curled wood excelsior with 80 percent of the fiber 6 in. or longer. The excelsior blanket shall be of consistent thickness. The wood fiber shall be evenly distributed over the entire area of the blanket. The top surface of the blanket shall be covered with a photodegradable extruded plastic mesh. The blanket shall be smolder resistant without the use of chemical

Geotextiles, Mats, Plastic Covers and Erosion Control Blankets

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additives and shall be non-toxic and non-injurious to plant and animal life. Excelsior blanket shall be furnished in rolled strips a minimum of 48 in. wide, and shall have an average weight of 0.1 lb/ft², ± 10 percent, at the time of manufacture. Excelsior blankets shall be secured in place with wire staples. Staples shall be made of 0.12 in. steel wire and shall be U-shaped with 8 in. legs and 2 in. crown.

- **Straw blanket** shall be machine-produced mats of straw with a lightweight biodegradable netting top layer. The straw shall be attached to the netting with biodegradable thread or glue strips. The straw blanket shall be of consistent thickness. The straw shall be evenly distributed over the entire area of the blanket. Straw blanket shall be furnished in rolled strips a minimum of 6.5 ft. wide, a minimum of 82 ft. long, and a minimum of 0.055 lb/ft². Straw blankets shall be secured in place with wire staples. Staples shall be made of 0.12- in. steel wire and shall 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 shall be secured to the ground with U-shaped staples or stakes in accordance with manufacturers' recommendations.
- **Coconut fiber blanket** shall be machine-produced mats of 100 percent coconut fiber with biodegradable netting on the top and bottom. The coconut fiber shall be attached to the netting with biodegradable thread or glue strips. The coconut fiber blanket shall be of consistent thickness. The coconut fiber shall be evenly distributed over the entire area of the blanket. Coconut fiber blanket shall be furnished in rolled strips with a minimum of 6.5 ft. wide, a minimum of 82 ft. long, and a minimum of 0.055 lb/ft². Coconut fiber blankets shall be secured in place with wire staples. Staples shall be made of 0.12 in steel wire and shall 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 shall be secured to the

Geotextiles, Mats, Plastic Covers and Erosion Control Blankets

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soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Straw coconut fiber blanket** shall 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 shall be attached to the netting with biodegradable thread or glue strips. The straw coconut fiber blanket shall be of consistent thickness and shall be evenly distributed over the entire area of the blanket. Straw coconut fiber blanket shall be furnished in rolled strips a minimum of 6.5 ft. wide, a minimum of 82 ft. long and a minimum of 0.055 lb/ft². Straw coconut fiber blankets shall be secured in place with wire staples. Staples shall be made of 0.12 in. steel wire and shall be U-shaped with 8 in. legs and 2 in. crown.
- Non-biodegradable RECPs are typically composed of polyethylene, polypropylene, 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 shall 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 2 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 shall 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 shall be secured with U-shaped

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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 ninety percent open area, which facilitates root growth. Its 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 shall 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 shall be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

Site Preparation

- Proper site preparation is essential to ensure complete contact of the blanket or matting with the soil.
- 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 in. to 3 in. of topsoil. When using a fabric or mat that is designed to be used in conjunction with seeding or re-vegetation follow the manufacturer's guidelines for proper seedbed for proper seedbed preparation, seed application, and/or planting.

Seeding

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 check slots and other areas disturbed during installation must be re-seeded.

Geotextiles, Mats, Plastic Covers and Erosion Control Blankets

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Adapted from Caltrans Construction Site BMPs

Where soil filling is specified, seed the matting and the entire disturbed area after installation and prior to filling the mat with soil.

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.
- Staples shall be made of 0.12 in. steel wire and shall be U-shaped with 8 in. legs and 2 in. crown. Wire staples shall be minimum of 11 gauge.
- Metal stake pins shall be 0.188 in. diameter steel with a 1.5 in. steel washer at the head of the pin.
- Wire staples and metal stakes shall be driven flush to the soil surface.
- All anchors shall be a minimum of 6 in. long and have sufficient penetration to resist pullout. Longer anchors may be required for loose soils as determined by the responsible party, NDEP Inspector, or by Manufacturer's installation guidelines.

Installation on Slopes

Installation shall 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 6 in. and staple every 3 ft.
- 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 shall be placed down the center and staggered with the staples placed along the edges. Steep slopes, 1:1 to 2:1, require a minimum of 2 staples/yd². Moderate slopes, 2:1 to 3:1, require a minimum of 1½ staples/yd², placing 1 staple/yd on centers. Gentle slopes require a minimum of 1 staple/yd².

Geotextiles, Mats, Plastic Covers and Erosion Control Blankets

Adapted from Caltrans Construction Site BMPs

Installation in Channels

Installation shall 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 slots 4 in. deep and 4 in. wide along each side of the installation to bury edges of matting, whenever possible extend matting 2 in. 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 6 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 6 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 ft. to 30 ft. intervals in lieu of excavated check slots.
- Shingle lap ends by overlapping uphill on top of downhill fabric a minimum of 12 in. to prevent water from flowing underneath fabric at splice locations. See schematics at end of this fact sheet.
- Place edges of outside mats in previously excavated longitudinal slots, anchor using prescribed staple pattern, backfill and compact soil.

Geotextiles, Mats, Plastic Covers and Erosion Control Blankets

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Adapted from Caltrans Construction Site BMPs

- Anchor, fill and compact upstream end of mat in a 6 in. by 12 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)

- 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.

Blanket Removal

- When no longer required for work, non-degradable temporary blankets shall be removed from the site and disposed of in conformance with NDOT Standard Specifications Section 107.

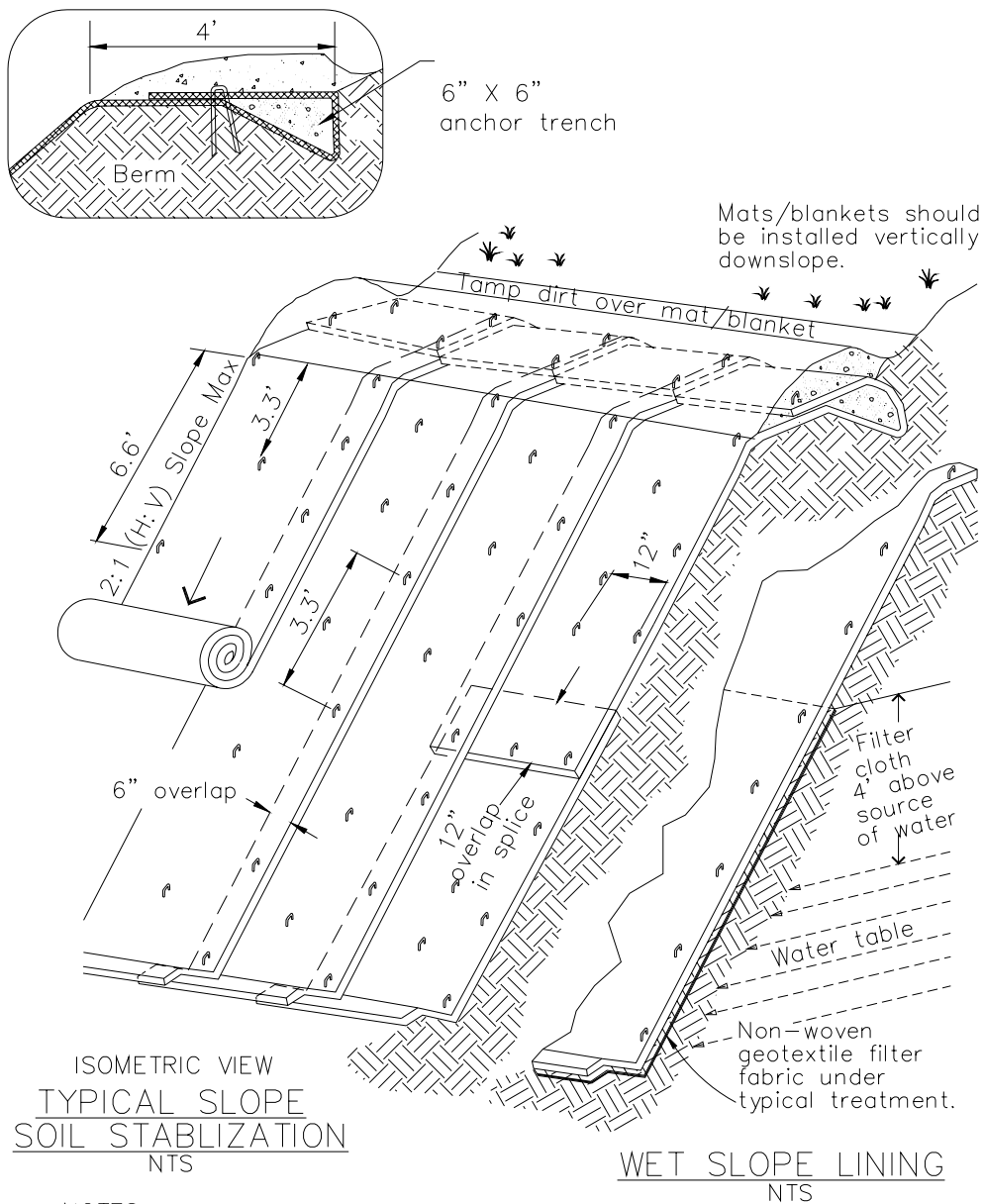
Maintenance and Inspection

Areas treated with temporary soil stabilization shall be inspected as specified in the special provisions. Areas treated with temporary geotextiles, mats, blankets and other covers shall be maintained to provide adequate erosion control. Temporary geotextiles, mats, blankets and other covers shall be reapplied or replaced on exposed soils when greater than 10% of the previously treated area becomes exposed or exhibits visible erosion or as determined by the responsible party.

- All blankets and mats shall be inspected periodically after installation.
- Installation shall be inspected after significant rainstorms to check for erosion and undermining. Any failures shall be repaired immediately.
- If washout or breakage occurs, re-install the material after repairing the damage to the slope or channel.

Geotextiles, Mats, Plastic Covers and Erosion Control Blankets

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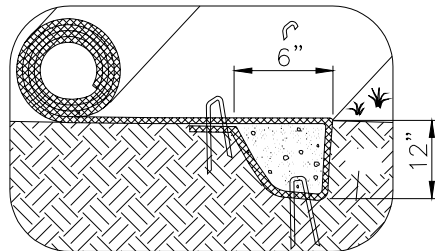
NOTES:

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

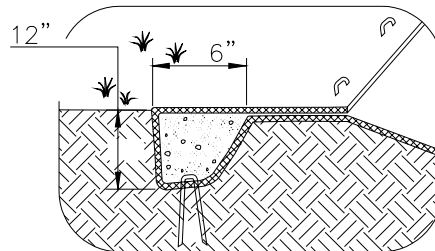
Geotextiles, Mats, Plastic Covers and Erosion Control Blankets

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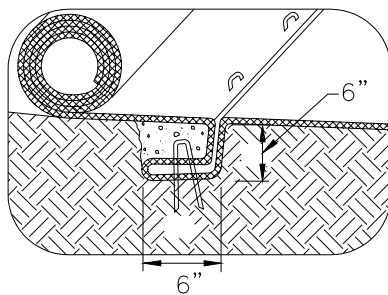
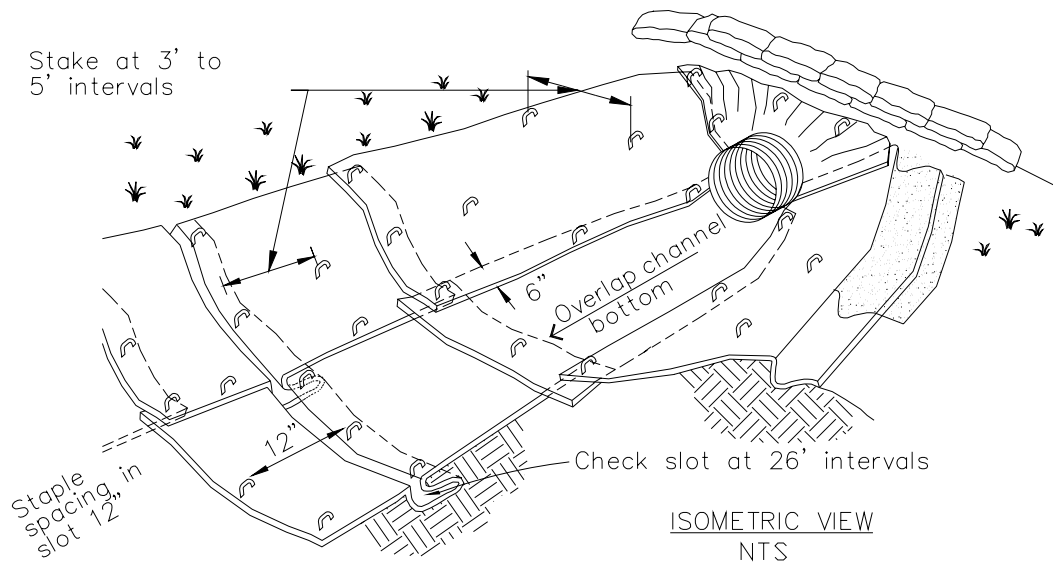
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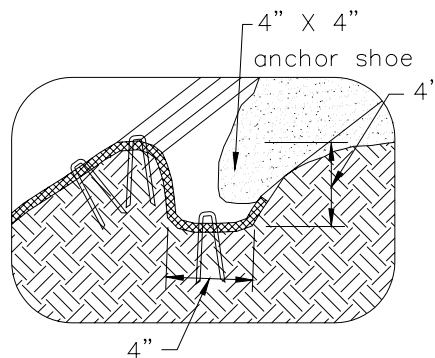
INITIAL CHANNEL ANCHOR TRENCH XS
NTS



TERMINAL SLOPE AND CHANNEL
ANCHOR TRENCH XS
NTS



INTERMITTENT CHECK SLOT XS
NTS



LONGITUDINAL ANCHOR TRENCH XS
NTS

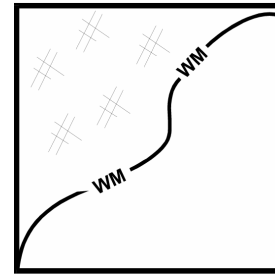
NOTES:

1. Check slots to be constructed per manufacturers specifications.
2. Staking or stapling layout per manufacturers specifications.
3. Install per manufacturer's recommendations

Wood Mulching

SS-8

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose Wood mulching consists of applying a mixture of chipped or cut wood mulch per Standard Specification Section 726, bark or compost. Wood mulch is mostly applicable to landscape projects.

The primary function of wood mulching is to reduce erosion by protecting bare soil from rainfall impact, increasing infiltration, and reducing runoff.

Appropriate Applications Wood mulching is considered a temporary soil stabilization (erosion control) alternative in the following situations:

- As a stand-alone temporary surface cover on disturbed areas until soils can be prepared for revegetation and permanent vegetative cover can be established.
- As short term, non-vegetative ground cover on slopes to reduce rainfall impact, decrease the velocity of sheet flow, settle out sediment and reduce wind erosion.

Limitations

- Wood mulch may introduce unwanted species.
- Chipped or cut wood per Standard Specification Section 726 does not withstand concentrated flows and is prone to sheet erosion.
- Green material has the potential for the presence of unwanted weeds and other plant materials. Delivery system is primarily by manual labor, although pneumatic application equipment is available.
- Wood mulch should not be applied in winds that cause unwanted or excessive spreading of the mulch.

Standards and Specifications ***Mulch Selection***

There are many types of mulches, and selection of the appropriate type shall be based on the type of application and site conditions. Prior to use of wood mulches, there shall be concurrence with the NDOT headquarters Landscape Architect since some mulch use on construction projects may not be compatible with planned or future projects. Selection of wood mulches by the Contractor shall comply with Standard Specifications Sections 726 and 211.

Application Procedures

Prior to application, after existing vegetation has been removed, roughen embankment and fill areas by rolling with 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 (2) methods are highlighted here:

- **Green Material:** This type of mulch is produced by recycling of vegetation trimmings such as chipped or cut shrubs and trees. Methods of application are generally by hand, although pneumatic methods are available. Materials composted must be indigenous-no compost of noxious weeds. Green material must conform to Standard Specification Section 726.
 - It can be used as a temporary ground cover with or without seeding.
 - The green material shall be evenly distributed on site to a depth of not more than 2 in.
- **Chipped or cut Wood per Standard Specification Section 726:** Suitable for ground cover in ornamental or revegetated plantings.
 - Chipped or cut wood/bark per Standard Specification Section 726 is conditionally suitable; see note under limitations.
 - Shall be distributed by hand or another method approved by the engineer.
 - The mulch shall be evenly distributed across the soil surface to a depth of 3 in.
- **Avoid mulch placement onto the traveled way, sidewalks, lined drainage channels, sound walls, and existing vegetation.**
- **All material must be removed prior to re-starting work on the slopes. In some cases, wood mulch may be incorporated into the soil if approved**

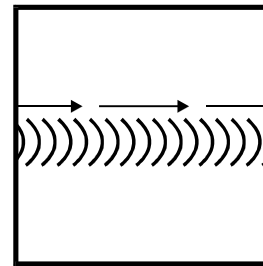
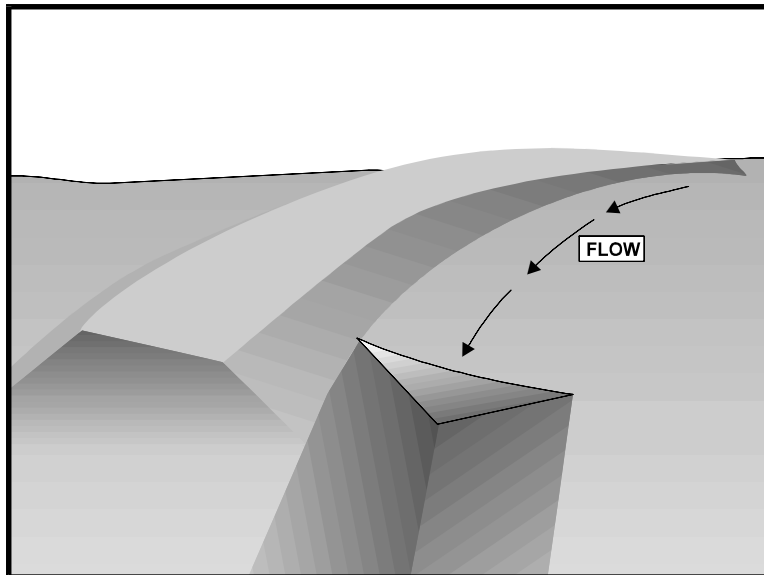
by the Engineer.

- Mulch material should come from indigenous plants only.
- Regardless of the mulching technique selected, the key consideration in Maintenance and Inspection 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 shall last the length of time the site will remain barren or until final re-grading and re-vegetation.
- Where vegetation is not the ultimate cover, such as ornamental and landscape applications of bark or wood chips, inspection and maintenance shall focus on longevity and integrity of the mulch.

Earth Dikes/Drainage Swales and Lined Ditches

SS-9

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose These are structures that intercept, divert and convey surface run-on, generally sheet flow, to prevent erosion.

Appropriate Applications Earth dikes/drainage swales and lined ditches may be used to:

- Convey surface runoff down sloping land.
- Intercept and divert runoff to avoid sheet flow over sloped surfaces.
- Divert and direct runoff towards a stabilized watercourse, drainage pipe or channel.
- To intercept runoff from paved surfaces.

Earth dikes/drainage swales and lined ditches also may be used:

- Below any grade where runoff begins to concentrate
- Along roadways and facility improvements subject to flood drainage
- At the top of slopes to divert run-on from adjacent or undisturbed slopes
- At bottom and mid-slope locations to intercept sheet flow and convey concentrated flows

This BMP may be implemented on a project-by-project basis with other BMPs when determined necessary.

Earth Dikes/Drainage Swales and Lined Ditches

Adapted from Caltrans Construction Site BMPs

- Limitations**
- Earth dikes/drainage swales and lined ditches are not suitable as sediment trapping devices.
 - 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.

Standards and Specifications Care must be applied to correctly size and locate earth dikes, drainage swales and lined ditches. The risks to public safety and property damage and environmental consequences, due to erosion of the measure, soil types, over topping, flow backups, washout, and drainage flow patterns, should be carefully considered when designing these facilities. Unless local drainage design ordinances or criteria state otherwise and are more stringent, the following general design guidelines should be considered:

- One temporary drain or swale should serve no more than 5 acres,
- In the Lake Tahoe Basin, temporary conveyances shall not be overtopped by the 20 yr., 1 hr. event, for the remainder of Nevada facilities should be designed for the 2 yr., 24 hour event unless local criteria are more stringent.
- Avoid constructing drains or swales in cut or fill slopes whenever possible.
- Compact all dikes, berms and fills per Standard Specification Section 207 for culvert foundation backfill,
- Conveyances with slopes less than 5% shall be stabilized by seeding or by mulching and/or geotextile fabric if re-vegetation is not possible. Slopes greater than 5% should be lined with erosion control mats, blankets, and/or geogrids, webs or meshes with rock mulch or rip-rap as deemed appropriate by the designer,
- Side slopes should be 2:1 or flatter,
- Drainage gradients should be at least 1% but not greater than 15%,
- Construct swales and dikes downstream to upstream
- Provide stabilized outlets.

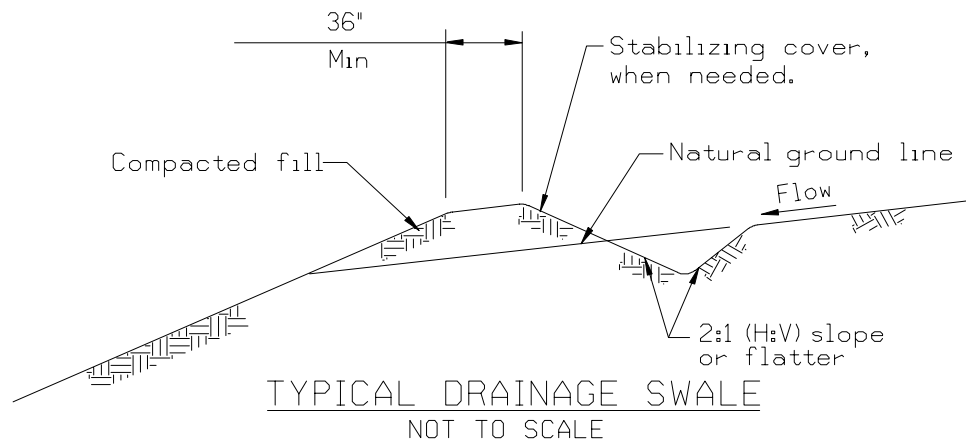
- Maintenance and Inspections**
- Inspect temporary measures prior to the rainy season, after rainfall events, and regularly (approximately once per week) during the rainy season. See Section 2 of this manual for rainy season description.
 - Inspect ditches and berms for washouts. Replace lost riprap, damaged linings or soil stabilizers as needed.

Earth Dikes/Drainage Swales and Lined Ditches

SS-9

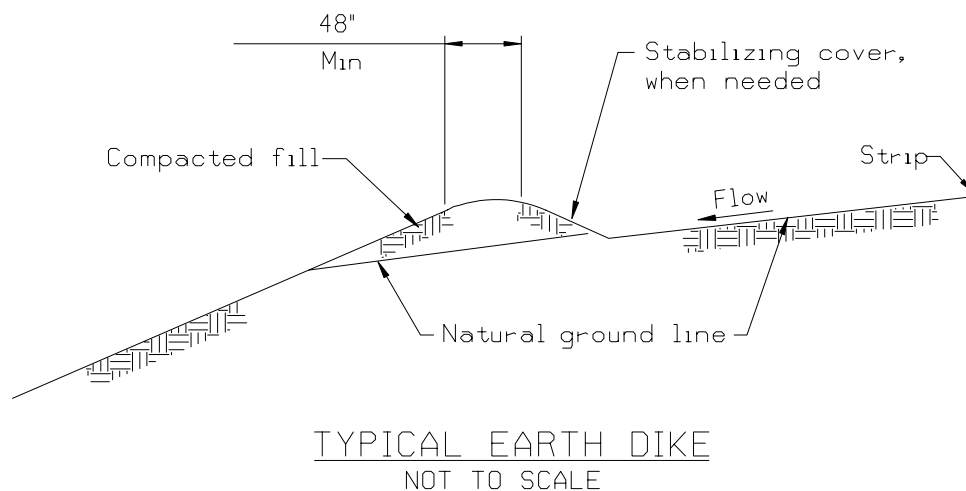
Adapted from Caltrans Construction Site BMPs

- 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 shall be completely removed as soon as the surrounding drainage area has been stabilized, or at the completion of construction.



NOTES:

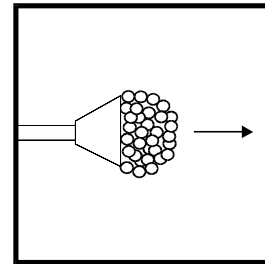
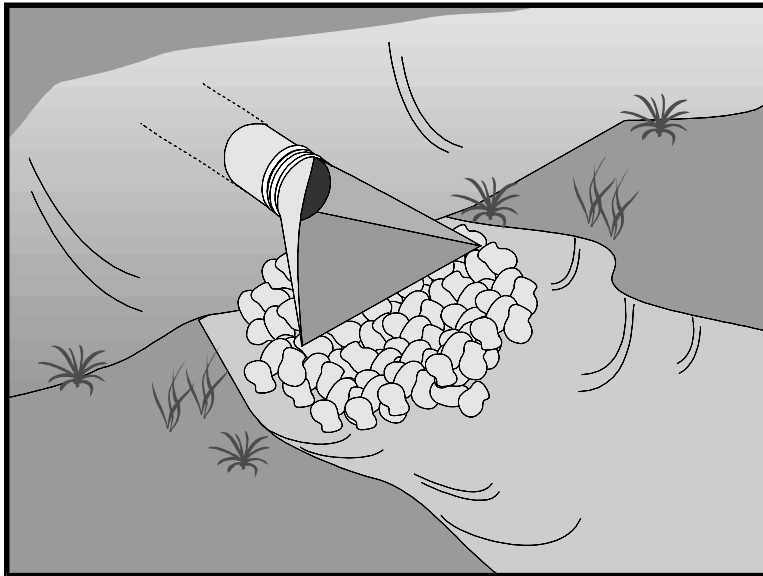
1. Stabilize inlet, outlets and slopes.
2. Properly compact the subgrade.



Outlet Protection/Velocity Dissipation Devices

SS-10

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

Outlet protection/velocity dissipation devices are placed at pipe outlets to prevent scour and reduce the velocity and/or energy of exiting storm water flows. This fact sheet provides guidance for their use as a temporary BMP, which must be removed at the end of construction. Permanent outlet protection will be specified in the construction plans. Additional guidance on the sizing and the use of outlet protection may be found in the NDOT Drainage Manual or in FHWA's Hydraulic Engineering Circular (HEC) 14, Hydraulic Design of Energy Dissipaters for Culverts and Channels, Sept. 1983 FHWA #EPD-86-110.

Appropriate Applications

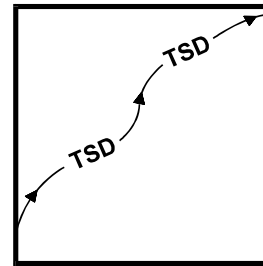
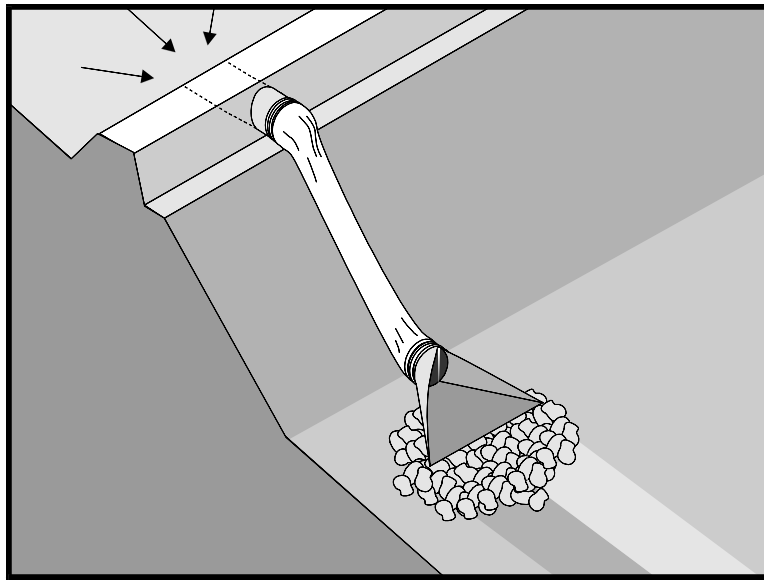
- These devices may be used at the following locations:
 - Outlets of pipes, drains, culverts, slope drains, diversion ditches, swales, conveyances or channels.
 - Outlets located at the bottom of mild to steep slopes.
 - Discharge outlets that carry continuous flows of water.
 - Outlets subject to short, intense flows of water, such as flash floods.
 - Points where lined conveyances discharge to unlined conveyances.
- This BMP may be implemented on a project-by-project basis with other BMPs when determined necessary.

Outlet Protection/Velocity Dissipation Devices

Adapted from Caltrans Construction Site BMPs

- | | |
|------------------------------|--|
| Limitations | ■ Loose rock may have stones washed away during high flows unless it is designed properly. |
| Standards and Specifications | <ul style="list-style-type: none">■ There are many types of energy dissipaters, one of which is shown in Standard Drawing R-3.1.4, Riprap Apron.■ Install riprap at selected outlet. Riprap aprons are best suited for temporary use during construction.■ Carefully place riprap to avoid damaging the filter fabric in accordance with Standard Specifications Section 610.■ For proper operation of apron:<ul style="list-style-type: none">- 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.- Protect the underlying erosion control fabric with the corresponding class of riprap bedding per Standard Specification Section 706.■ Outlets on slopes steeper than 10 percent shall have additional protection. |
| Maintenance and Inspection | <ul style="list-style-type: none">■ Inspect temporary measures prior to the rainy season, after rainfall events, and regularly (approximately once per week) during the rainy season.■ Inspect apron for displacement of the riprap and/or damage to the underlying fabric. Repair fabric and replace riprap that has washed away.■ Inspect for scour beneath the riprap and around the outlet. Repair damage to slopes or underlying erosion control fabric per Standard Specification Section 726.■ Temporary devices shall be completely removed as soon as the surrounding drainage area has been stabilized, or at the completion of construction. |

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition 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 lined ditches to intercept and direct surface flow away from slope areas to protect cut or fill slopes. Functions as both a temporary and permanent BMP. Functions as both a temporary and permanent BMP.

Appropriate Applications

- Slope drains may be used at construction sites where slopes may be eroded by surface runoff.
- This BMP may be implemented on a project-by-project basis with other BMPs.
- Slope drains must be designed by a hydraulic engineer.

Limitations

- Severe erosion may result when slope drains fail by over topping, piping, or pipe separation.

Standards and Specifications

- 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.
- Maximum slope generally limited to 2:1, as energy dissipation below steeper slopes is difficult.
- Direct surface runoff to slope drains with interceptor dikes. See BMP SS-8, "Earth Dikes/Drainage Swales, and Lined Ditches".
- Slope drains can be placed on or buried underneath the slope surface.
- Allowable materials are Corrugated Steel, Aluminum or Polyethylene per Standard Specifications Section 608.

- 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. The Contractor or his/her engineer must insure that high velocities/energy is not created at the outlet of the drain.
 - Protect inlet and outlet of slope drains: use standard flared end section at entrance for pipe slope drains 12 in. and larger.
 - Slope drains should not exceed 18" diameter. Use parallel pipes if necessary to convey design flows.
 - In Lake Tahoe, size slope drains to convey the 20 year, 1 hr. storm. In the remainder of Nevada the 2 yr., 24 hr. event shall be used to size temporary slope drains.

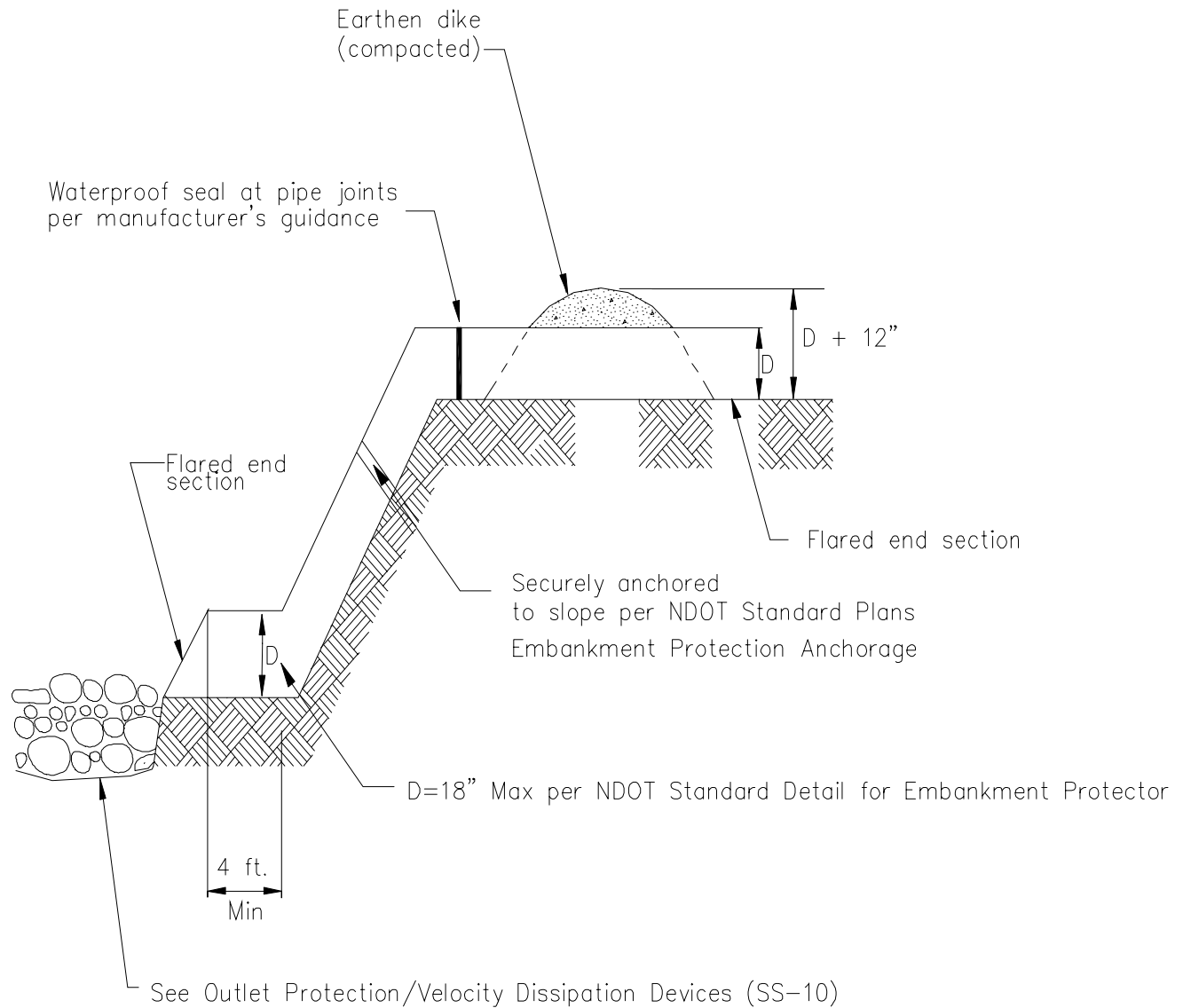
Maintenance and Inspection

- Inspect when rain is forecasted and after each rainstorm, and twice monthly until the tributary drainage area has been stabilized. Follow routine inspection procedures for inlets thereafter.
- 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.
- 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.).

Slope Drains

SS-11

Adapted from Caltrans Construction Site BMPs



TYPICAL SLOPE DRAIN
NOT TO SCALE

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

Drainage systems including the stream channel, streambank, 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. Best Management Practices can reduce the discharge of sediment and other pollutants and minimize the impact of construction activities on watercourses. Streams listed as 303(d) by the Nevada Department of Environmental Protection (NDEP) may require numerous measures to prevent any increases in sediment load to the stream.

Appropriate 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 approval by the NDEP may be included in contract documents. 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, by the Nevada Division of Environmental Protection will require stringent controls to prevent further water quality degradation.

Standards and Specifications

Planning

- Proper planning, design, and construction techniques can minimize impacts normally associated with in-stream construction activities. Poor planning can adversely affect soil, fish, and 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 (SS-1)

- Construction activities should be scheduled according to the relative sensitivity of the environmental concerns and in accordance with SS-1 "Scheduling." Scheduling considerations will be different when working near perennial streams vs. ephemeral streams and are as follows:

When working in or next to ephemeral streams, or next to perennial 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. For perennial streams, scheduling in-stream work for low flows, establishing an isolation area, or diverting the stream will significantly decrease the amount of sediment stirred up by construction work. However, when closing out 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 ("first flush") of the season. When working next to ephemeral or perennial streams, erosion and sediment controls (see silt fences, 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 (15 m) from stream channel unless not possible. 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 pre-disturbed areas 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 pounds per square inch (PSI) 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 (SS-2)

- Preserve existing vegetation in accordance with SS-2. 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. This information is intended as general guidance only, refer to the Project Plans and Special Provisions for specific slope and buffer width requirements.

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, evapotranspiration, 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 100-1,500 ft.

When working near watercourses, it is important to understand the work site's placement in the watershed. Riparian vegetation in the 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. This information is intended as general guidance only, refer to the Project Plans and Special Provisions for specific slope and buffer width requirements.

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 (SS-3)

- Apply hydraulic mulch on disturbed streambanks above mean high water level in accordance with SS-3 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 (SS-4)

- Hydroseed disturbed streambanks in accordance with SS-4.

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 stabilizers (SS-5)

- Apply soil stabilization to disturbed streambanks in accordance with SS-5.

Limitations

- Do not place soil stabilizer below the mean high water level. Soil stabilizer must be environmentally benign and non-toxic to aquatic organisms.

Straw Mulch (SS-6)

- Apply straw mulch to disturbed streambanks in accordance with SS-6.

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, Plastic Covers, and Erosion Control Blankets (SS-7)

- Install geotextiles, erosion control blankets and plastic as described in SS-7 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. Contact NDEP for appropriate applications. 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 (SS-9)

- Convey, intercept, or divert runoff from disturbed streambanks using earth dikes, drainage swales, or lined ditches (SS-9).

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 outlet protection/velocity dissipation devices (SS-10) must be placed at outlets to minimize erosion and scour.

Outlet Protection/Velocity Dissipation Devices (SS-10)

- Place outlet protection or velocity dissipation devices at outlets of pipes, drains, culverts, slope drains, diversion ditches, swales, conduits or channels in accordance with SS-10.

Slope Drains (SS-11)

- Use slope drains to intercept and direct surface runoff or groundwater into a stabilized watercourse, trapping device or stabilized area in accordance with SS-11.

Limitations

- Appropriately sized outlet protection/velocity dissipation devices (SS-10) must be placed at outlets to minimize erosion and scour.

STREAMBANK SEDIMENT CONTROL***Silt Fences (SC-1)***

- Install silt fences in accordance with SC-1 to control sediment. Silt fences should only be installed where sediment-laden water can pond, thus allowing the sediment to settle out.

Sediment logs (SC-5)

- Install sediment logs in accordance with SC-5 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, sediment logs should be used in conjunction with other sediment control methods such as silt fence (SC-1). Install silt fence (SC-1), or other sediment control method along toe of slope above the high water level.

Gravel Bag Berm (SC-6)

- A gravel bag berm or barrier can be utilized to intercept and slow the flow of sediment-laden sheet flow runoff in accordance with SC-6. 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.

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 Section.

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 esthetics 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 20-gauge (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 berms before and after each significant rainfall event and weekly throughout the rainy season.
- Reshape berms as needed and replace lost or dislodged rock, and/or wire mesh.
- Inspect for sediment accumulation; remove sediments when depth reaches one-third of the berm height or 12 in., whichever occurs first.
- When project is complete remove the wire mesh.

Portable Precast Concrete Barrier Rail (PPCBR)

Description and Purpose:

This is temporary sediment control that uses PPCBR to form the sediment deposition area, or to isolate the near-bank construction area. Install PPCBR at toe of slope in accordance with procedures described in Clear Water Diversion (NS-5).

Barriers are placed end-to-end in a pre-designed configuration and gravel-filled bags are used at the toe of the barrier and also 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 PPCBR method should not be used to dewater a project site, as the barrier is not watertight.

Standards and Specifications:

- Refer to NS-5 "Clear Water Diversion" for standards and specifications.

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)

- 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 of soil 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 any 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 flows, or ‘first flush’. 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 Nevada Department of Wildlife and NDEP may be required.

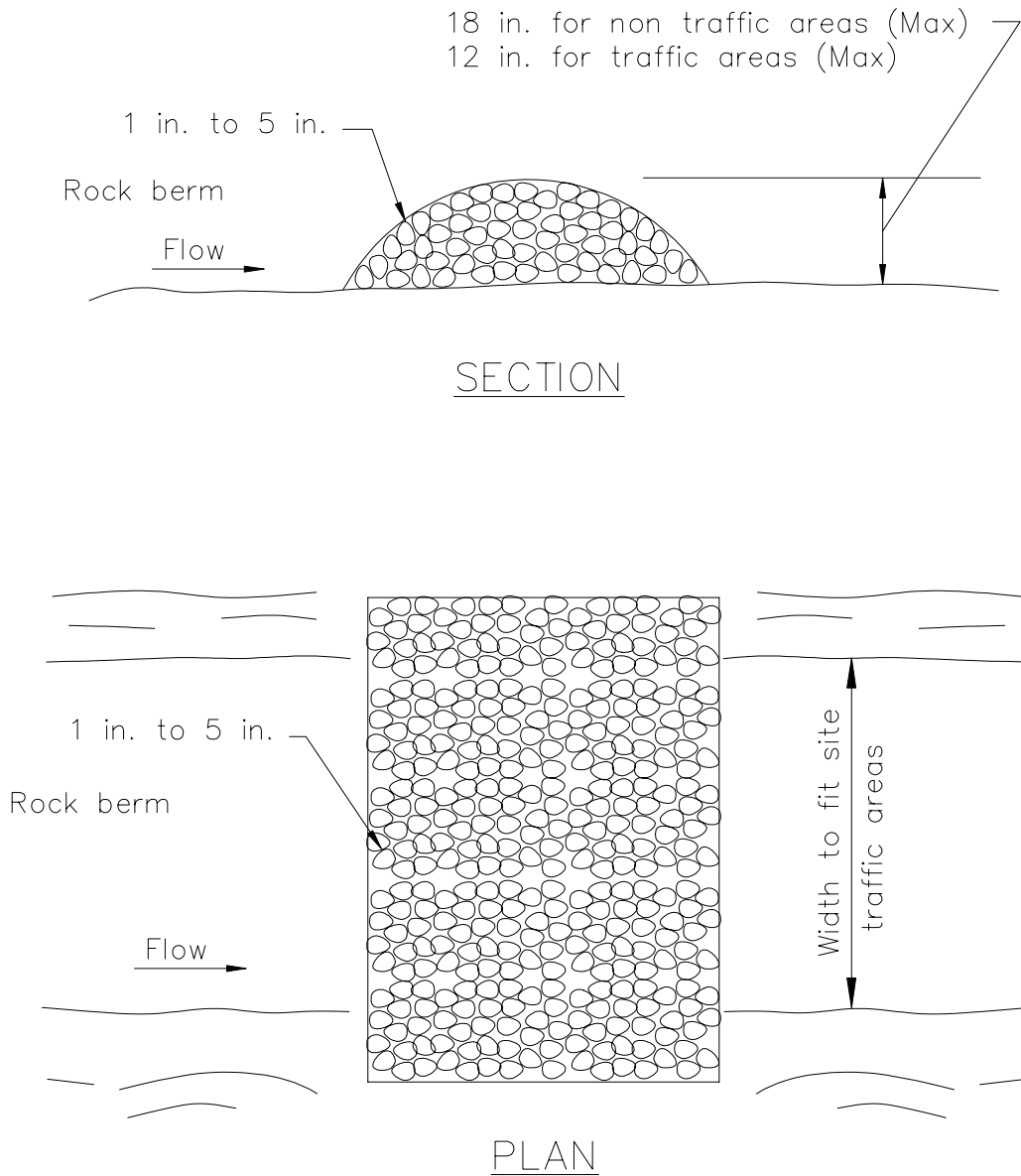
Standards and Specifications:

- 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 Nevada Department of Wildlife and NDEP for specific water quality requirements of applied water (e.g. chlorine).

Inspection and Maintenance:

Inspection and Maintenance

- None necessary
- Inspect all BMPs daily during construction.
- Inspect and repair equipment (for damaged hoses, fittings, and gaskets).

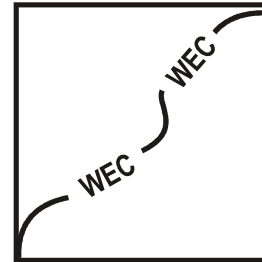
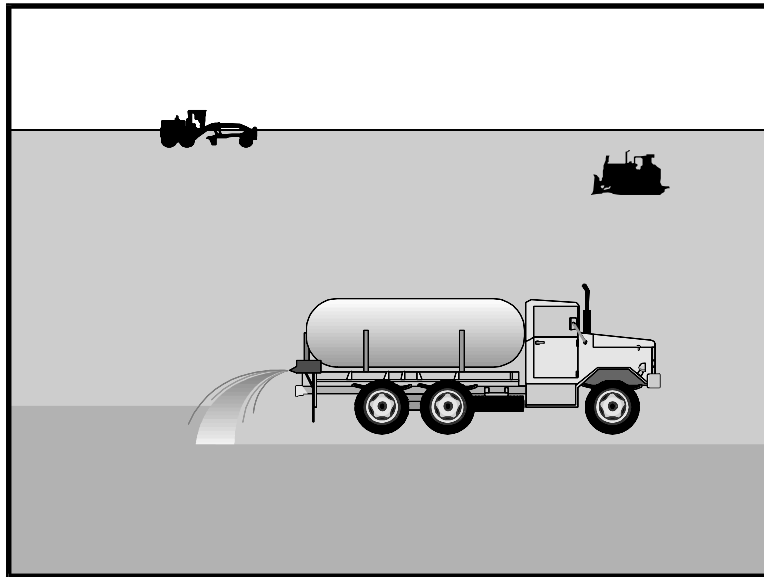


TYPICAL ROCK FILTER
NOT TO SCALE

Wind Erosion Control

SS-13

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose	Dust or wind erosion control consists of applying water, soil stabilizers, dust palliatives, or other soil stabilization BMP as necessary to prevent or alleviate dust nuisance and to comply with state and local permit regulations. Dust control shall be applied in accordance with NDOT Standard Specifications 107.21 and 107.22. Covering stockpiles or exposed soil areas with blankets, mats or mulches is an alternative to applying water, soil stabilizers, or dust palliatives.
Appropriate Applications	This practice is implemented on all exposed soils subject to wind erosion.
Limitations	Effectiveness depends on soil, temperature, humidity and wind velocity. Soil stabilizers are to be used where specified in the contract plans or as directed by the engineer. The contractor may determine when and where to apply dust palliatives in order to comply with applicable regulations.
Standards and Specifications	<ul style="list-style-type: none"> ■ Water shall 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 shall be equipped with a positive means of shutoff. ■ Unless water is applied by means of pipelines, at least one mobile unit shall 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 NDEP requirements. Non-potable water shall not be conveyed in tanks or drain pipes that will be used to convey potable water and

there shall be no connection between potable and non-potable supplies. Non-potable tanks, pipes and other conveyances shall be marked "NON-POTABLE WATER - DO NOT DRINK."

- Materials applied as temporary soil stabilizers will also provide wind erosion control benefits.
- Monitoring is required in Clark County and is performed visually.
- In Clark County, construction activity must cease if wind is causing Fugitive Dust in excess of 20% or 50% opacity (depending on analysis method), or if wind is causing a plume 100 yards or more in length (See Clark County Air Regulations).
- In Washoe county, construction activity must cease if dust generation cannot be satisfactorily controlled or upon request of the AQMD, i.e. under high wind conditions (See Washoe County Air Quality Management Division Regulations).
- In Clark County, contractor must document and retain records of all use of dust palliatives on the Dust Control Permit Forms.
- Application of dust palliatives are subject to sample collection and testing for compliance with applicable regulations of the Nevada Administrative Code and the requirements set for in the Interim Policy On Dust Palliative Use In Clark County.

**Maintenance and
Inspection**

- Check areas protected to ensure coverage.
- Implement requirements of the Standard Specifications Section 107, 210 and 637.

Section 4

Temporary Sediment Control Best Management Practices

4.1 Temporary Sediment Control Practices

Temporary sediment control practices include those practices that intercept and slow or detain the flow of storm water to allow sediment to settle and be trapped.

Temporary sediment control practices can consist of installing temporary linear sediment barriers (such as silt fence and gravel bag barrier); providing sediment logs, gravel bag berms, or check dams to break up slope length or flow; or constructing a temporary sediment trap or sediment basin. Linear sediment barriers are typically placed below the toe of exposed and erodible slopes, down slope of exposed soil areas, around temporary soil stockpiles, and at other appropriate locations along the site perimeter.

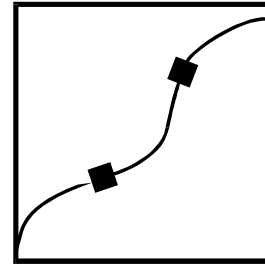
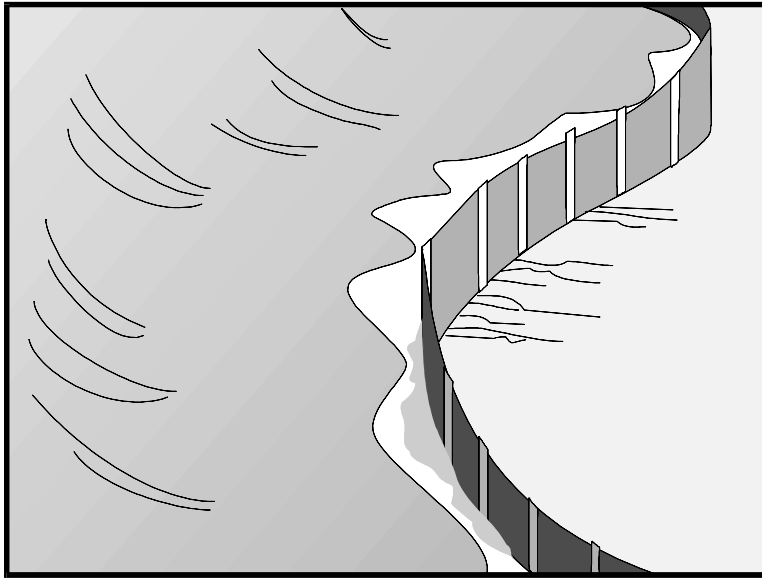
Temporary sediment control practices shall be implemented in conformance with the criteria presented in Section 2, Selecting and Implementing Construction Site Best Management Practices (BMPs), of this Manual. Temporary sediment control practices include the BMPs listed in Table 4-1.

Table 4-1 TEMPORARY SEDIMENT CONTROL BMPs	
ID	BMP NAME
SC-1	Silt Fence
SC-2	Sediment Basin
SC-3	Sediment Trap
SC-4	Check Dam
SC-5	Sediment Logs
SC-6	Gravel Bag Berm
SC-7	Street Sweeping and Vacuuming
SC-8	Storm Drain Inlet Protection

The remainder of this Section shows the working details for each of the temporary sediment control BMPs.

Use of straw bale barriers has been one of the most common and familiar methods historically used when attempting to retain sediment on construction sites. However,

their widespread use does not reflect the fact that they are relatively ineffective and are maintenance intensive. Although initially inexpensive, improper installation and application of straw bale barriers can result in accelerated erosion and sediment transport. Straw bales typically only last three months, however they are often misused and remain onsite for extended periods of time, falling apart and becoming an additional pollutant source. Although “weed free straw” is typically specified, they can introduce noxious weeds to a site. In addition, health districts have requested that straw bales not be used because the straw provides a nutrient medium for the breeding of mosquitoes. For these considerations, straw bales shall not be used as BMPs on NDOT construction sites.



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose A silt fence is a temporary linear sediment barrier of permeable fabric designed to intercept and slow the flow of sediment-laden sheet flow runoff. Silt fences allow sediment to settle from runoff before water leaves the construction site.

Appropriate Applications Silt fences are placed:

- Along the perimeter of a project.
- Below the toe of exposed and erodible slopes.
- Along slope contours for longer slope lengths.
- Down-slope of exposed soil areas.
- Around temporary stockpiles.
- Along streams and channels.

- Limitations**
- Not effective unless trenched and keyed in.
 - The maximum length of slope draining to any point along the silt fence shall be 200 ft.
 - Slope of area draining to fence shall be less than 1:1.
 - Limit to locations suitable for temporary ponding or deposition of sediment.
 - Fabric life span typically is increased if reinforced with wire mesh. Extended periods may require fabric replacement.
 - Silt fences shall not be used in concentrated flow areas.

- Design in accordance with Page 5 of this working detail (BMP).
- Must be maintained by removing sediment accumulations and repairing damaged areas.
- Must be removed and disposed of.
- Don't use below slopes subject to creep, slumping, or landslides.
- Don't use in streams, channels, or anywhere flow is concentrated.
- Don't use silt fences to divert flow.

Standards and Specifications

Design and Layout

- **Type 1.** Silt fence shall be constructed of silt fence fabric and wood posts at 6' maximum spacing. This installation typically is only suitable for up to two-week duration, especially in wind prone areas. Longer duration installations typically require significant maintenance as posts fail easily and the fabric quickly becomes unsuitable.
- **Type 2.** Silt fence shall be constructed of silt fence fabric, wire mesh backing, and steel T-posts at 8' maximum spacing. This installation is intended for construction activities of two weeks duration or longer, and will typically last the duration of a construction season if installed and maintained properly.
- Not intended for use as mid-slope protection on slopes steeper than 4:1.
- For slopes steeper than 2:1 and that contain a high number of rocks or large dirt clods that tend to dislodge, it may be necessary to install additional protection fencing immediately adjacent to the bottom of the slope, prior to installing silt fence. Additional protection may be required in accordance with Standard Specification Section 616.
- For slopes adjacent to water bodies or Environmentally Sensitive Areas (ESAs), additional temporary soil stabilization BMPs (SS-1 – SS-11) shall be used.

Materials

- Silt fence fabric shall be woven polypropylene with a minimum width of 35 in. and a minimum tensile strength of 100 lbs. The fabric shall conform to the requirements in ASTM designation D4632 and shall have an integral reinforcement layer. The reinforcement layer shall be a polypropylene, or equivalent, net provided by the manufacturer. The permittivity of the fabric shall be between 0.1 sec⁻¹ and 0.15 sec⁻¹ in conformance with the requirements in ASTM designation D4491. Contractor must submit certificate of

compliance in accordance with Standard Specifications Section 724.

- Wood posts shall be commercial quality lumber of nominal dimensions 2 in. x 2 in x 5 ft. Each post shall be free from decay, splits or cracks longer than the thickness of the post or other defects that would weaken the posts and cause the posts to be structurally unsuitable.
- Steel T-posts shall be 5 ft tall and conform to Standard Specifications Section 724.03.02.
- Wire mesh shall be 2 in x 2 in x 14-gauge wire.
- Fabric shall be fastened to the posts in accordance with manufacturer's recommendations.

Installation

- Generally, silt fences shall be used in conjunction with soil stabilization source controls up slope to provide effective control.
- Trenches shall not be excavated wider and deeper than necessary for proper installation of the temporary linear sediment barriers.
- Excavation of the trenches shall be performed immediately before installation of the temporary linear sediment barriers. The bottom of the silt fence shall be keyed-in a minimum of 6 in.
- Construct silt fences with a setback of at least 10 ft. from the toe of a slope. Where setback is not practical, the silt fence may be constructed at the toe of the slope, but shall be constructed as far from the toe of the slope as practical to allow for equipment (i.e. Bobcat) access for removal of accumulated sediment.
- Construct the length of each reach between the cross barriers so that the change in base elevation along the reach does not exceed 1/3 the height of the barrier; in no case shall the reach exceed 500 ft.
- Cross barriers shall be a minimum of 1/3 and a maximum of 1/2 the height of the linear barrier. Cross barriers shall be installed at the ends of fence sections (every 500 ft, see detail) or at joints in the fabric to minimize overloading of the fence due to sediment transport parallel to the fence line.
- Install in accordance with Page 5 of this Fact Sheet.

Maintenance and Inspection

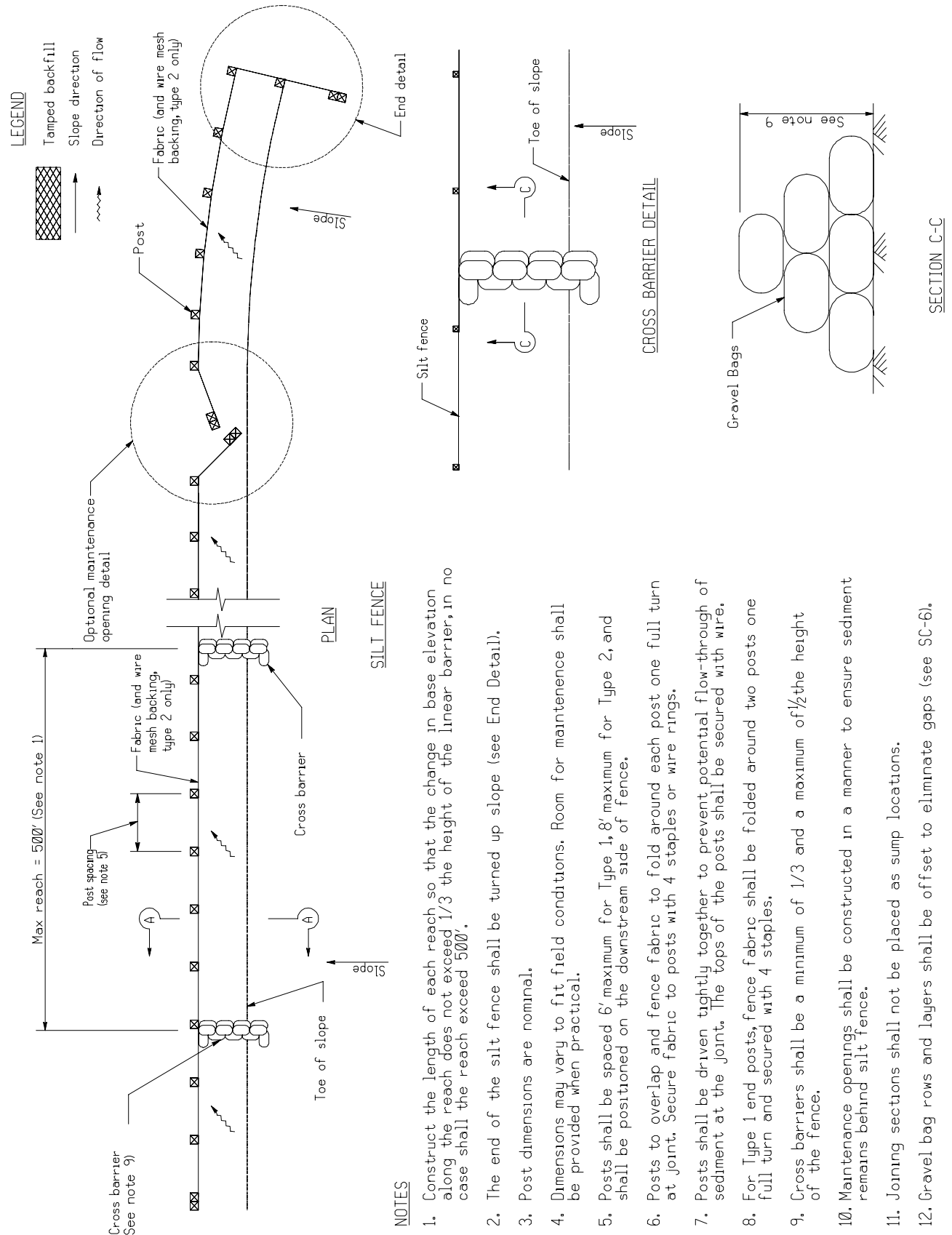
- Repair undercut silt fences.
- Repair or replace split, torn, slumping, or weathered fabric.
- Inspect silt fence when rain is forecast. Perform necessary maintenance, or maintenance as required by SWPPP.

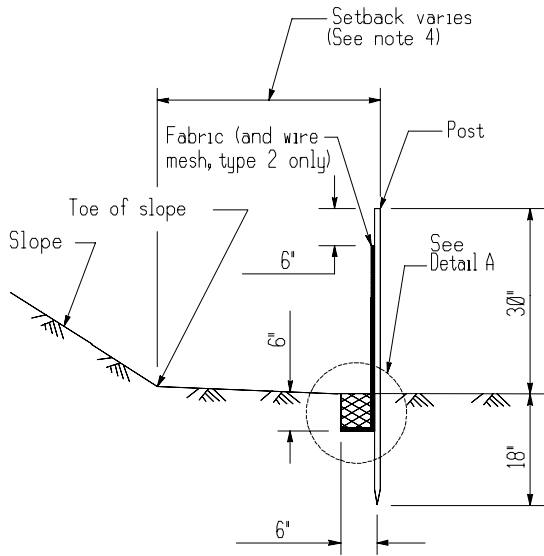
- Inspect silt fence following rainfall events. Perform maintenance as necessary, or as required by the SWPPP.
- Maintain silt fences to provide an adequate sediment holding capacity. Sediment shall be removed when the sediment accumulation reaches one-third (1/3) of the barrier height. Removed sediment shall be incorporated in the project at locations designated by the RE or disposed of outside the highway right-of-way in conformance with the Standard Specifications.
- Silt fences that are damaged and become unsuitable for the intended purpose, as determined by the RE, shall be removed from the site of work, disposed of outside the highway right-of-way in conformance with the Standard Specifications, and replaced with new silt fence barriers. This is included in the maintenance of the silt fence, and is included in the bid price. Additional payment will not be made.
- Holes, depressions or other ground disturbance caused by the removal of the temporary silt fences shall be backfilled and repaired in conformance with the Standard Specifications.
- Remove silt fence when no longer needed or as required by the Engineer. Fill and compact postholes and anchorage trench, remove sediment accumulation, re-seed or re-vegetate as appropriate, and grade fence alignment to blend with adjacent ground.

Silt Fence

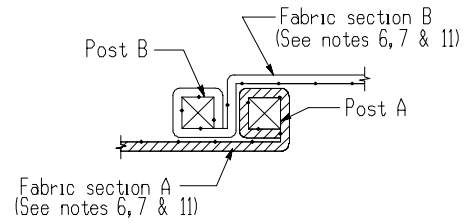
SC-1

Adapted from Caltrans Construction Site BMPs

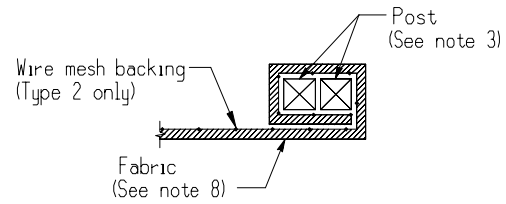




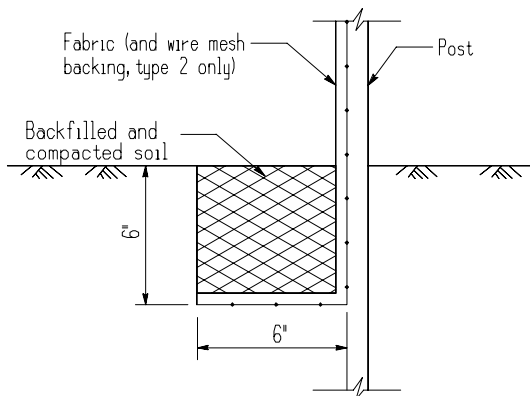
SECTION A-A



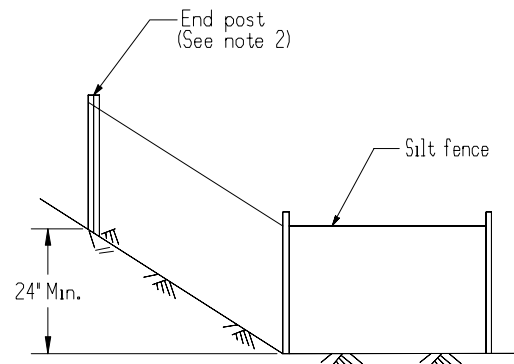
JOINING SECTION DETAIL (TOP VIEW)



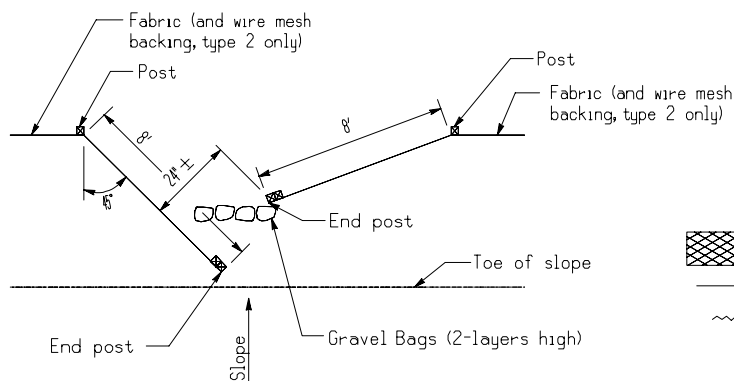
END STAKE DETAIL (TOP VIEW)



DETAIL A



END DETAIL



OPTIONAL MAINTENANCE OPENING DETAIL
(SEE NOTE 10)

LEGEND



Tamped backfill

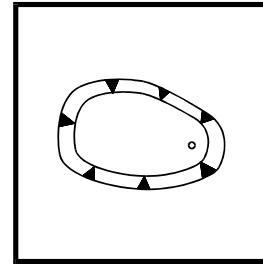
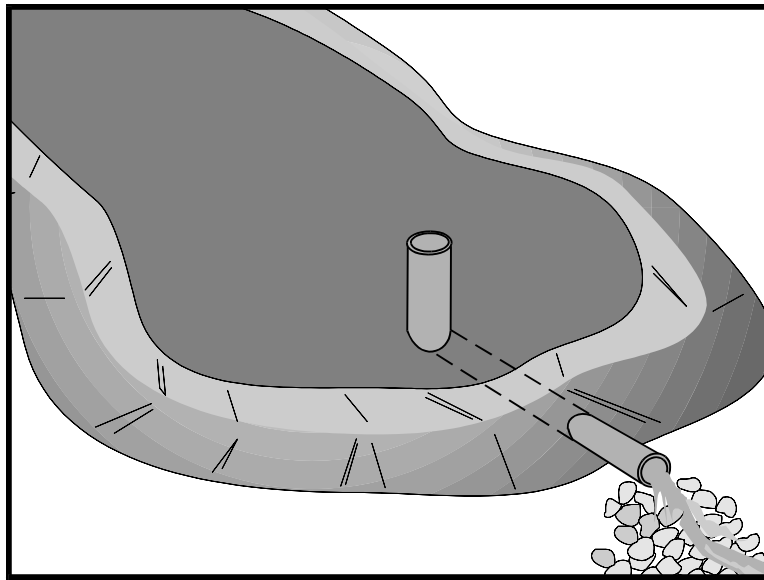


Slope direction



Direction of flow

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose A sediment basin is a temporary basin formed by excavation and/or constructing an embankment so that sediment-laden runoff is temporarily detained under quiescent conditions, allowing sediment to settle out before the runoff is discharged.

Appropriate Applications Sediment basins shall be designed in accordance with Section I.B. of the *General Permit for Storm Water Discharges Associated with Construction Activity* (General Permit) where sediment basins are the only control measure proposed for the site. Additional reference may come from the NDOT Drainage Design Manual and Section 2.5 of this manual. Sediment basins shall be considered for use:

- On construction projects with disturbed areas during the rainy season; and
- Where sediment-laden water may enter the drainage system or watercourses; and
- At outlets of disturbed soil areas with areas between 5 and 10 acres.
- In the Lake Tahoe Basin as needed to retain and treat the 20-year, 1-hour storm.

Limitations

- Due to the high cost and complex design and construction requirements, alternative sediment control BMPs must be thoroughly investigated before selecting temporary sediment basins.
- Requires large surface areas to permit settling of sediment.
- It is recommended to size basins for a drainage area of 5-10 acres, however, basins may be designed for drainage areas with an absolute

Standards and Specifications

maximum of 75 acres. For drainage areas greater than 75 acres it may be necessary to construct more than one sediment basin.

- Not to be located in live streams.
- If safety is a concern, basins may require protective fencing.
- Size may be limited by availability of right-of-way.
- 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.
- Sediment basins shall be designed to have a capacity equivalent to 3,600 ft³ of storage per acre of contributory area.
- Sediment basins should be used in combination with appropriate soil stabilization controls (See SS Fact Sheets).
- The length of the basin shall be more than twice the width of the basin. Length shall be determined by measuring the distance between the inlet and the outlet.
- It is recommended that the depth be no less than 3 ft. and not greater than 5 ft.
- Basins with an impounding levee greater than 5 ft. tall, measured from the lowest point of the impounding area to the highest point of the levee, and basins capable of impounding more than 36,000 ft³, shall be designed by a professional Civil Engineer registered with the state of Nevada. The design shall include maintenance requirements, including sediment and vegetation removal, to ensure continuous function of the basin outlet and bypass structures. A Nevada Division of Water Resources permit is required to construct, reconstruct, or alter a dam that has a crest height 20 feet or higher, as measured from the downstream toe to the crest, or has a crest height less than 20 feet but will impound 20 acre-feet or more of movable material. This provision does not pertain to United States Bureau of Reclamation or United States Army Corps of Engineer Projects.
- Design and locate sediment basins so that they can be maintained. Construct sediment basins prior to the rainy season and soil disturbing activities.
- Sediment basins, regardless of size and storage volume, shall include features to accommodate overflow or bypass flows that exceed the design storm event. The design storm event for Lake Tahoe Basin is the 20-year, 1-hour event; and for the remainder of Nevada, is the 2-year, 24-hour event.

- Basins shall be designed to drain within 72 hours following storm events. Disease vector control regulations require 7-day maximum dewatering time to apply during summer months (April- September) only. Basins should also have a low flow channel in the bottom so water is concentrated rather than spread when the basin is near empty to facilitate spraying for mosquitoes.
- The outflow from the sediment basin shall be provided with outlet protection to prevent erosion and scouring of the embankment and channel.
- Basin shall 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, (3) where failure would not cause loss of life or property damage, and (4) 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.
- Areas under embankments, structural works, and sediment basin must be cleared, stripped of vegetation in accordance with Standard Specifications Section 201, "Clearing and Grubbing".
- Earthwork shall be in accordance with Standard Specifications Section 203 "Excavation and Embankment". Contractor is specifically directed to Standard Specifications Section 203, "Compaction, Embankment".
- Basin inlets shall be located to maximize travel distance to the basin outlet.
- Rock or vegetation shall be used to protect the basin inlet and slopes against erosion.
- A forebay is a settling basin or plunge pool constructed at the inlet of the basin that may be provided to remove debris and larger particles and can be cleaned on a more frequent basis.
- Principal outlet shall 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 shall be designed to accommodate the design storm inflow (as shown in schematics below).
- Structure shall be placed on a firm, smooth foundation with the base securely anchored with concrete or other means to prevent floatation

(as shown in schematics below).

- Attach riser pipe (watertight connection) to a horizontal pipe (barrel) that extends through the embankment to toe of fill. Provide anti-seep collars on the barrel (as shown in schematics below).
- Provide anti-seep collars on the barrel that are designed to increase the effective length along the outside of the barrel by 10%. Collars should project a minimum of 1.5 ft. radially outward from the outside of the pipe. Ensure that adequate cover is provided for the anti-seep collars. Cleanout level shall be clearly marked on the riser pipe.
- Avoid dewatering of groundwater to the sediment basin during the rainy season.
- Barbed wire shall be provided around each sediment basin to prevent unauthorized entry to the basin or if safety is a concern. Fencing shall be in accordance with Standard Specifications Sections 616 "Fencing" and 724 "Barbed Wire".
- One of the dewatering configurations shown below for the principal outlet may be used. The Contractor shall verify that the outlet is properly designed to handle the design and peak flows.

Outlet #1, See Page 6

- Perforate the top one-third of the riser with 0.5 in. diameter holes spaced 8 in. vertically and 10 in. - 12 in. horizontally.
- Place 0.75 in. gravel over perforated holes to approximately 2 in. minimum thickness to assist in prevention of clogging of dewatering holes. Gravel will naturally settle into a cone surrounding the riser pipe.

Outlet #2, See Page 7

- Perforate the lower one-half of the riser pipe with 0.5 in. diameter holes spaced approximately 3 in. apart, in each outside valley (corrugated metal pipe).
- Place 0.75 in. gravel over perforated holes to approximately 2 in. minimum thickness to assist in prevention of clogging of dewatering holes. Gravel will naturally settle into a cone surrounding the riser pipe.

Outlet #3, See Page 8

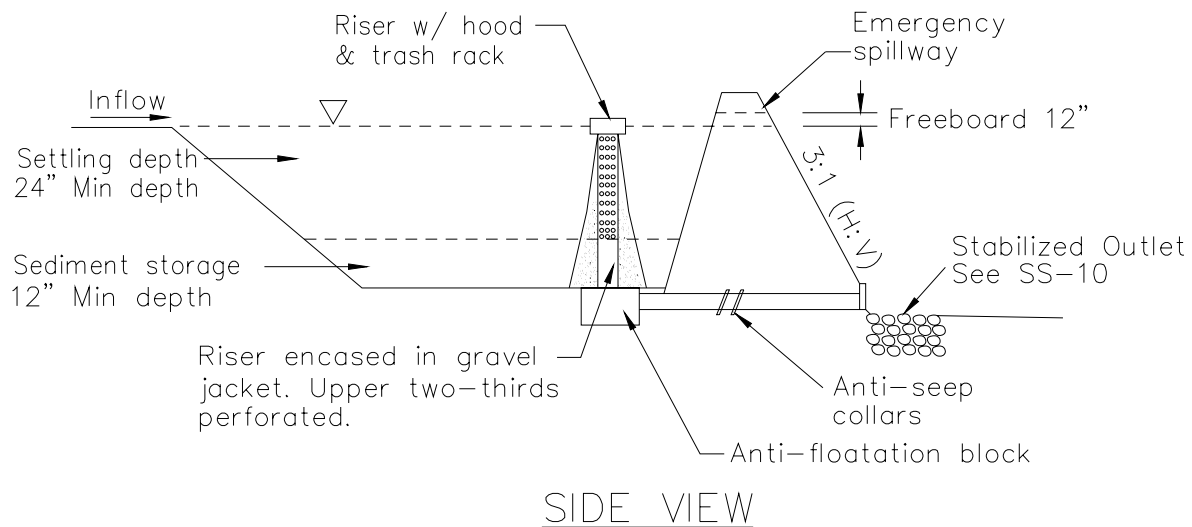
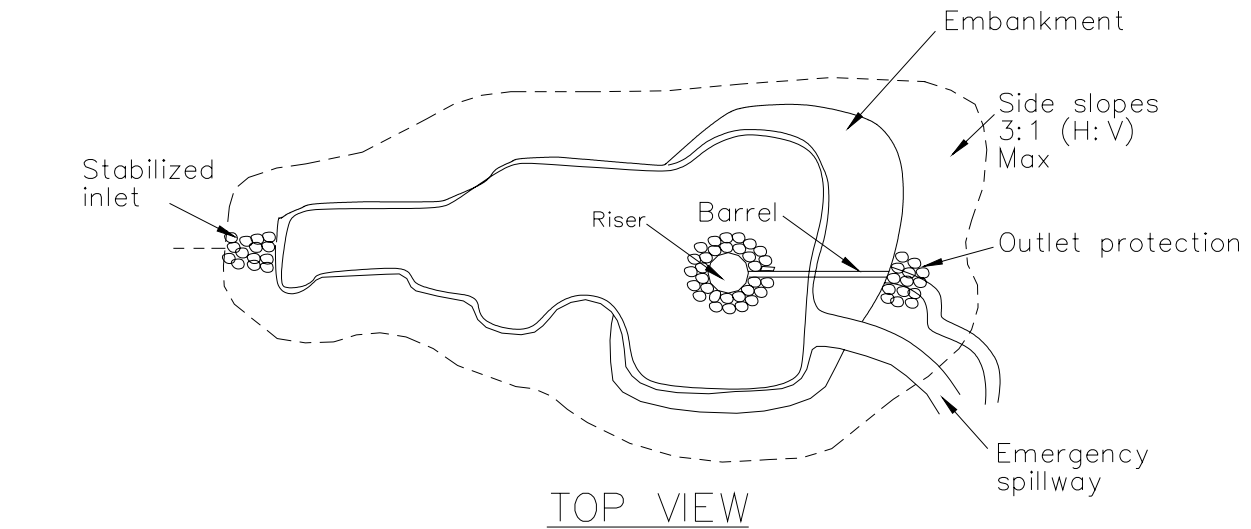
- Provide two 1 in. diameter holes above the sediment storage volume on opposite sides of the non-perforated riser pipe. This

will typically provide sufficient detention time for basins to drain approximately 10 acres.

- Construct an emergency spillway to accommodate flows not carried by the principal spillway. Spillway shall consist of an open channel (earthen or vegetated) over undisturbed material (not fill) or constructed of a non-erodible riprap.
- Spillway control section, which is a level portion of the spillway channel at the highest elevation in the channel, shall be a minimum of 20 ft. in length.
- Use outlet protection at the pipe outlet. See BMP SS-10, "Outlet Protection/Velocity Dissipation Devices".

Maintenance and Inspection

- Inspect temporary sediment basins before and after rainfall events and weekly during the rest of the rainy season. During extended rainfall events, inspect at least every 24 hours.
- 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.
- Remove accumulated sediment when its volume reaches one-third the volume of the sediment trap. Properly dispose of sediment and debris removed from the trap in accordance to the Standard Specification Section 107.
- Check fencing for damage and repair as needed.
- Embankments shall be constructed to be improved using materials such as clay, geomembranes, grout or cement.
- Follow dam safety regulations if applicable (see above).
- If there is potential for dam failure, a competent geotechnical engineer shall design or review embankment details or specifications.
- All design standards/guidelines should match the AASHTO Model Drainage Manual. Exceptions must be approved by Chief Hydraulics Engineer.

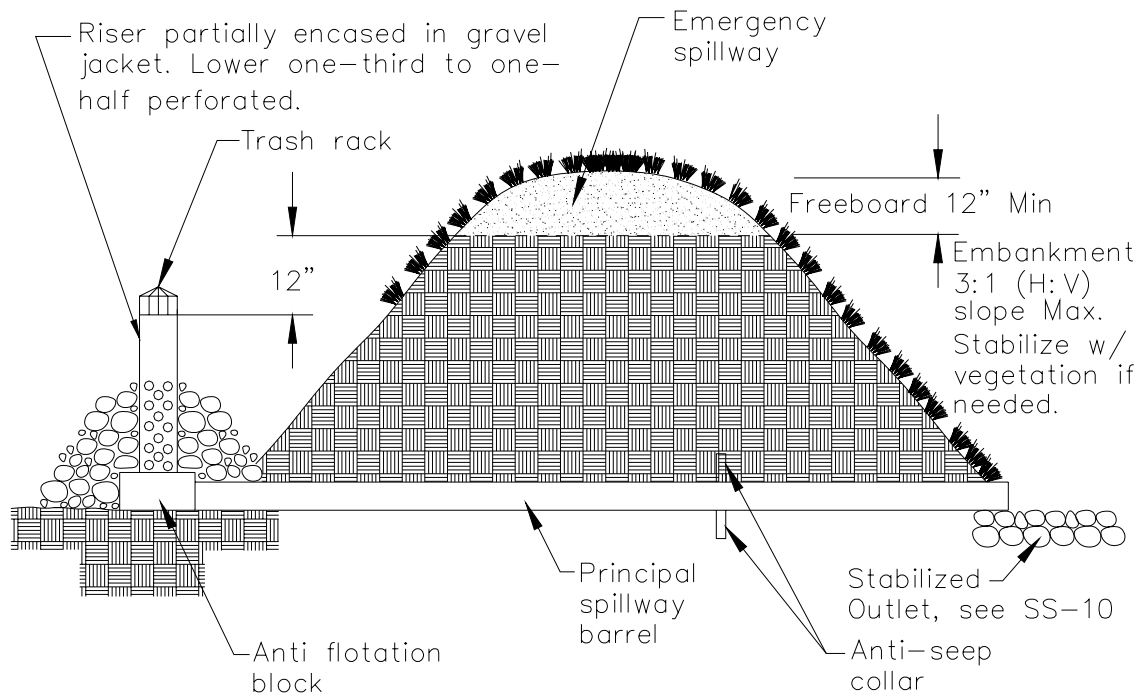


TYPICAL TEMPORARY SEDIMENT BASIN – OUTLET #1
NOT TO SCALE

Sediment Basin

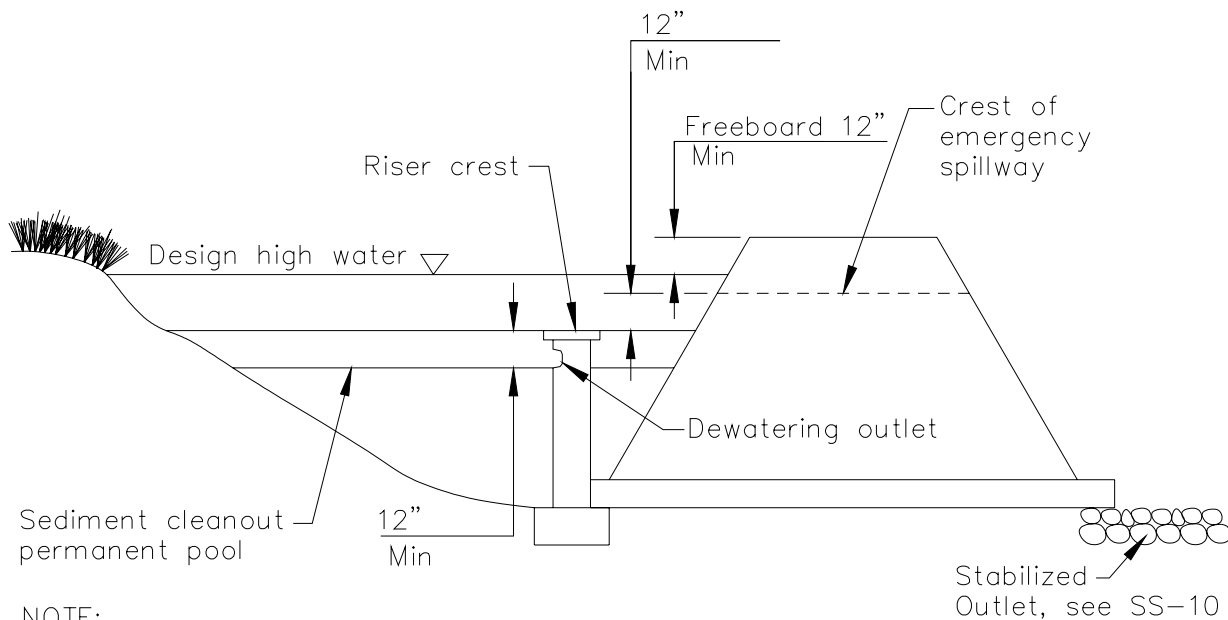
SC-2

Adapted from Caltrans Construction Site BMPs



NOTE:
This outlet provides
complete draining of pool.

TYPICAL TEMPORARY SEDIMENT BASIN – OUTLET #2
NOT TO SCALE



NOTE:

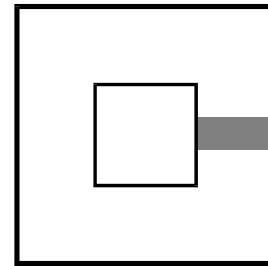
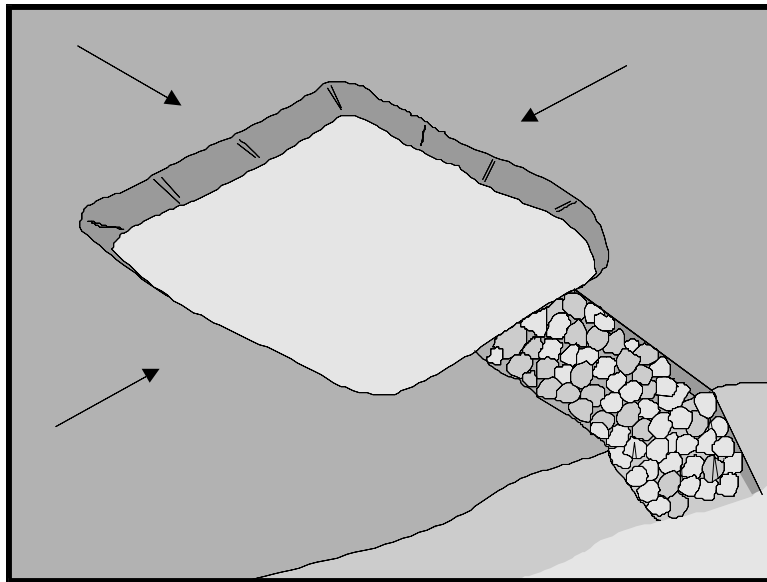
This outlet provides no drainage for permanent pool.

TYPICAL TEMPORARY SEDIMENT BASIN – OUTLET #3

NOT TO SCALE

NOTE:

DIMENSIONS REPRESENT A SIZE RANGE FOR MOST TYPICAL INSTALLATIONS. DESIGNER SHALL VERIFY THAT THE OUTLET IS PROPERLY DESIGNED TO HANDLE THE DESIGN AND PEAK FLOWS.



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose A sediment trap is a temporary containment area that allows sediment in collected storm water to settle out during infiltration or before the runoff is discharged through a stabilized spillway. Sediment traps are formed by excavating a depression or constructing an earthen embankment or other check dam across a drainageway.

- Appropriate Applications**
- Sediment traps may be used on construction projects where the drainage area is less than 5 acres to provide temporary storage and settling time for runoff. Traps should be placed to intercept sediment-laden storm water prior to entering a storm drain or watercourse.
 - This BMP may be implemented on a project-by-project basis with other BMPs when determined necessary. NDOT approval must be obtained if additional Right-of-Way (ROW) is needed for this facility or the facility will cause negative impacts to NDOT ROW or adjacent property owners.
 - As a supplemental control to soil stabilization BMPs, 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/or 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.

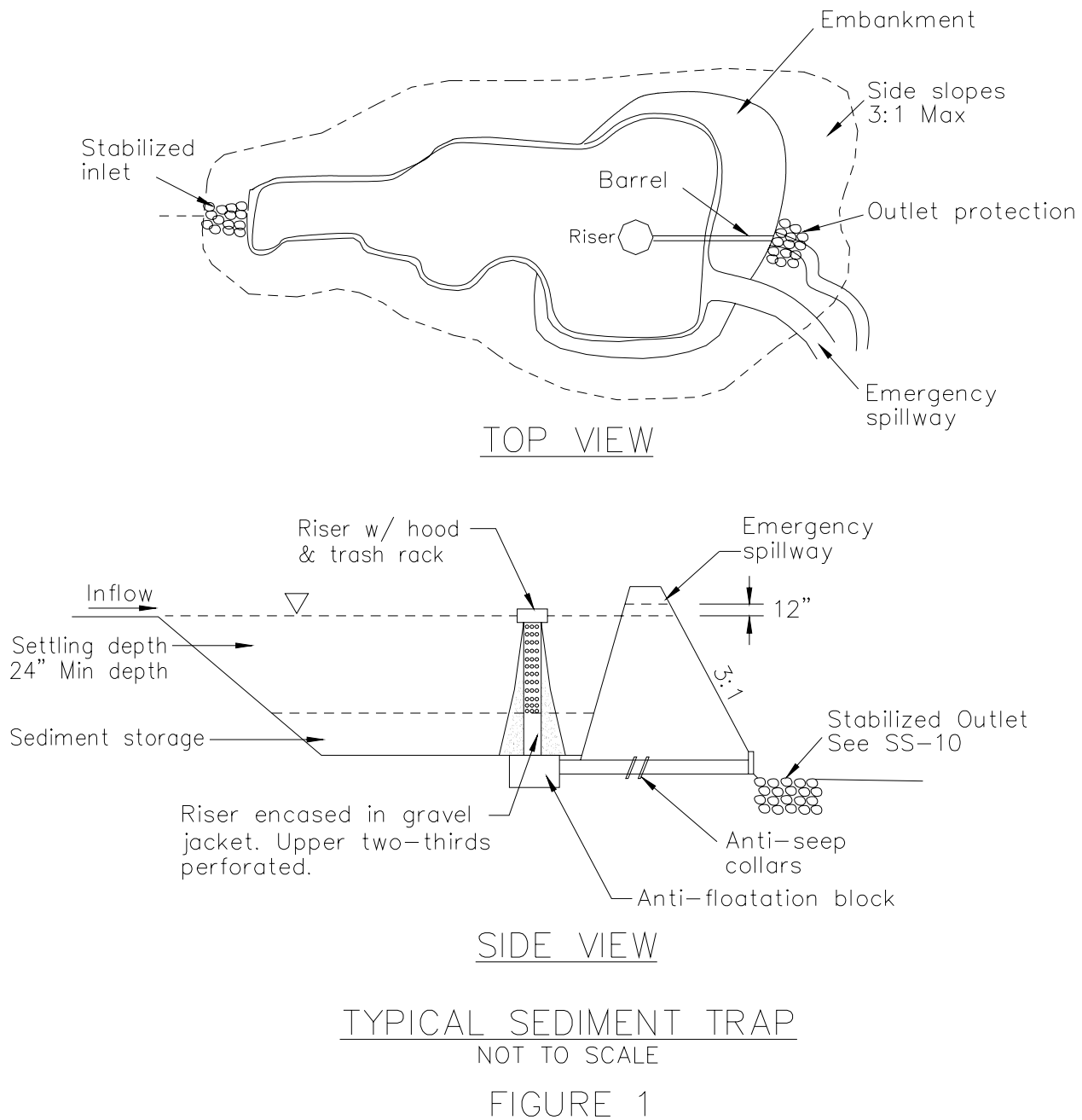
Standards and Specifications

- Not to be located in live streams.
- Size may be limited by availability of Right-of-Way.
- Design in accordance with page 4 of this Fact Sheet.
- Construct sediment traps prior to rainy season and soil disturbing activities.
- Traps shall be sized to accommodate a settling zone and sediment storage zone. The 2-year, 24-hour rain event shall be used for temporary sediment trap sizing, unless working in the Lake Tahoe Basin, where the 20-year, 1-hour event shall be used.
- The minimum recommended volumes for settling and sediment storage are 67 yd³/acre and 33 yd³/acre of contributing drainage area respectively. These minimum volumes are based on 0.5 in. over a 24-hr period.
- Multiple traps and/or additional volume may be required to accommodate site-specific rainfall and soil conditions.
- Traps with an impounding levee greater than 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 ft³, shall be designed by a professional Civil Engineer registered with the state of Nevada. The design shall include maintenance requirements, including sediment and vegetation removal, to ensure continuous function of the trap outlet and bypass structures.
- Earthwork shall be in accordance with Standard Specifications Section 203 – Excavation and Embankment. Contractor is specifically directed to Standard Specifications Section 203, “Compaction, Embankment”.
- Areas under embankments, structural works, and sediment traps shall be cleared and stripped of vegetation in accordance with Standard Specifications Section 201–“Clearing and Grubbing”.
- Use rock or vegetation to protect the trap outlets against erosion.
- Fencing, in accordance with Standard Specifications Section 616 – “Fencing”, shall be provided to prevent unauthorized entry. Fencing (Type C – NV – 4B) as shown in the NDOT Standard Plans Sheet R-6.1.2.

Maintenance and Inspection

- Inspect sediment traps before and after rainfall events and weekly during the rest of the rainy season. During extended rainfall events, inspect sediment traps at least every 24 hours.

- If captured runoff has not completely infiltrated with 72 hours, the sediment trap should be dewatered. Disease vector control regulations require 7-day maximum dewatering time to apply during summer months (April- September) only. Basins should also have a low flow channel in the bottom so water is concentrated rather than spread when the basin is near empty to facilitate spraying for mosquitoes.
- Inspect trap banks for seepage and structural soundness.
- Inspect outlet structure and spillway for any damage or obstructions. Repair damage and remove obstructions as needed.
- Inspect outlet area for erosion and stabilize if required.
- Remove accumulated sediment when the volume has reached one-third the original trap volume.
- Properly disposed of sediment and debris removed from the trap according to Standard Specifications Section 107.
- Inspect fencing for damage and repair as needed.



Sediment Trap

SC-3

Adapted from Caltrans Construction Site BMPs

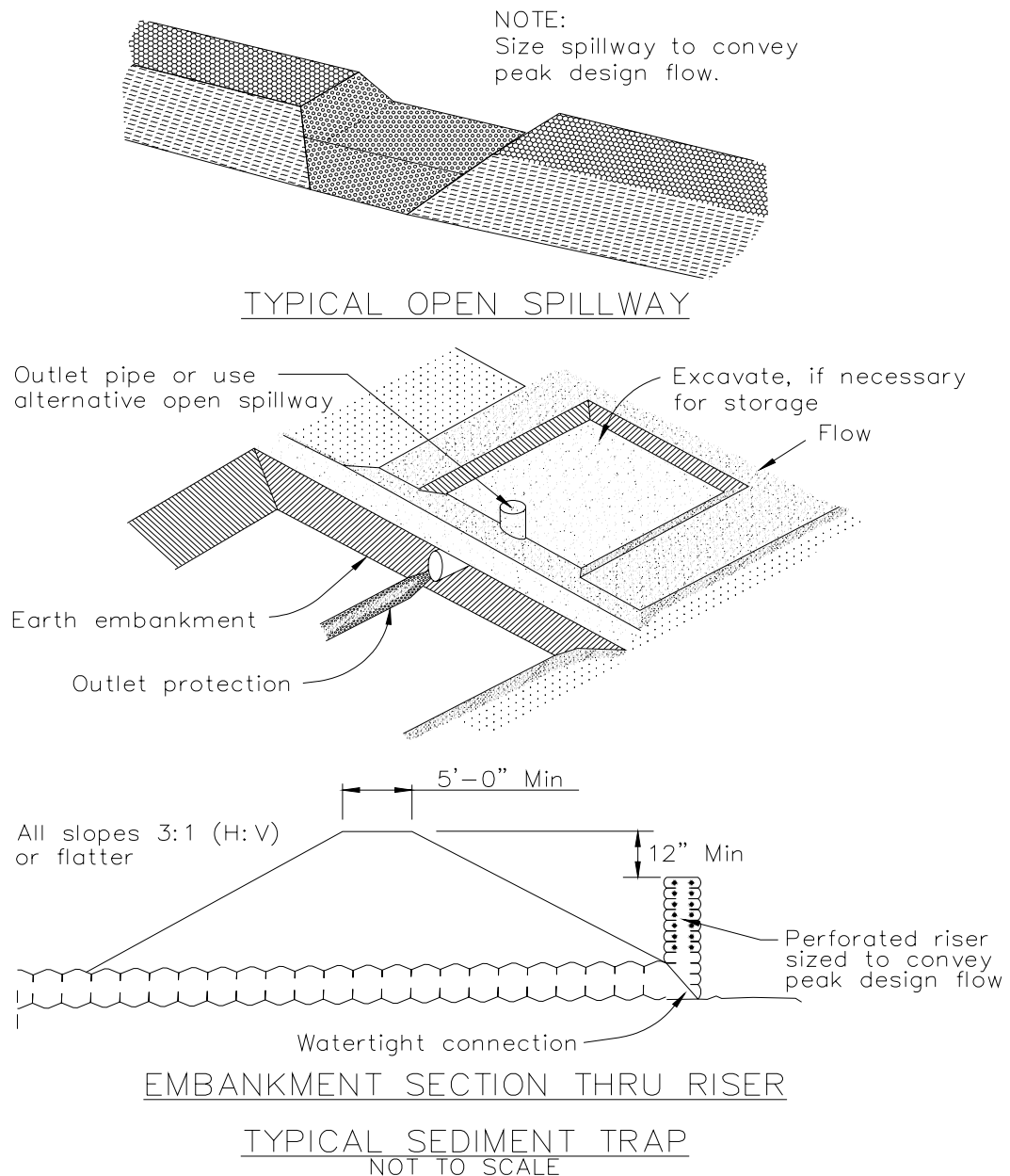
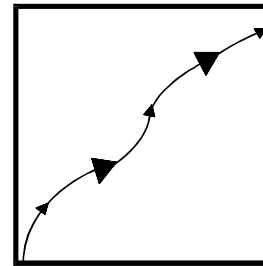
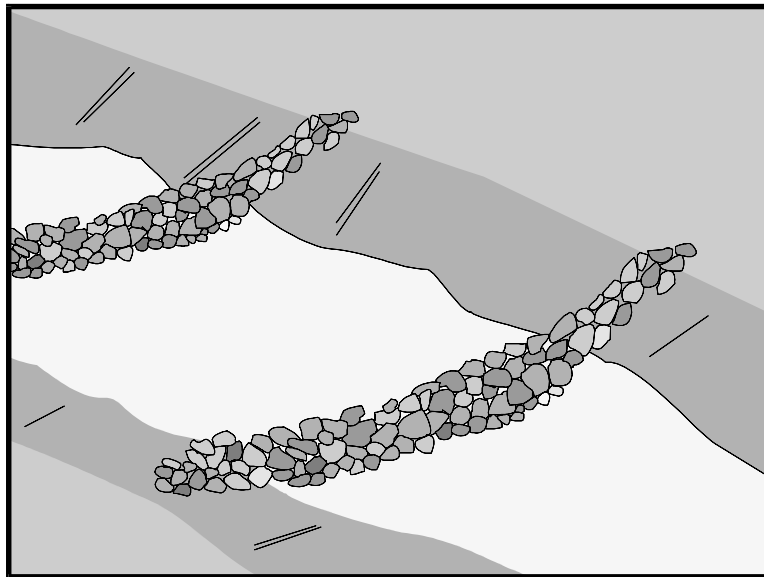


FIGURE 2



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

A check dam is a device constructed of rock, gravel bags, sediment logs, or reusable products manufactured by one of the companies listed in the QPL placed across a natural or man-made channel or drainage ditch. Check dams reduce scour and provide runoff treatment by reducing flow velocity and encouraging sediment deposition. Sediment logs can be used in low flow and low gradient channels and have the advantage of decomposing naturally so removal is not required. They must be securely anchored and keyed-in at least one-third of their diameter. Sediment logs may be stacked, provided the anchorage is secure, typically stacks should not exceed three rows high.

Appropriate Applications

- The check dams described in this fact sheet are intended for low to moderate flow channels. Grade control in larger conveyances requires more detailed design beyond the scope of this fact sheet.
- Check dams may be installed in the following:
 - In small open channels that drain 10 acres or less.
 - In steep channels where storm water runoff velocities exceed 3 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.
- Sediment logs are appropriate for low flow channels, with gravel bags being more appropriate in moderate flow channels.
- This BMP may be implemented on a project-by-project basis with other BMPs.

- Limitations
- Not to be used in live streams.
 - Not appropriate in channels that drain areas greater than 10 acres.
 - Not to be placed in channels that are already grass lined unless erosion is expected, as installation may damage vegetation.
 - Can require extensive maintenance following high velocity flows.
 - Promotes sediment trapping which can be re-suspended during subsequent storms or removal of the check dam.
 - Not to be constructed from a silt fence.

- Standards and Specifications
- Check dams shall be placed at a distance and height to allow small pools to form behind them. Install the first check dam approximately 16 ft. from the outfall device and at regular intervals based on slope gradient and soil type.
 - Install the first check dam approximately 16 ft. from the outfall device and at regular intervals based on slope gradient and soil type. Steeper slopes and more erosive soils (e.g. loose sand or silt) will require shorter spacing between check dams.
 - For multiple check dam installation, backwater from downstream check dam shall reach the toe of the upstream dam.
 - High flows (typically a 2-year storm or larger) shall 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 shall be removed when grass has matured sufficiently to protect the ditch or swale. Sediment log or other degradable check dams may be left in place to minimize disturbance to the channel if appropriate.
 - Rock shall be placed individually by hand or by mechanical methods (no dumping of rock) to achieve complete ditch or swale coverage.

Gravel bags may be used as check dams with the following specifications. See details at the end of this fact sheet for additional information.

Materials

- **Sediment Logs:** Sediment log materials shall conform to SC-05 fact sheet in this manual.
- **Gravel Bags:** Gravel bags and fill material shall conform to SC-06 fact sheet in this manual.
- **Rock Size for Check Dams:** Rock gradation shall conform to the following, or be designed in accordance with acceptable practices.

“Slope” in the table is to be the average channel flow line slope in the vicinity of the check dam. Check dams with rock selected from this table shall not exceed 2 ft in height. Check dams higher than 2 ft or with depth x slope values greater than 0.032 shall be designed by a Nevada registered Professional Engineer.

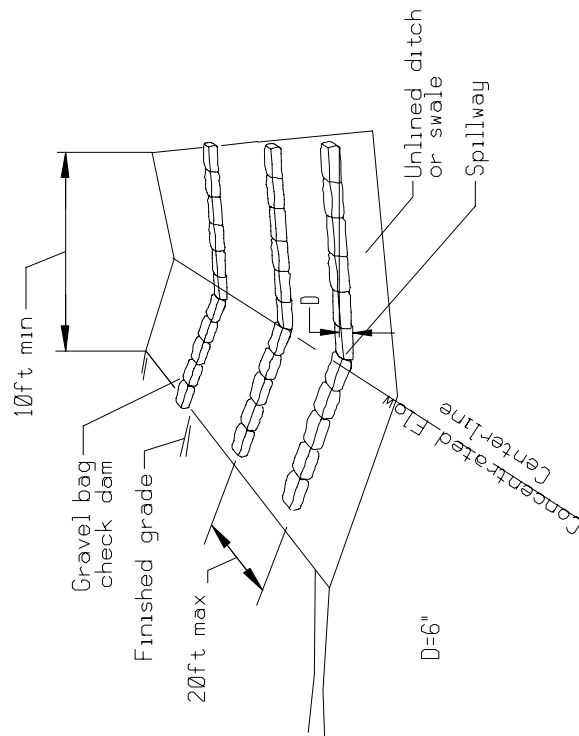
Rock Designation	D ₅₀	Max Flow Depth (ft) x Slope (ft/ft)
Class 300/400 Riprap Bedding	3"	up to 0.016
Class 150 Riprap	6"	0.017 to 0.032

Installation

- Sediment Logs shall be installed per SC-05 fact sheet in this manual.
- Gravel Bags shall be installed per SC-06 fact sheet in this manual.
- Install along a level contour.
- Tightly abut bags and stack according to detail shown in figure. Gravel bags shall not be stacked any higher than 3 ft.
- For permanent or long-term rock check dams, installations (over one year), key stone into the channel banks and extend it beyond the abutments a minimum of 18 in. to prevent flow around the dam.

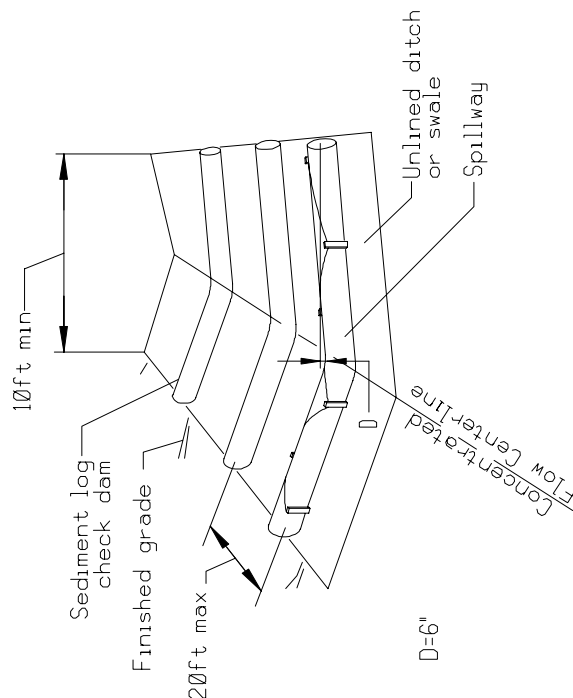
Maintenance and Inspection

- Inspect check dams after each significant rainfall event. Repair damage as needed.
- Remove sediments when depth reaches 50% of the check dam height and dispose of per Standard Specification Section 107.
- Remove accumulated sediment prior to permanent seeding or soil stabilization and dispose of per Standard Specification Section 107.
- Remove check dam and accumulated sediment when check dams are no longer needed.
- Removed sediment shall be incorporated in the project at locations designated by the Engineer or disposed of outside the highway right-of-way in conformance with the Standard Specifications section 107.



PERSPECTIVE

TEMPORARY CHECK DAM (TYPE II)



PERSPECTIVE

TEMPORARY CHECK DAM (TYPE I)

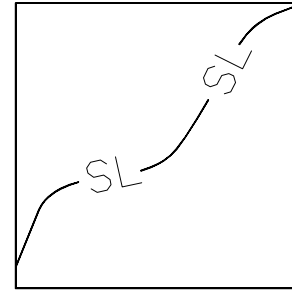
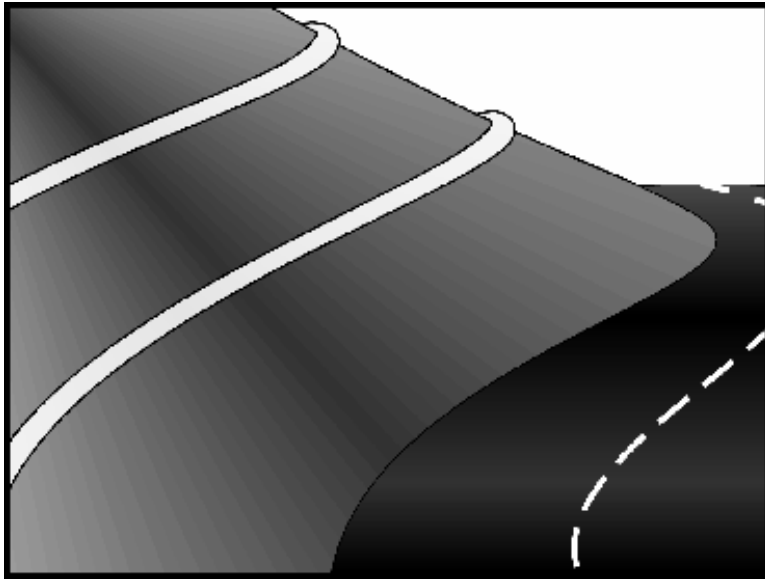
NOTES

1. Spillway depth "D" shall be maintained to prevent flanking of concentrated flow around the ends of the check dam.
2. Sediment log materials and installation shall be per SC-5, Type 2
3. Gravel bag materials and installation shall be per SC-6

Sediment Logs

SC-5

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- ☐ Soil Stabilization
- ☒ Sediment Control
- ☐ Tracking Control
- ☐ Wind Erosion Control
- ☐ Non-Storm Water Management
- ☐ Materials and Waste Management

Definition and Purpose A sediment log consists of wood excelsior, rice, or wheat straw, or coconut fibers that are rolled or bound into a tight tubular roll and placed on the toe and face of slopes to intercept runoff, reduce its flow velocity, release the runoff as sheet flow, and provide removal of sediment from the runoff.

Appropriate 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.
- Below the toe of exposed and erodible slopes.
- Sediment logs may be used as check dams in unlined ditches if approved by the individual responsible for the implementation of the SWPPP.
- Down-slope of exposed soil areas.
- Around temporary stockpiles.
- This BMP may be implemented on a project-by-project basis with other BMPs.

Limitations

- Runoff and erosion may occur if sediment log is not adequately trenched in.
- Sediment logs at the toe of slopes greater than 2:1 shall be a minimum of 20- in. diameter or installations achieving the same protection (i.e. stacked at smaller diameter sediment logs, etc.).
- Sediment logs placed on paved surfaces for inlet protection must be weighted down to prevent sediment from passing beneath the roll.
- On soil, sediment logs must be keyed in a minimum of one-third their

diameter and securely anchored to be effective.

- Difficult to move once saturated.
- Sediment logs could be transported by high flows if not properly trenched in.
- Sediment logs have limited sediment capture zone.
- Do not use sediment logs on slopes subject to creep, slumping, or landslide.

Standards and Specifications

Sediment log Materials

- Sediment logs shall be either:
 - Prefabricated rolls; or,
 - Rolled tubes of erosion control blanket.
 - Plant-derived materials shall be certified weed free.

Assembly of Field Rolled Sediment log

- Roll length of erosion control blanket into a tube of minimum 8 in. diameter.
- Bind roll at each end and every 4 ft. along length of roll with jute-type twine.

Installation

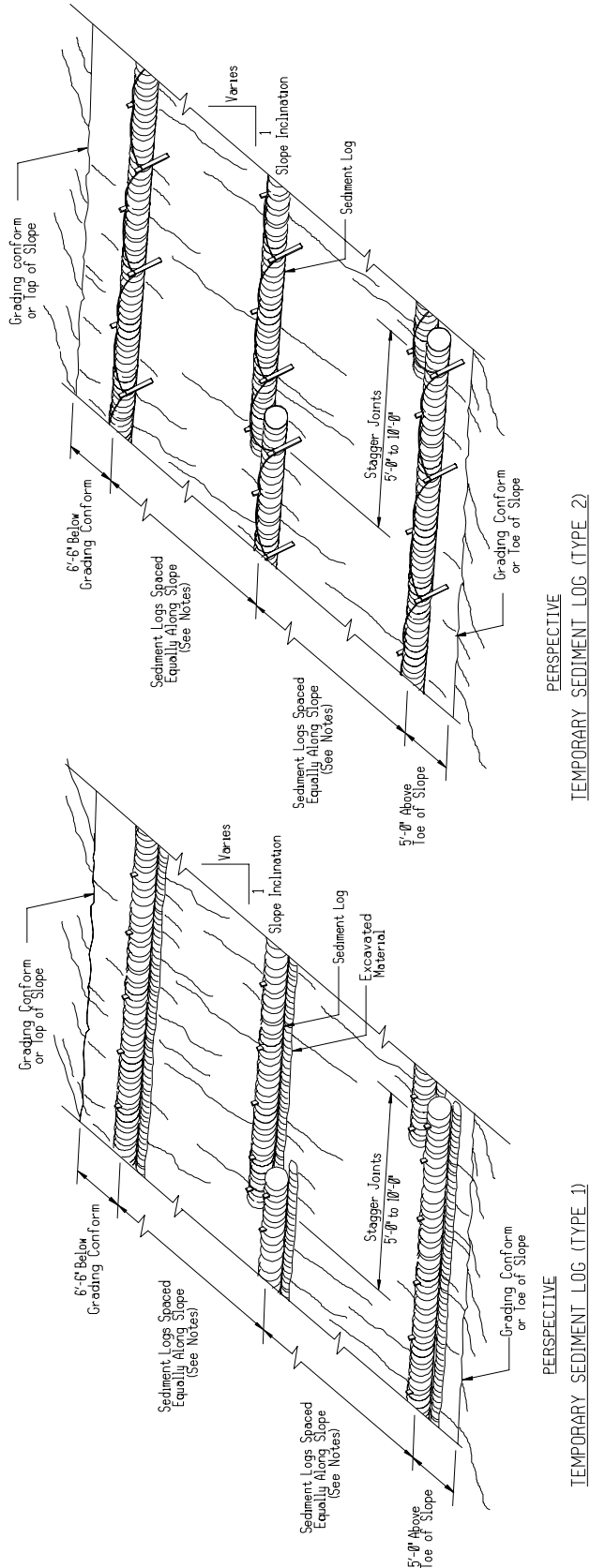
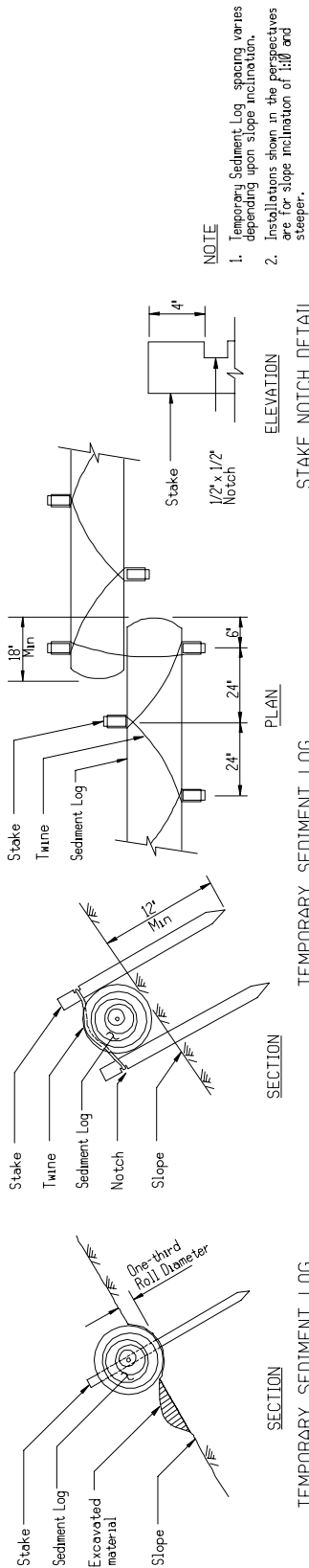
- Slope inclination of 4:1 or flatter: sediment logs shall be placed on slopes 20 ft. apart.
- Slope inclination of 4:1 to 2:1: sediment logs shall be placed on slopes 15 ft. apart.
- Slope inclination 2:1 or greater: sediment logs shall be placed on slopes 10 ft. apart.
- Key –in sediment logs into the ground a minimum of one-third their diameter.
- Anchor sediment logs with stakes at the ends and spaced 4 ft. maximum on center.
- Use wood stakes with a nominal classification of 3/4 by 3/4 in., and minimum length of 24 in (Type 1 installation), and 1 by 1 1/2 in. by minimum length of 24" (Type 2 installation).
- If more than one sediment log is placed in a row, the rolls shall be overlapped, not abutted.

Removal

- Sediment logs are typically left in place.
- If sediment logs are removed, collect and dispose of sediment accumulation, and fill and compact holes, trenches, depressions or any other ground disturbance to blend with adjacent ground.

Maintenance and Inspection

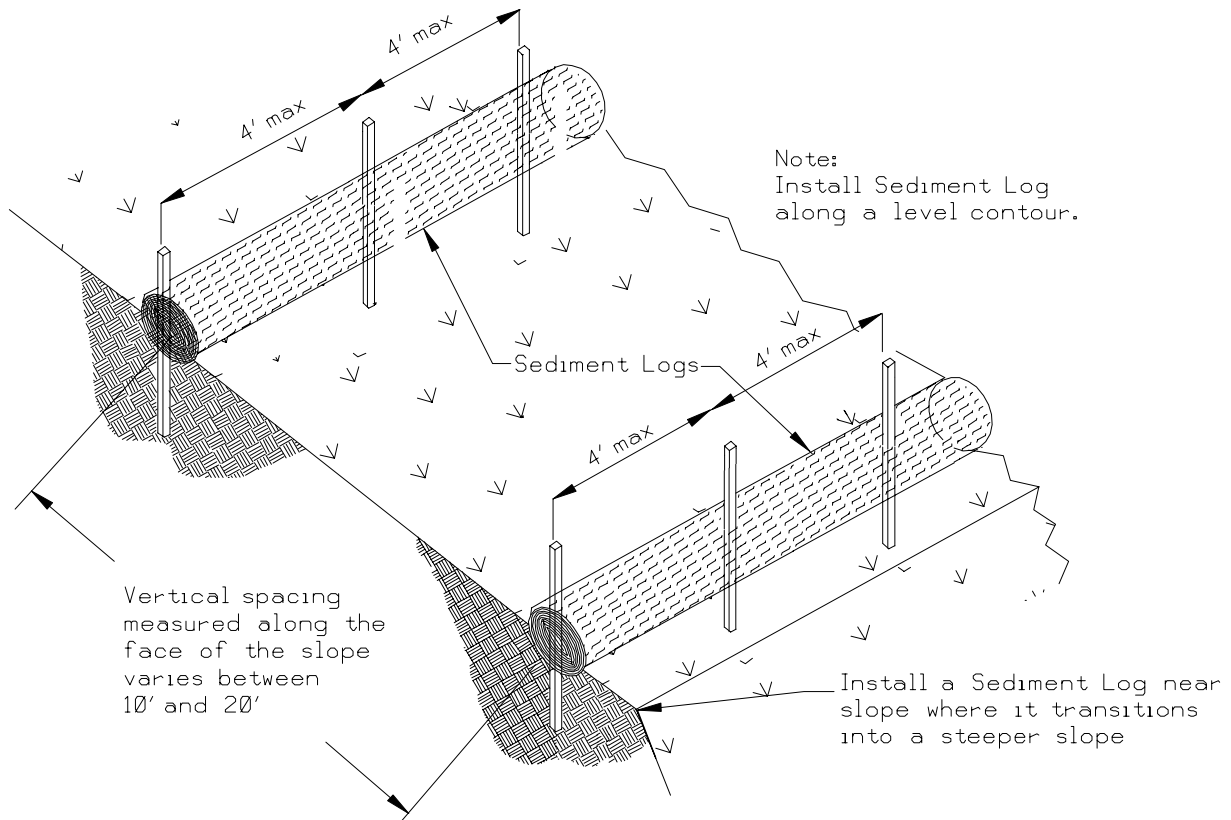
- Repair or replace split, torn, unraveling, or slumping sediment logs.
- Inspect sediment logs when rain is forecast, following rainfall events and at least daily during prolonged rainfall. Perform maintenance as needed or as required to comply with the SWPPP.
- Maintain sediment logs to provide an adequate sediment holding capacity. Sediment shall be removed when the sediment accumulation reaches three quarters (3/4) of the barrier height. Removed sediment shall be incorporated in the project or disposed of outside the highway Right-of-Way in conformance with the Standard Specifications Section 107.



Sediment Logs

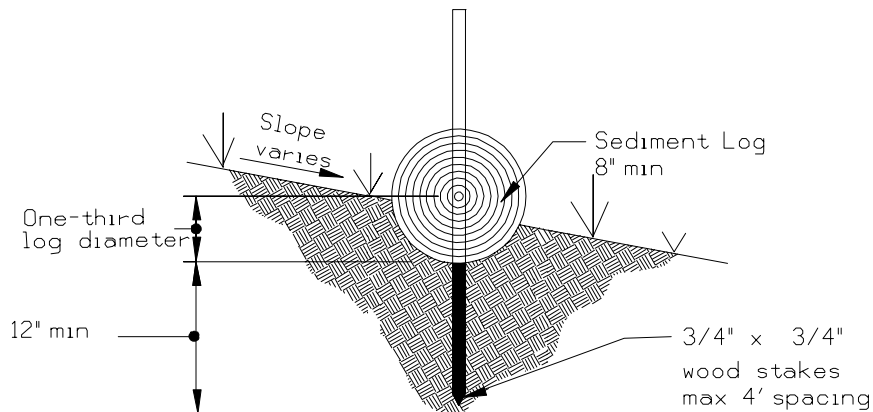
SC-5

Adapted from Caltrans Construction Site BMPs



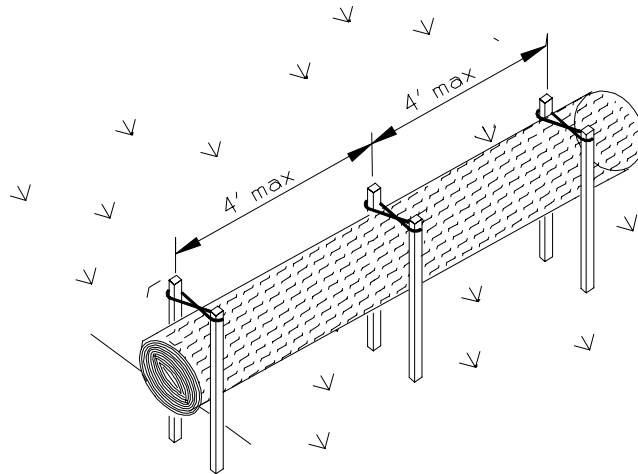
TYPE 1 SEDIMENT LOG INSTALLATION

N.T.S.



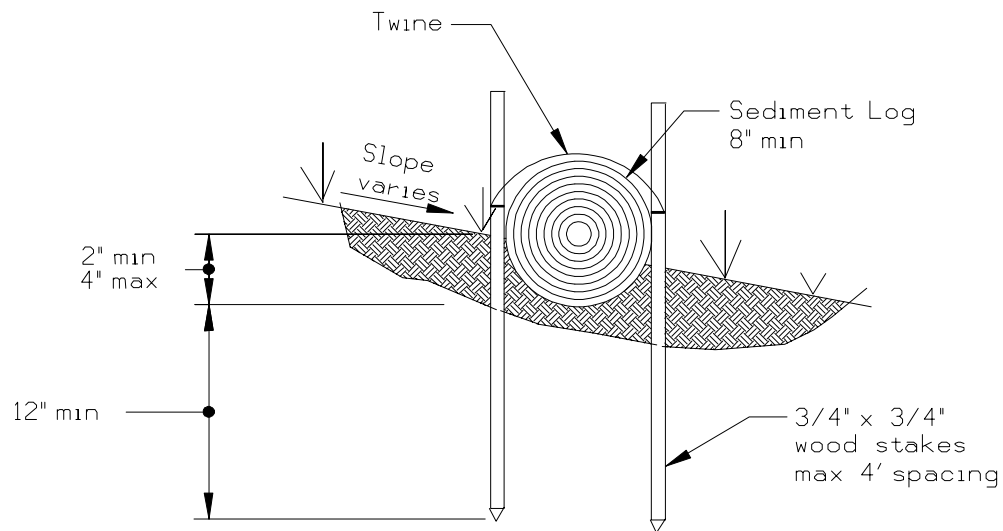
ENTRENCHMENT DETAIL

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TYPE 2 SEDIMENT LOG INSTALLATION

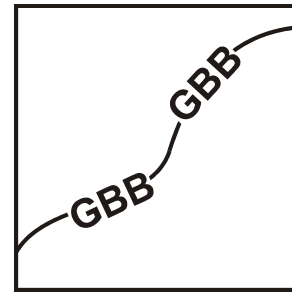
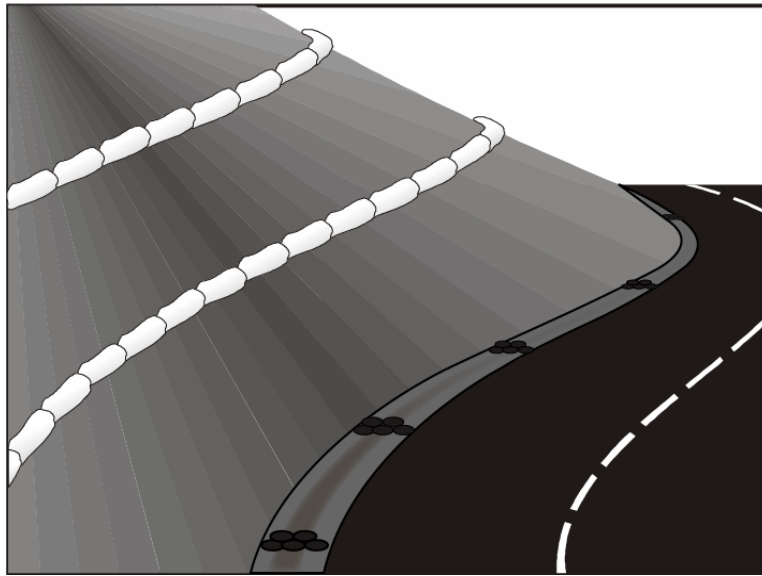
N.T.S.



OPTIONAL ENTRENCHMENT DETAIL

N.T.S.

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

A gravel bag berm consists of a single row of gravel bags that are installed end-to-end to form a barrier across a slope to intercept runoff, reduce its flow velocity, release the runoff as sheet flow, and provide some sediment removal. Gravel bags can also be used where flows are moderately concentrated, such as ditches, swales, and storm drain inlets (see BMP SC-08, Storm Drain Inlet Protection) to divert and/or detain flows.

Appropriate Applications

- Along the perimeter of a site.
- Along streams and channels.
- Below the toe of exposed and erodible slopes.
- Down slope of exposed soil areas.
- Around stockpiles.
- Where flows are moderately concentrated, such as ditches, swales, and storm drain inlets.
- Across channels in constructing check dams or diversions.
- Parallel to a roadway to keep sediment off paved areas.
- At the top of slopes to divert runoff away from disturbed slopes.
- To divert or direct flow or create a temporary sediment basin.
- During construction activities in channels when the contributing drainage area is less than 10 acres.
- When conditions require a more durable product than silt fence, assuming that the bag material conforms to the requirements below and burlap is not used.

- When site conditions or construction sequencing require adjustments or relocation of the barrier to meet changing field conditions and needs during construction.
 - At grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow.
- Limitations
- Degraded gravel bags may rupture when removed, spilling contents.
 - Installation can be labor intensive.
 - Burlap bags have limited durability for long-term projects. .
 - When used to detain concentrated flows, maintenance requirements increase.

Standards and Specifications

Materials

- *Bag Material:* Bags shall be woven polypropylene, polyethylene or polyamide fabric or burlap, minimum unit weight 4 ounces/yd², Mullen burst strength exceeding 300 psi in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70 percent in conformance with the requirements in ASTM designation D4355.
- *Bag Size:* Each gravel-filled bag shall have a length of 18 in., width of 12 in., thickness of 3 in., and mass of approximately 33 lb. Bag dimensions are nominal, and may vary based on locally available materials.
- *Fill Material:* Fill material shall be one-half to one-inch washed, well graded, gravel or crushed rock with less than five percent fines, such as Class 150 Riprap Bedding.

Installation

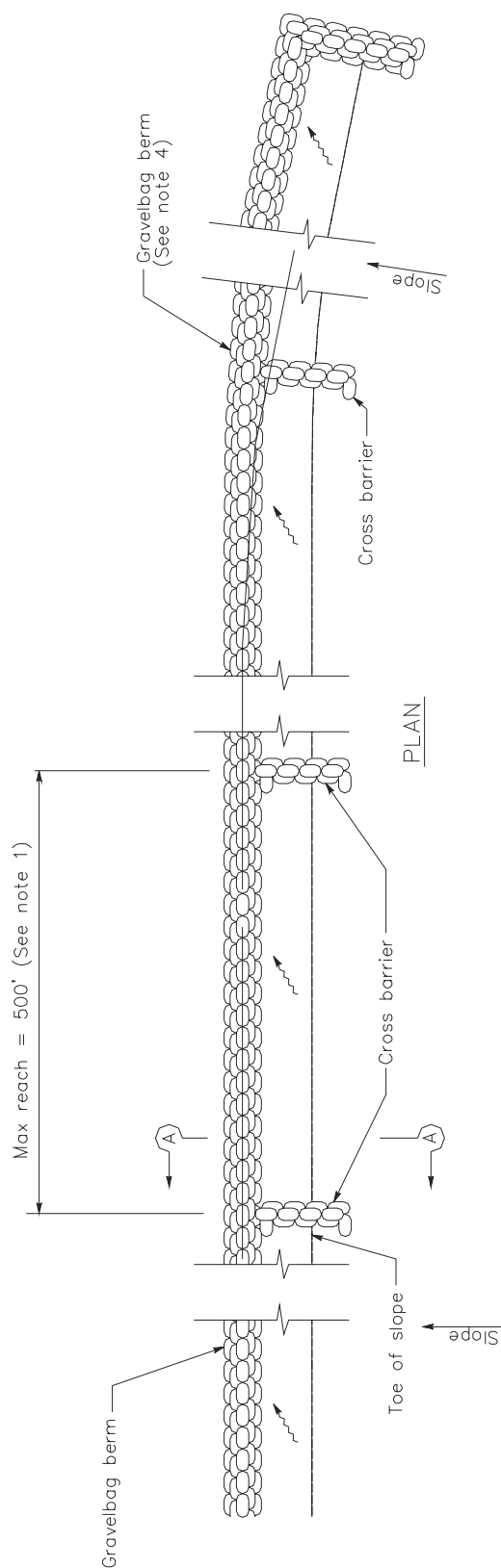
- When used as a linear control for sediment removal:
 - Install along a level contour.
 - Turn ends of gravel bag row up slope to prevent flow around the ends.
 - Generally, gravel bag barriers shall be used in conjunction with temporary soil stabilization controls up slope to provide effective control.
- When used for concentrated flows:
 - Stack gravel bags to a maximum height of 3 ft. and maximum side slopes of 1:1, using a pyramid approach.

- Upper rows of gravel bags shall overlap joints in lower rows.

- Construct gravel bag barriers with a setback of at least 3 ft. from the toe of a slope. Where it is not practical due to specific site conditions, the gravel bag barrier may be constructed at the toe of the slope, but shall be constructed as far from the toe of the slope as practical to allow for maintenance access.
- Trenching or keying-in of bags is generally not necessary since the bags are heavy and flexible enough to prevent underflow. Bags should be placed on a stable surface with complete ground contact.

Maintenance and Inspection

- Inspect gravel bag berms before and after each rainfall event, and weekly throughout the rainy season.
- Reshape or replace gravel bags as needed.
- Repair washouts or other damages as needed.
- Inspect gravel bag berms for sediment accumulations and remove sediments when accumulation reaches one-third of the berm height. Removed sediment shall be incorporated in the project at locations designated by the RE or disposed of outside the highway Right-of-Way in conformance with the Standard Specifications Section 107.
- Remove gravel bag berms when no longer needed. Remove sediment accumulation, and clean, re-grade, and stabilize the area.



GRAVELBAG BERM

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 gravelbags tightly.
3. Dimension may vary to fit field condition.
4. Gravelbag 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. Gravelbag rows and layers shall be staggered to eliminate gaps.

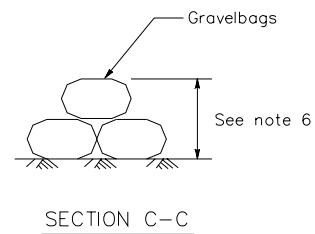
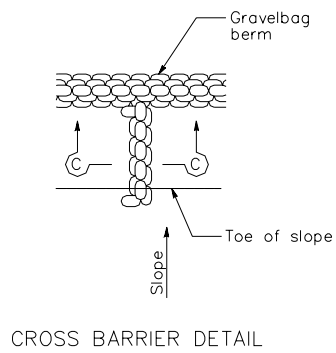
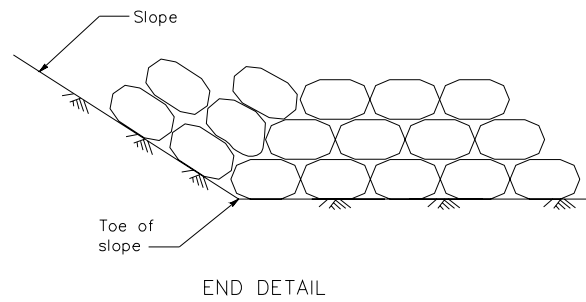
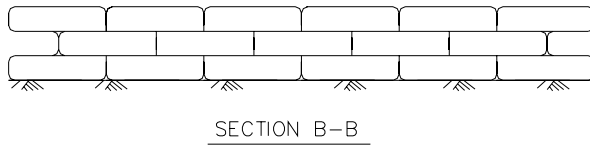
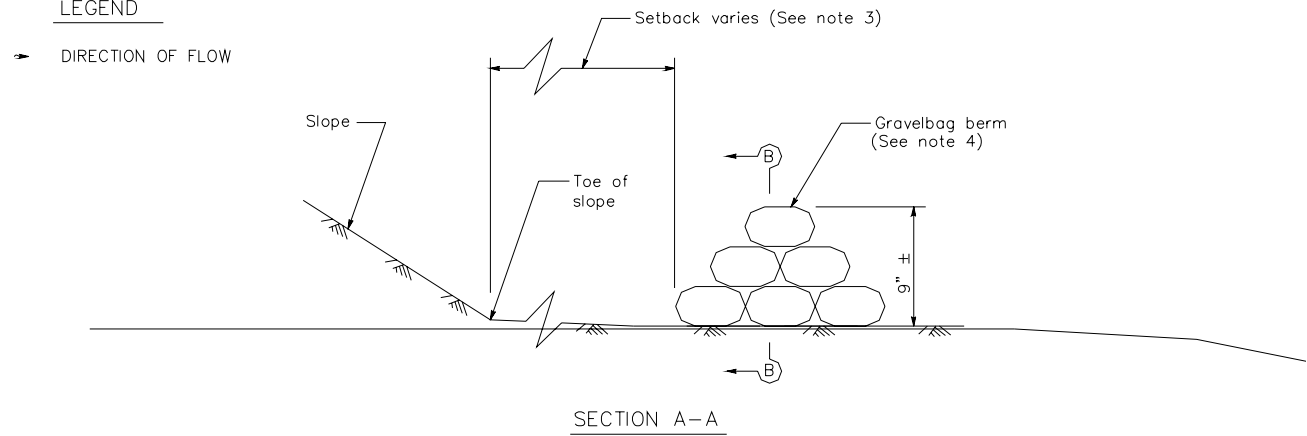
Gravel Bag Berm

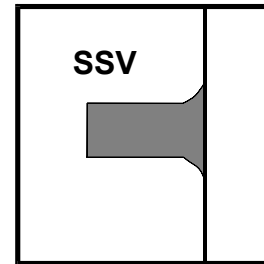
SC-6

Adapted from Caltrans Construction Site BMPs

LEGEND

➔ DIRECTION OF FLOW





BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose Practices to remove tracked sediment to prevent the sediment from entering a storm drain or watercourse.

Appropriate Applications These practices are implemented anywhere sediment is tracked from the project site onto public or private paved roads, typically at points of egress.

Limitations Sweeping and vacuuming may not be effective when soil is too wet or muddy however the soil should be moist to avoid dust.

Standards and Specifications

- Mechanical sweeping and washing with water require capture and treatment or proper disposal of any runoff.
- Inspect potential sediment tracking locations daily.
- Visible sediment tracking shall be swept per Standard Specification Section 107, or vacuumed to prevent excessive dust on a daily basis.

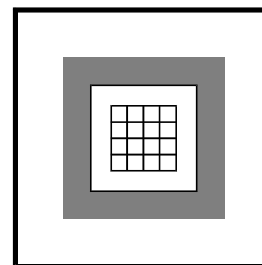
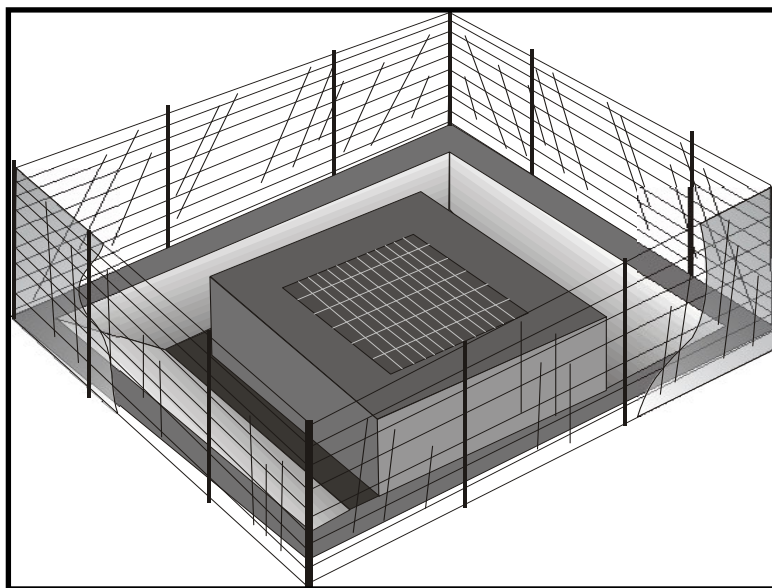
Maintenance and Inspection

- Inspect ingress/egress access points daily and clean track out areas in accordance with Standard Specifications Section 107.
- Be careful not to sweep up any unknown substance or any object that may be potentially hazardous.
- Adjust brooms frequently to maintain proper contact with the ground and maximize efficiency of sweeping operations.
- After sweeping is finished, properly dispose of sweeper wastes in conformance with the provisions in Standard Specifications Section 107.

Storm Drain Inlet Protection

SC-8

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose Devices used at storm drain inlets that are subject to runoff from construction activities to allow sediment to settle and/or to filter sediment prior to discharge into storm water drainage systems or watercourses.

- Appropriate Applications**
- Where ponding will not encroach into highway traffic or adjacent property owners.
 - Where sediment laden surface runoff may enter an inlet.
 - Where disturbed drainage areas have not yet been permanently stabilized.
 - Where the drainage area is 1 acre or less.

- Limitations**
- Requires an adequate area to place materials and for water to pond without encroaching upon the traveled portion of the highway.
 - Shoulders and paved portions of active highways utilizing inlet protection structures must be thoroughly closed off from traffic to prevent vehicle accidents.
 - May require other temporary BMPs in combination to prevent sediment-laden storm water and non-storm water discharges to enter the storm drain system.
 - Sediment removal may be difficult in high flow conditions or if runoff is heavily sediment laden. If high flow conditions are expected, use other on-site sediment trapping techniques (i.e. check dams) in conjunction with inlet protection.
 - Frequent maintenance is required.

- For drainage areas larger than 1 acre, runoff shall be routed to a sediment-trapping device designed for larger flows. See BMPs SC-2, "Sediment/Desilting Basin", and SC-3 "Sediment Traps".
- Filter fabric fence inlet protection appropriate in open areas is subject to sheet flow and for flows not exceeding 0.5 ft³/s.
- Gravel bag barriers for inlet protection are applicable when sheet flows or concentrated flows exceed 0.5 ft³/s, and it is necessary to allow for overtopping to prevent flooding.
- Sediment logs are not appropriate for inlet protection.
- Excavated drop inlet sediment traps are appropriate where relatively heavy flows are expected and overflow capability is needed.

Standards and Specifications Identify existing and/or 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.

Methods and Installation

- ***DI Protection Type 1 - Filter Fabric Fence*** - The silt fence fabric (Type 1) protection is illustrated on Page 5. Similar to constructing a silt fence. See BMP SC-1, "Silt Fence". Do not place filter fabric underneath the inlet grate since the collected sediment may fall into the drop inlet when the fabric is removed or replaced. This protection will only work if the inlet is surrounded by unpaved surface (e.g. when the road has not been built yet).
- ***DI Protection Type 2 - Excavated Drop Inlet Sediment Trap*** - The excavated drop inlet sediment trap (Type 2) is illustrated on Page 6. Similar to constructing a temporary silt fence, See BMP SC-1, "Silt Fence". Size excavated trap to provide a minimum storage capacity calculated at the rate of 67 yd³/acre of drainage area. This protection will only work if the inlet is surrounded by unpaved surface (e.g. when the road has not been built yet).
- ***DI Protection Type 3 - Gravel Bag Barrier*** - The gravel bag barrier (Type 3) is illustrated on Page 7. Flow from a severe storm shall not overtop the curb. In areas of high clay and silts, wrap or line the gravel bag structure with silt fence fabric and then cover with gravel to create additional filtering. Construct gravel bags in accordance with BMP SC-6, "Gravel Bag Berm". Gravel bags shall be used due to their high permeability.
- Many proprietary devices and products are available for drain inlet

protection and are listed in NDOT's qualified products list (QPL), or must be approved by the engineer. If used, these products should be installed and maintained per the manufacturer's recommendations.

Maintenance and Inspection **General**

- Inspect all inlet protection devices before and after every rainfall event and weekly during the rest of the rainy season. During extended rainfall events, inspect inlet protection devices at least once every 24 hours.
- Inspect the storm drain inlet after severe storms in the rainy season to check for bypassed material.
- Remove all inlet protection devices within thirty days after the site is stabilized, or when the inlet protection is no longer needed.
 - Bring the disturbed area to final grade and smooth and compact it. Appropriately stabilize all bare areas around the inlet.

Requirements by Method

- **Type 1 - Silt Fence Fabric**
 - This method shall be used for drain inlets requiring protection in areas where finished grade is established and erosion control seeding has been applied or is pending
 - Make sure the posts 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 posts in accordance with SC-1 "Silt Fence" and Standard Specifications Section 637.
 - Replace the fabric when the fabric becomes clogged with sediment. Make sure the fabric does not have any holes or tears. Repair or replace fabric as needed.
 - At a minimum, remove the sediment behind the fabric fence when accumulation reaches one-third the height of the fence or barrier height. Removed sediment shall be incorporated in the project or disposed of outside the highway Right-of-Way in conformance with the Standard Specifications Section 107.
- **Type 2 - Excavated Drop Inlet Sediment Trap**
 - This method may be used for drain inlets requiring protection in areas that have been cleared and grubbed, and where exposed

soil areas are subject to grading.

- Remove sediment from basin when the volume of the basin has been reduced by one-half.

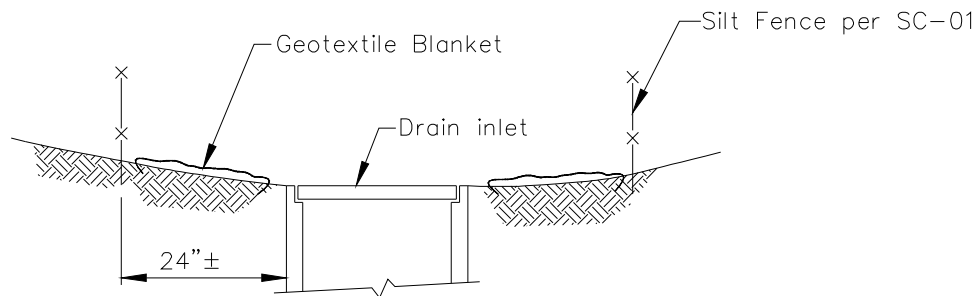
■ *Type 3 - Gravel Bag Barrier*

- This method may be used for drain inlets surrounded by AC or paved surfaces.
- Inspect bags for holes, gashes, and snags.
- Check gravel bags for proper arrangement and displacement. Remove sediment, manually or mechanically as appropriate, behind the barrier when it reaches one-third the height of the barrier. Removed sediment shall be incorporated in the project or disposed of outside the highway Right-of-Way in conformance with the Standard Specifications Section 107.

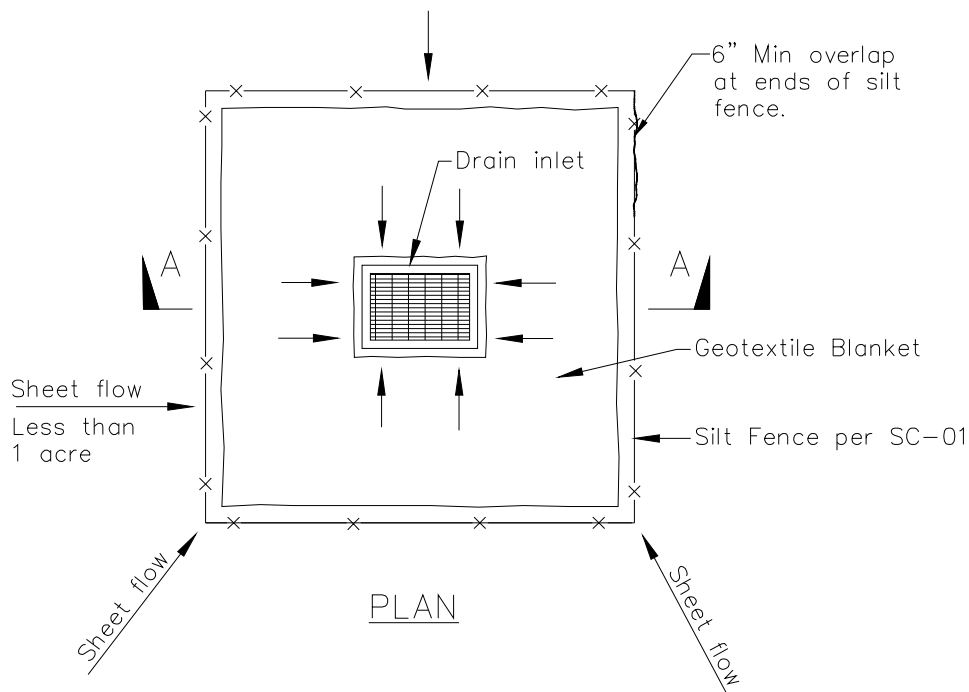
Storm Drain Inlet Protection

SC-8

Adapted from Caltrans Construction Site BMPs



SECTION A-A

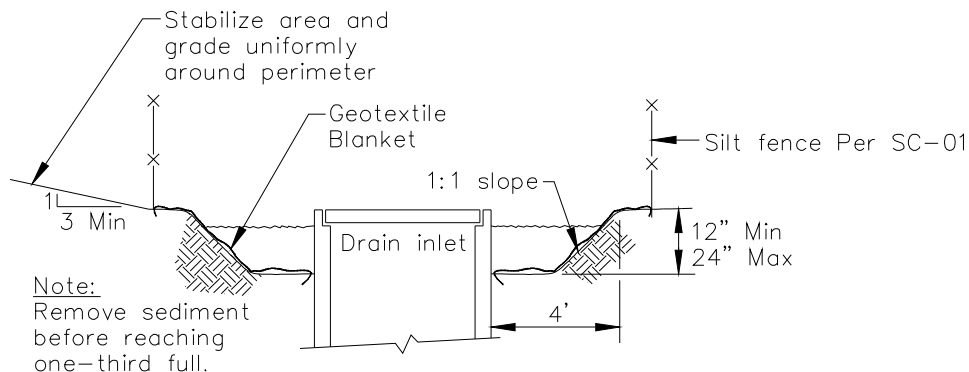


PLAN

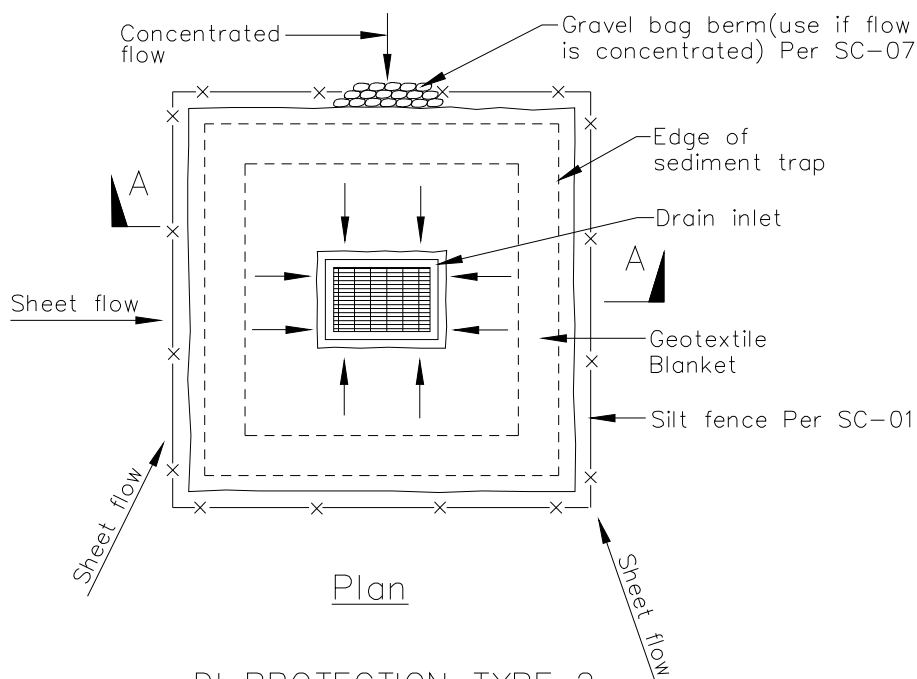
DI PROTECTION TYPE 1
NOT TO SCALE

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



DI PROTECTION TYPE 2
NOT TO SCALE

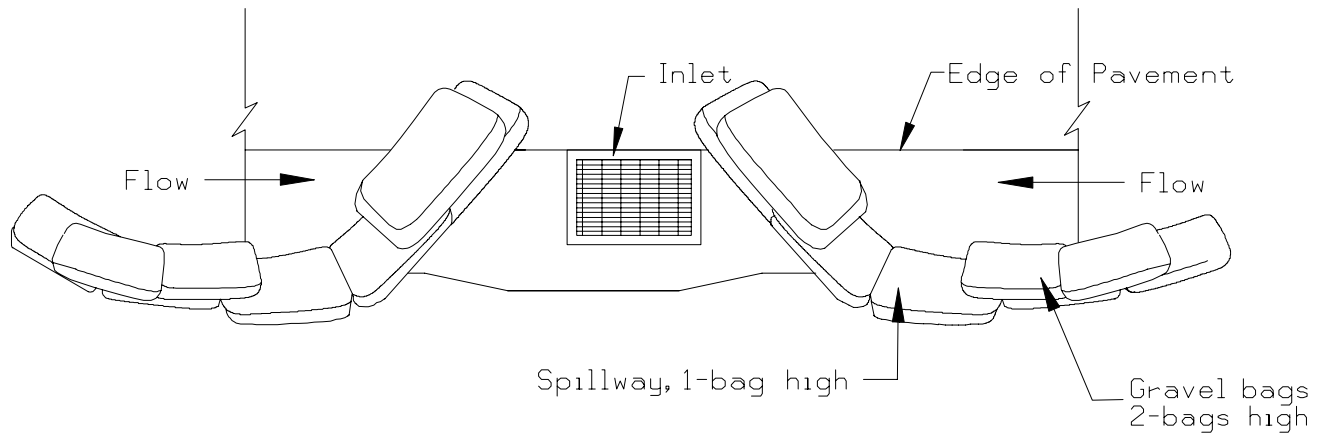
Notes

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.

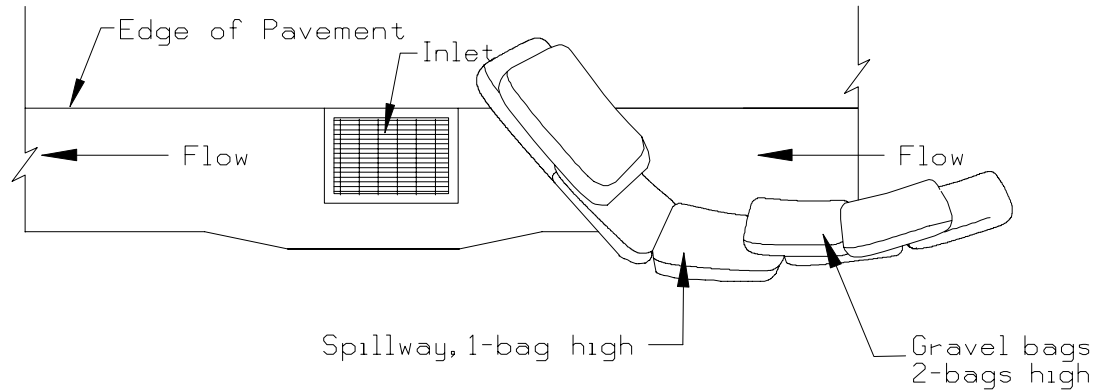
Storm Drain Inlet Protection

SC-8

Adapted from Caltrans Construction Site BMPs



TYPE 3 PROTECTION FOR INLET ON SUMP



TYPE 3 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.

Section 5

Tracking Control

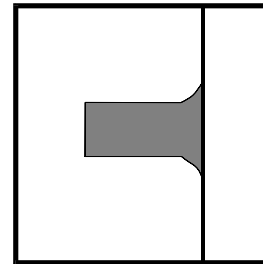
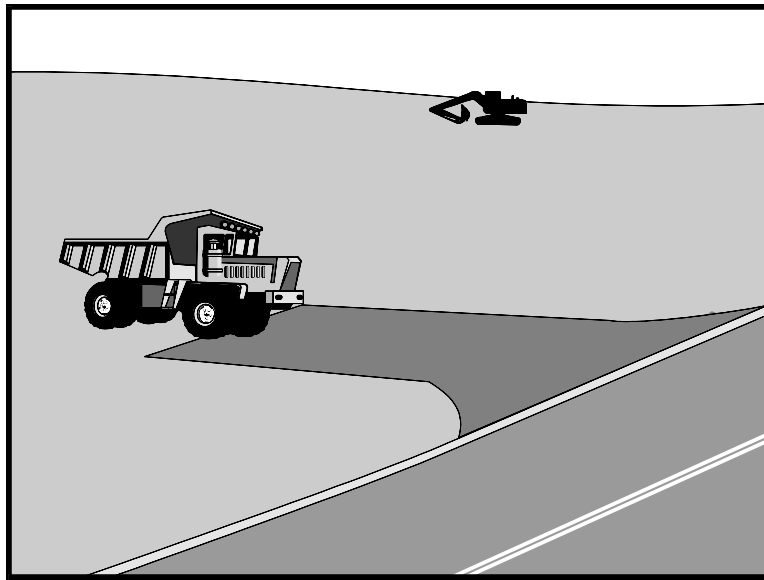
Best Management Practices

5.1 Tracking Control

Tracking control consists of preventing or reducing off-site vehicle tracking from entering a storm drain or watercourse. Tracking control best management practices (BMPs) are shown in Table 5-1.

Table 5-1 TRACKING CONTROL BMPs	
ID	BMP NAME
TC-1	Stabilized Construction Entrance/Exit
TC-2	Stabilized Construction Roadway
TC-3	Entrance/Outlet Tire Wash

The remainder of this Section shows the working details for the tracking control BMPs.



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose A stabilized construction approach is defined by a construction site ingress/egress point that is stabilized to reduce the tracking of mud and dirt onto public roads by construction vehicles.

- Appropriate 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.
 - This BMP may be implemented on a project-by-project basis in addition to other BMPs.

Limitations ■ Site conditions will dictate design and need.

- Standards and Specifications**
- Minimize the points of ingress/egress to the construction site.
 - Limit vehicle speeds to 15 mph on all unpaved routes and parking areas.
 - Properly grade each construction ingress/egress to prevent runoff from flowing onto paved roads.
 - Route runoff from stabilized ingress/egress points through a sediment-trapping device before discharge.
 - Design stabilized ingress/egress points to support the heaviest vehicles and equipment that will use it.

- Install gravel pad(s) consisting of 1 in. rough diameter, clean, well-graded gravel and crushed rock in conformance with Class 150 Riprap Bedding. Dimensions should be approximately 15 ft. wide by 6 inches deep, and 50 ft. long, or the length of the longest haul truck, whichever is greater. Re-screen, wash or apply additional rock in to maintain effectiveness.
- Clearly designate combination or single purpose entrances and exits to the construction site. Require all employees, subcontractors and others to use them.
- Implement BMP SC-7, "Street Sweeping and Vacuuming" as needed to maintain dust control and prevent sediment from leaving the site.
- Maintain dust control during working hours and clean trackout from paved surfaces at the end of each work shift/day. Trackout must be cleaned daily, at minimum in conformance with Standard Specification 107.
- Install wheel shakers consisting of constructed/ manufactured steel plates with ribs in the event that trackout cannot be controlled with gravel pads. Ribbed or corrugated steel plates must be manufactured to support all expected loads.
- Install wheel washers (TC-3) and maintain on a regular basis to maintain effectiveness in the event that trackout cannot be controlled with gravel pads and wheel shakers.
- Clark County Health District "Dust Control Handbook" provides additional guidance for ribbed plate wheel shakers.

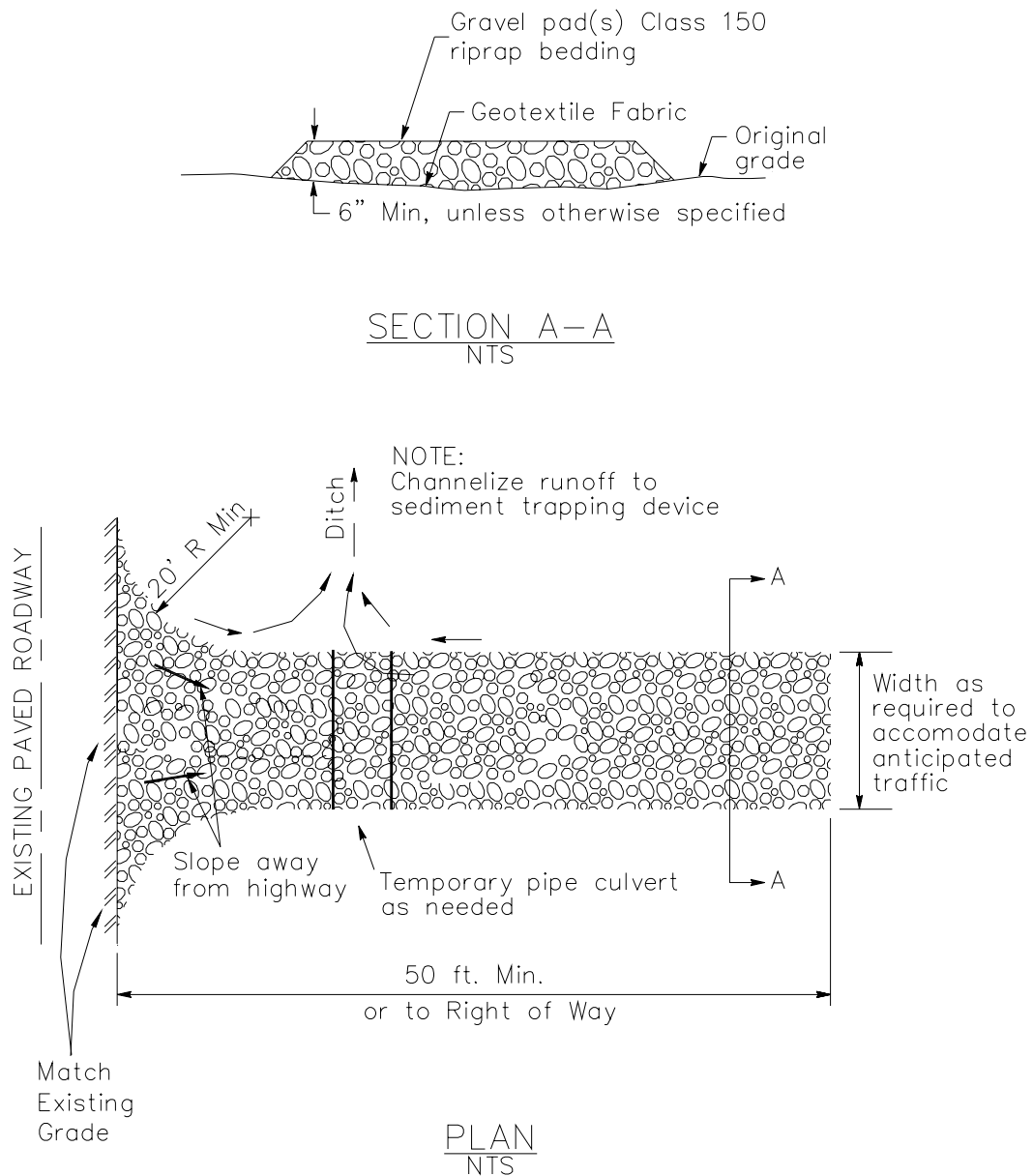
Maintenance and Inspection

- Inspect routinely for damage and assess effectiveness of the BMP. Remove aggregate, separate and dispose of sediment if gravel is clogged with sediment or as directed by the RE.
- Keep all temporary roadway ditches clear.
- Inspect for damage and repair as needed.

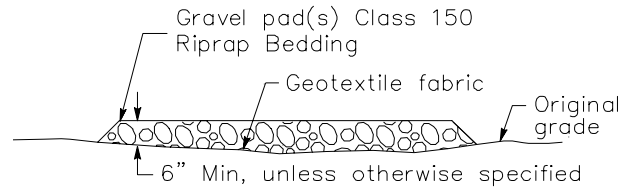
Stabilized Construction Approaches

TC-1

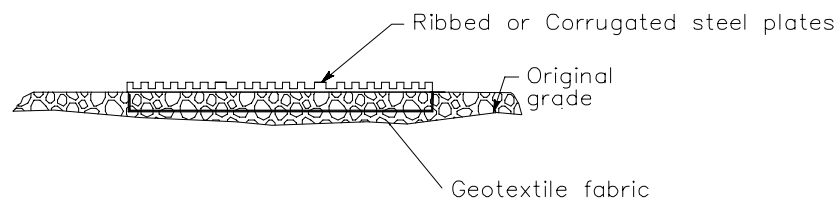
Adapted from Caltrans Construction Site BMPs



Stabilized Construction Approach

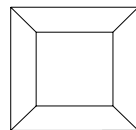


SECTION B-B
NTS

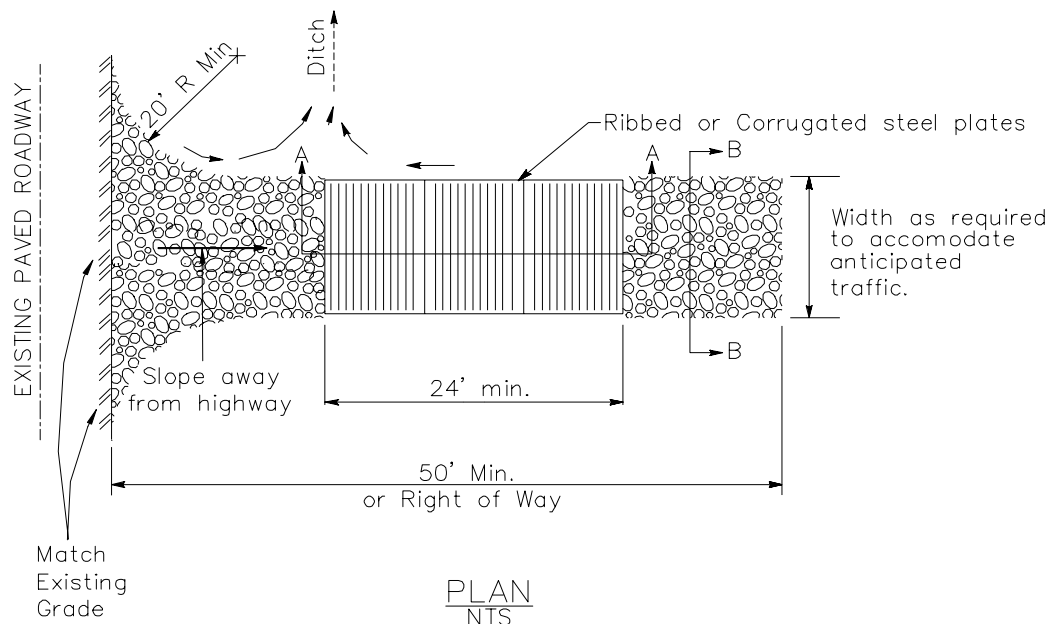


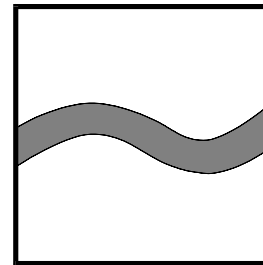
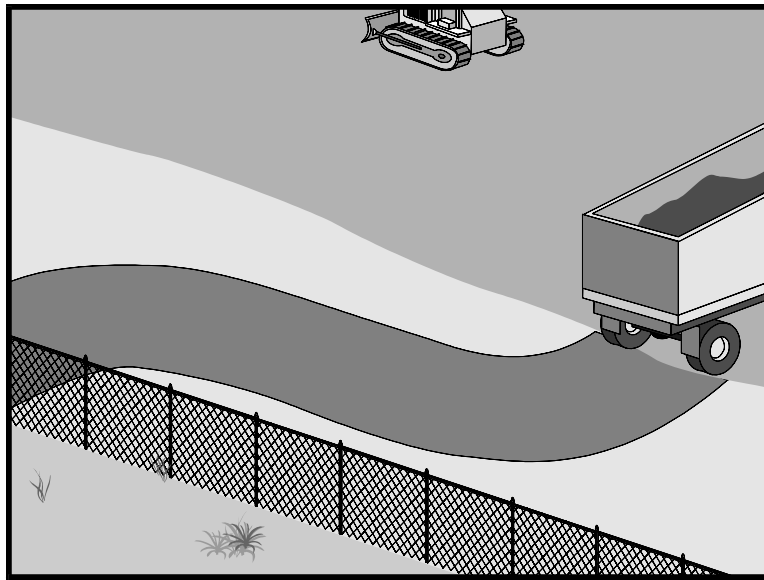
SECTION A-A
NOT TO SCALE

NOTE:
Channelize runoff to
sediment trapping device



Sediment trapping
device





BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose A stabilized construction roadway is a temporary access road or haul road. It is designed for the control of dust and erosion created by vehicular traffic. Construction roads with heavier traffic such as haul roads may require increased protection over smaller lateral roads such as employee parking.

- Appropriate Applications**
- Construction roadways and short-term detour roads:
 - Where mud tracking is a problem during wet weather.
 - Where dust is a problem during dry weather.
 - Adjacent to water bodies.
 - Where silt or clay content is higher than 15%.
 - Where there are steep grades and additional traction is needed.

- This BMP may be implemented on a project-by-project basis with other BMPs.

- Limitations**
- Materials will likely need to be removed prior to final project grading and stabilization.
 - Site conditions will dictate design and need.

- Standards and Specifications**
- Properly grade roadway to prevent runoff from leaving the construction site.
 - Design stabilized construction roadways to support the heaviest vehicles and equipment that will use it.

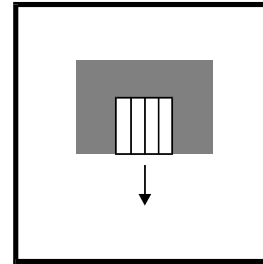
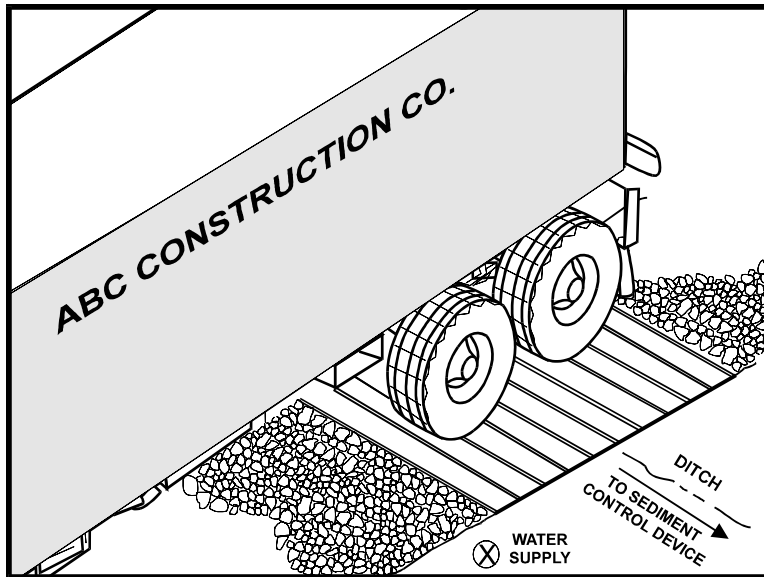
- Stabilize roadways using water, dust palliative, aggregate, asphalt concrete, or concrete; based on required longevity, performance, and site conditions and maintain in a stabilized condition.
- Coordinate materials with those used for stabilized construction ingress/egress points (TC-2).
- If aggregate is selected, use clean, well-graded gravel or crushed rock in conformance with Class 150 Riprap Base. Minimum dimensions should be approximately 15 feet wide by 6 inches deep or as needed to accommodate the types of vehicles that will use the road.
- Limit vehicles speeds to 15 mph on all unpaved routes and parking areas.
- The use of bumps or dips for speed control is encouraged.
- Apply bituminous or concrete paving as soon as possible to all future permanent roadway or parking areas.
- Inspect routinely for damage and repair as needed, or as directed by the RE.
- Keep all temporary roadway ditches clear.
- When no longer required, remove stabilized construction roadway and re-grade and restore slopes to match site conditions.

Maintenance and Inspection

Entrance/Outlet Tire Wash

TC-3

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose Tire wash stations can be located at stabilized construction egress points to remove sediment from tires and under-carriages, and to prevent sediment from being transported onto public roadways.

Appropriate Applications

- Tire washes may be used on construction sites where dirt and mud tracking onto public roads by construction vehicles may occur.
- This BMP may be appropriate when stabilized ingress/egress points and construction roads are not sufficient in preventing sediment tracking onto adjacent roads or highways or in Environmentally Sensitive Areas (ESAs).
- Tire and vehicle washing may also be required to prevent the spread of noxious weeds. Refer to the contract documents to verify compliance with noxious weed requirements.

Limitations

- Requires a supply of wash water. Potential sources include existing water service connections if available, fire hydrants, or temporary water storage tanks. The contractor shall verify that the use of any municipal or other existing water service is allowable with the appropriate agency.
- Requires a turnout or doublewide exit to avoid having entering vehicles drive through the wash area.

Standards and Specifications

- This BMP should be used in combination with TC-1, "Stabilized Construction Entrance/Exit".
- Construct on level ground when possible, on a pad of coarse aggregate. A geotextile fabric shall be placed below the aggregate.
- The wash rack must be designed for anticipated traffic loads.

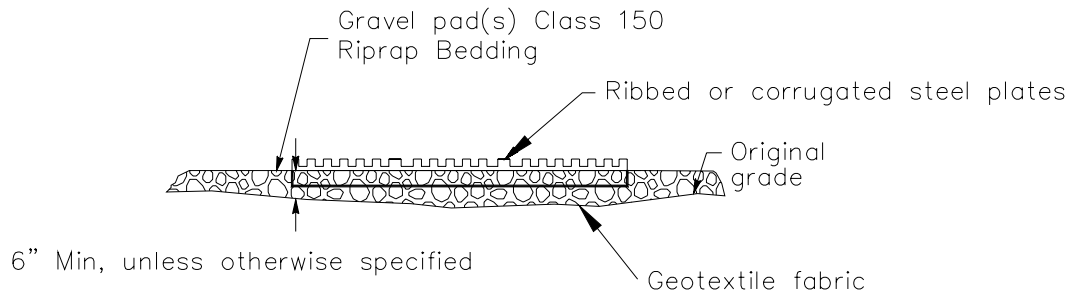
**Maintenance and
Inspection**

- Provide a drainage ditch that will convey the runoff from the wash area to a sediment-trapping device. See SC-3 for additional guidance regarding sediment traps. The drainage ditch shall be of sufficient grade, width, and depth and adequately stabilized to safely carry the wash runoff.
- Require that all employees, subcontractors, and others use the wash facility as appropriate.
- Implement BMP SC-7, "Street Sweeping and Vacuuming" as needed.
- Remove accumulated sediment in wash rack and/or sediment trap to maintain system performance and dispose of in accordance with Standard Specifications Section 107.
- Inspect routinely for damage and repair as needed.

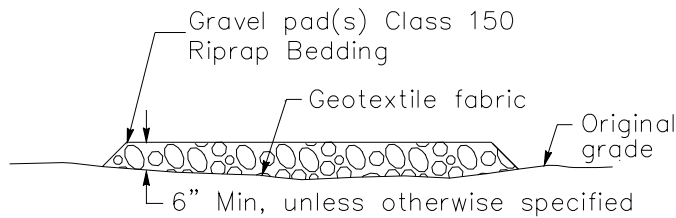
Entrance/Outlet Tire Wash

TC-3

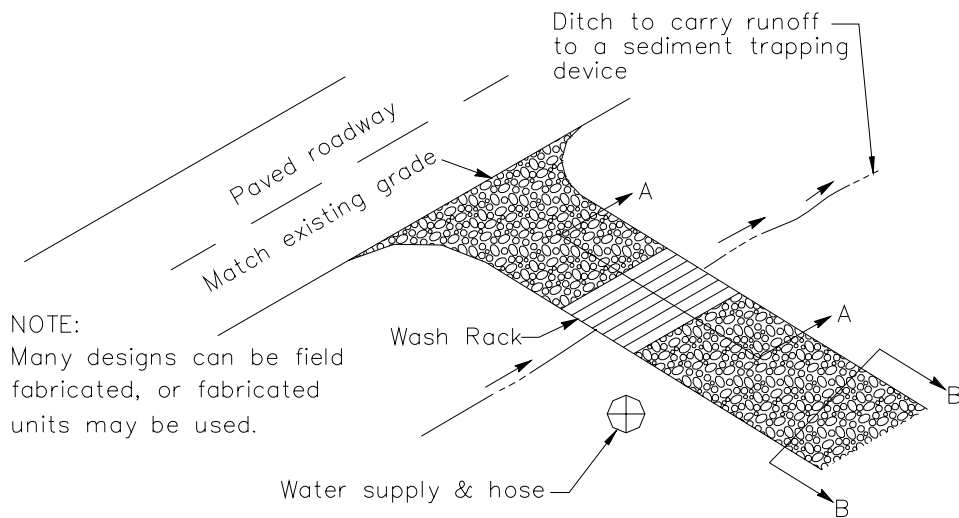
Adapted from Caltrans Construction Site BMPs



SECTION A-A
NOT TO SCALE



SECTION B-B
NTS



TYPICAL TIRE WASH
NOT TO SCALE

Section 6

Non-Storm Water Management Best Management Practices

6.1 Definition

Non-storm water management best management practices (BMPs) are source control BMPs that prevent pollution by limiting or reducing potential pollutants at their source before they come in contact with storm water. These practices involve day-to-day operations of the construction site and are usually under the control of the Contractor. These BMPs are also referred to as “good housekeeping practices”, which involve keeping a clean, orderly construction site.

Table 6-1 lists the non-storm water management BMPs. It is important to note that all these BMPs have been approved by NDOT for statewide use and they shall be implemented depending on the conditions/applicability of deployment described as part of the BMP.

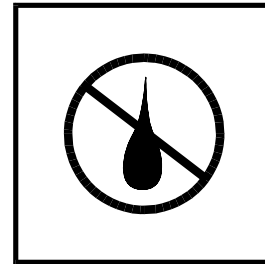
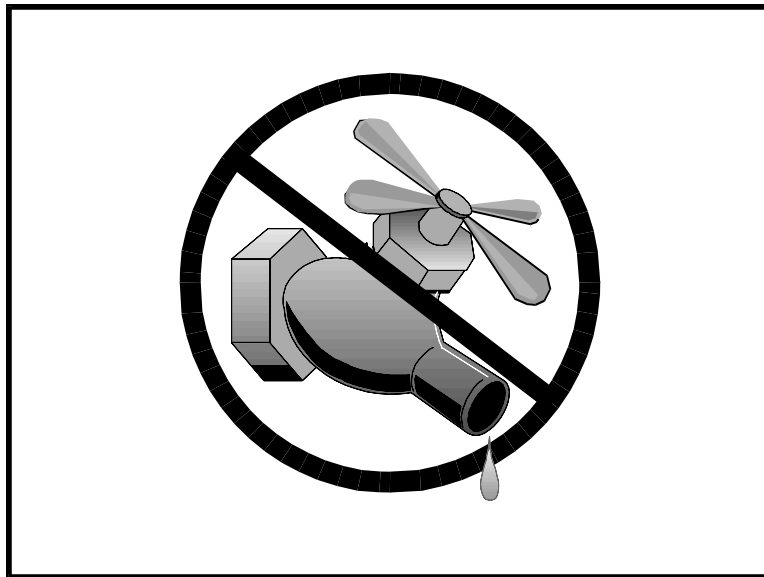
Table 6-1 NON-STORM WATER MANAGEMENT BMPs	
ID	BMP NAME
NS-1	Water Conservation Practices
NS-2	Dewatering Operations
NS-3	Paving and Grinding Operations
NS-4	Temporary Stream Crossing
NS-5	Clear Water Diversion
NS-6	Illicit Connection/Illegal Discharge Detection and Reporting
NS-7	Potable Water/Irrigation
NS-8	Vehicle and Equipment Cleaning
NS-9	Vehicle and Equipment Fueling
NS-10	Vehicle and Equipment Maintenance
NS-11	Pile Driving and Drilling Operations
NS-12	Concrete and Pavement Curing
NS-13	Material and Equipment Use Over Water
NS-14	Concrete Finishing
NS-15	Structure Demolition/Removal Over or Adjacent to Water
NS-16	Temporary Batch Plants

6.1.1 Vehicle and Equipment Operations

These are procedures and practices designed to minimize or eliminate the discharge of pollutants from vehicle and equipment cleaning, fueling and maintenance operations to storm water drainage systems or to watercourses. Vehicle and equipment operations include the following BMPs:

- Vehicle and Equipment Cleaning
- Vehicle and Equipment Fueling
- Vehicle and Equipment Maintenance

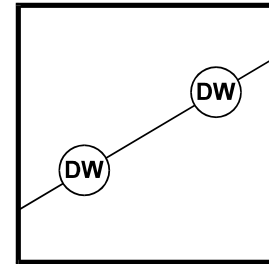
The remainder of this Section shows the working details for each of the non-storm water management BMPs.



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose	Water conservation practices are activities that use water during the construction of a project in a manner that avoids causing erosion and/or the transport of pollutants off site.
Appropriate Applications	<ul style="list-style-type: none"> ■ Water conservation practices are implemented on all construction sites and wherever water is used. ■ Applies to all construction projects. ■ Washing of equipment may be required to reduce the spreading of invasive weeds and other species. Check Special Provisions for requirements.
Limitations	<ul style="list-style-type: none"> ■ None identified.
Standards and Specifications	<ul style="list-style-type: none"> ■ Keep water equipment in good working condition and repair water leaks promptly. ■ Stabilize water truck filling area. ■ Washing of vehicles and equipment on the construction site should be minimized or avoided if possible. ■ Avoid using water to clean construction areas. Do not use water to clean pavement. Paved areas shall be swept and/or vacuumed. ■ Apply water for dust control in accordance with the Standard Specifications Sections 107, 210. ■ Report unexpected discharges to the Engineer immediately.
Maintenance and Inspection	<ul style="list-style-type: none"> ■ Inspect water equipment at least weekly and repair as needed.



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose Dewatering Operations are practices that manage the discharge of pollutants when non-storm water and accumulated precipitation (storm water) must be removed from a work location so that construction work may be accomplished.

Appropriate Applications These practices are implemented for discharges of non-storm water and storm water (accumulated rain water) from construction sites. Non-storm waters include, but are not limited to, groundwater, water from cofferdams, de-watering of piles, water diversions, and waters used during construction activities that must be removed from a work area.

Practices identified in this section are also appropriate for implementation when managing the removal of accumulated precipitation (storm water) from depressed areas at a construction site. Storm water mixed with non-storm water should be managed as non-storm water.

- Limitations**
- Dewatering operations for non-storm water will require, and must comply with, applicable local permits, project-specific permits, and regulations.
 - Site conditions will dictate design and use of dewatering operations.
 - A dewatering plan shall be submitted as part of the SWPPP/WPCP detailing the location of dewatering activities and equipment, and discharge point.
 - The controls discussed in this BMP address sediment only. If the presence of polluted water with hazardous substances is identified in the contract, the contractor shall implement dewatering pollution controls as required by the contract documents. If the quality of water to be removed by dewatering is not identified as polluted in

the contract documents, but is later determined by observation or testing to be polluted, the contractor shall notify the Engineer and the Storm Water Quality Coordinator and comply with Standard Specifications Section 107.

Standards and Specifications

- Avoid dewatering discharges where possible by using the water for dust control, or by infiltration if appropriate.
- Dewatering for accumulated precipitation (storm water) shall follow this BMP and use treatment measures specified herein.
- NDEP may require a separate NPDES Dewatering Permit prior to the discharge of non-storm water. Dewatering Permits are classified as Temporary Discharge Permits and can take at least 2 weeks to be issued from the time that the permit application is submitted to NDEP. The application requires that the applicant provide owner and facility/site information, receiving water name, narrative description of the site and activities, water quality analysis, quantity of discharge, topographic and site maps, and existing environmental permits. The Dewatering Permit will have specific testing, monitoring, and discharge requirements.
- The discharge of accumulated precipitation (storm water) to a water body or storm drain is subject to the requirements of the General Permit. Sediment control and other appropriate BMPs must be employed when this water is discharged.
- The flow chart shown at the end of this BMP shall be utilized to guide dewatering operations.
- Discharges must comply with regional and watershed-specific discharge requirements.
- Additional permits or permissions from other agencies may be required for dewatering cofferdams or diversions.
- Dewatering discharges must not cause erosion at the discharge point.
- Dewatering records shall be maintained for a period of 3 years.

Implementation **Sediment Treatment**

A variety of methods can be used to treat water during dewatering operations from the construction site. Several devices are presented in this section that provide options to achieve sediment removal. The size of particles present in the sediment and General Permit or receiving water limitations on sediment are key considerations for selecting sediment treatment option(s); in some cases, the use of multiple devices may be appropriate.

Tank size will depend on flow volume, constituents of concern, and residency period required. A qualified Professional Engineer is required to properly size and design dewatering equipment.

Category 1: Constructed Settling Technologies

The devices discussed in this category are to be used exclusively for dewatering operations only.

Sediment Basin

Description:

A sediment basin is a temporary basin with a controlled release structure that is formed by excavation and/or construction of an embankment to detain sediment-laden runoff and allow sediment to settle out before discharging (see SC - 2).

Appropriate Applications:

Effective for the removal of trash, gravel, sand, and silt and some metals that settle out with the sediment.

Implementation:

- Excavation and construction of related facilities is required.
- Temporary sediment basins must 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 outfall structures, as well as other features.
- Removal of sediment is required when the design capacity is reduced by 50%.

Sediment Trap

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 (see SC-3).

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 shall be located to maximize the travel distance to the trap outlet.
- Use rock or vegetation to protect the trap outlets against erosion.

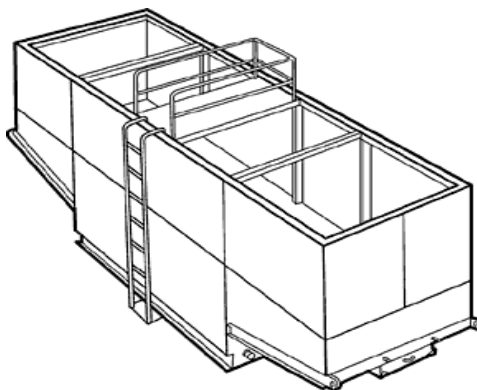
Maintenance:

- Maintenance is required for vegetation, embankment, inlet and outfall structures, as well as other features.
- Removal of sediment is required when the design capacity is reduced by 50%.

Category 2: Mobile Settling Technologies

The devices discussed in this category are typical of tanks that can be used for sediment treatment of dewatering operations. A variety of vendors are available who supply these tanks.

Weir Tank



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. A qualified Professional Engineer is required to properly size and design weir tanks.

Maintenance:

- Periodic cleaning is required based on visual inspection or reduced flow.
- Oil and grease disposal must be by licensed waste disposal company.

Dewatering Tank



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:

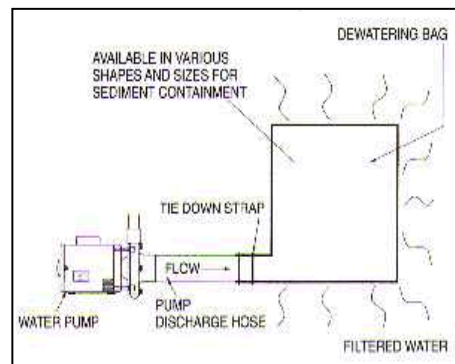
The tank removes trash, gravel, sand, and silt, some visible oil and grease, and some metals (removed with sediment). To achieve high levels of flow, multiple tanks can be used in parallel. If additional treatment is desired, the tanks can be placed in series or as pre-treatment for other methods.

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. A Professional Engineer is required to appropriately size tank.

Maintenance:

- Periodic cleaning is required based on visual inspection or reduced flow.
- Oil and grease disposal must be by licensed waste disposal company as per Standard Specifications Section 107.

Category 3: Basic Filtration Technologies**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 sand, silt, and fines.

Appropriate Applications:

Effective for the removal of sediments (gravel, sand, and silt). Some metals are removed with the sediment.

Implementation:

- Water is pumped into one side of the bag and seeps through the bottom and sides of the bag.
- A secondary barrier, such as a rock filter bed barrier, is placed beneath and beyond the edges of the bag to capture sediments that escape the bag.

Maintenance:

- Inspection of the flow conditions, bag condition, bag capacity, and the secondary barrier is required.
- Replace the bag when it no longer filters sediment or passes water at a reasonable rate.
- The bag is disposed off-site as per Standard Specifications Section 107.

Category 4: Advanced Filtration Technologies

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.

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 standalone 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 monthly service to monitor and maintain the level the sand media.

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, allowing for the discharge of flow in series to an additional treatment unit. Vendors provide pressurized 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 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 pressurized 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:

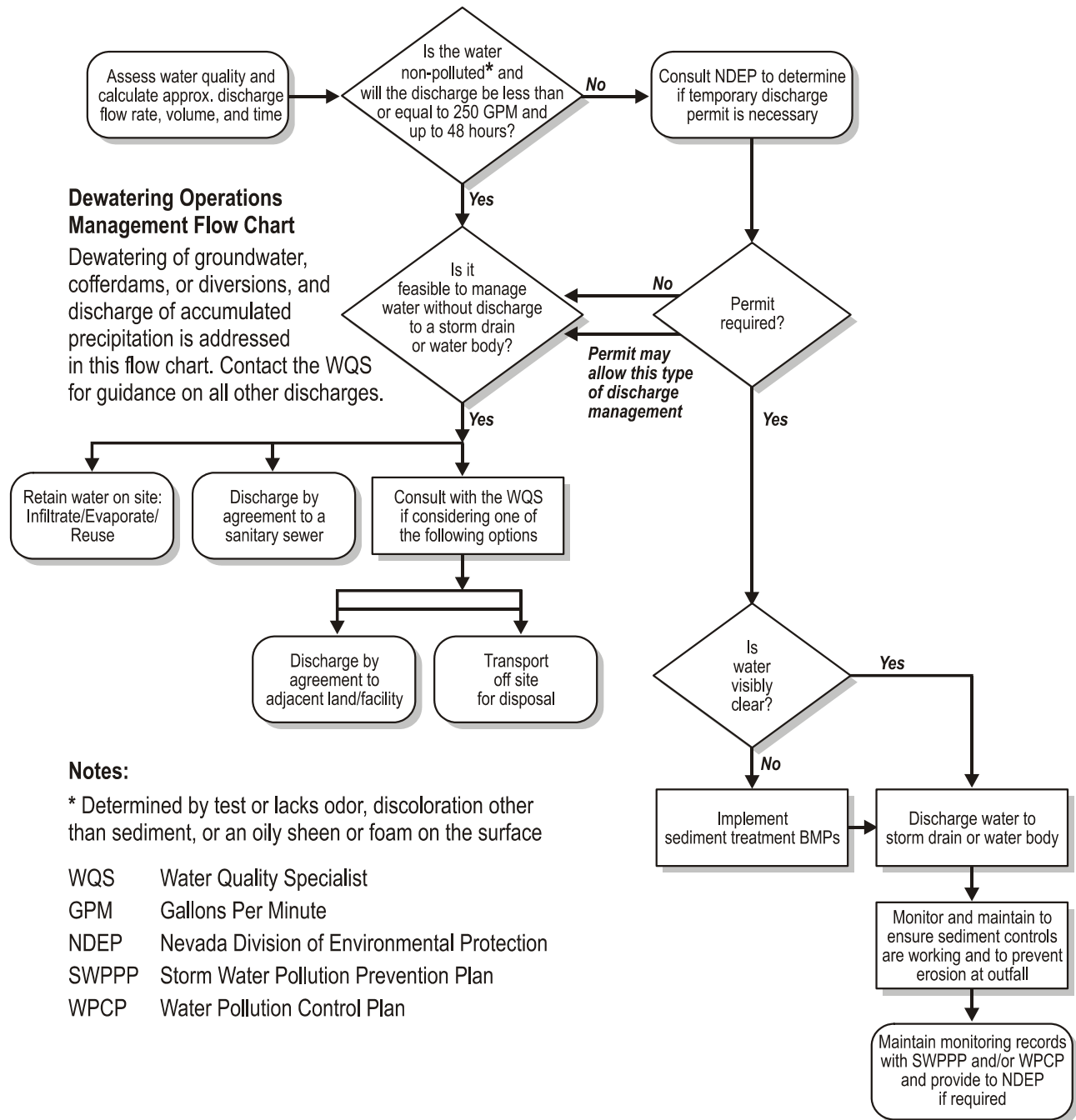
The filters require delivery to the site and initial set up. The vendor can provide assistance.

Maintenance:

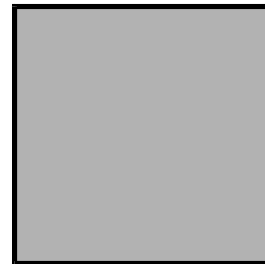
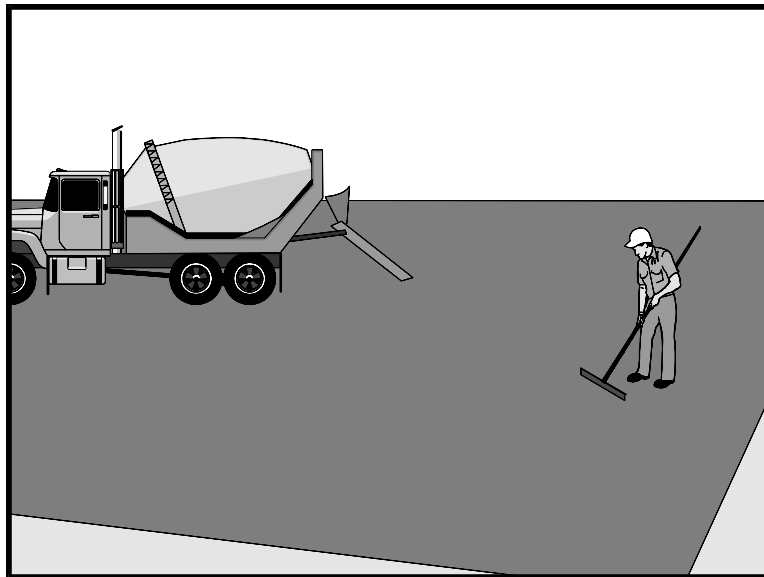
The cartridges require replacement when the pressure differential exceeds the manufacturer's recommendation.

Maintenance and Inspection

- Inspect all BMPs implemented to comply with permit requirements frequently and repair or replace to ensure the BMPs function as designed.
- Accumulated sediment removed during the maintenance of a dewatering device may be either spread on site and stabilized or disposed of at a disposal site as approved by the Engineer.
- Accumulated sediment that is commingled with other pollutants must be disposed of in accordance with all applicable laws and regulations and as approved by the Engineer.



Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose Paving, saw cutting, and grinding operations often involve the use of materials containing potentially harmful chemicals and can generate fine particles that should not be allowed to enter receiving waters. The procedures within this fact sheet are designed to minimize the transport of pollutants associated with these activities to the storm drain system or receiving water body.

Appropriate Applications These procedures are implemented where paving, surfacing, resurfacing, grinding, or sawcutting, may pollute storm water runoff or discharge to the storm drain system or watercourses.

Limitations

- Finer solids are not effectively removed by filtration systems.
- Paving opportunities may be limited during wet weather.

Standards and Specifications

- Release agents used to coat asphalt transport trucks and asphalt spreading equipment shall adhere to Standard Specifications Section 401 and shall be non-foaming and non-toxic.
- Place plastic materials under asphaltic concrete (AC) paving equipment while not in use, to catch and/or contain drips and leaks. See also BMP WM-4 "Spill Prevention and Control."
- 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 other paving materials:
 - Prevent sand and gravel from new asphalt from getting into storm drains, streets, and creeks.

- Old or spilled asphalt must be recycled or disposed of in accordance with Standard Specifications Section 404 or 107, respectively.
 - AC grindings, pieces, or chunks used in embankments or shoulder material must not be allowed to enter any storm drains or watercourses. Install silt fence or inlet protection until structure is stabilized or permanent controls are in place.
 - Collect and remove all broken asphalt and recycle when practical; otherwise, dispose in accordance with Standard Specification Section 107.
 - During chip seal application and sweeping operations, petroleum, petroleum-covered aggregate, or fine particulates, must not be allowed to enter any storm drain or water courses. Apply temporary perimeter controls, such as inlet protection, until all chip seal materials are completely cured and sweeping of excess is complete.
- Use care during application of seal coat, tack coat, slurry seal, and/or fog seal near drainage inlet structures and manholes. To avoid introduction of these materials into the storm drain system or sewer, apply these materials by hand sprayer or brush when working adjacent to inlets, or cover drainage inlet structures and manholes with plastic.
 - Seal coat, tack coat, slurry seal, or fog seal shall not be applied if rain is predicted to occur during the application or curing period.
 - Paving equipment parked onsite shall be parked over plastic to prevent de minimus release to soil.
 - Clean asphalt coated equipment off-site whenever possible. When cleaning dry, hardened asphalt from equipment, manage hardened asphalt debris as described in BMP WM-5, "Construction Debris and Litter Management". Any cleaning on site shall follow BMP NS-8, "Vehicle and Equipment Cleaning".
 - Do not wash sweepings or grindings from exposed aggregate concrete into a storm drain system. Collect and return to aggregate base stockpile or dispose of per Standard Specification 107.
 - If aggregate is washed on-site, allow aggregate rinse to settle. Then, either allow rinse water to dry in a temporary pit as described in BMP WM-06, "Concrete Waste Management", or dispose in accordance with Standard Specifications Section 202.
 - Do not allow saw-cut Portland Concrete Cement (PCC) slurry to enter storm drains or watercourses.

Pavement Grinding or Removal

- Residue from grinding operations collected and contained, shall not be allowed to flow across the pavement, and shall not be left on the surface of the pavement. See also BMP WM-06, "Concrete Waste Management", and BMP WM-08, "Liquid Waste Management".
- Collect pavement digout material by mechanical or manual methods. This material may be recycled or, if allowed in the contract documents, used as shoulder material or base material at locations approved by the Engineer.
- If digout material cannot be recycled, dispose of in accordance with Standard Specifications Section 107.
- Digout activities shall not be conducted in the rain.
- Stockpile material removed from roadways away from drain inlets, drainage ditches, and watercourses, and store consistent with BMP WM-3, "Stockpile Management".
- Disposal or use of AC grindings shall be approved by the Engineer. See also BMP WM-06, "Concrete Waste Management."

Raised/Recessed Pavement Marker Application and Removal

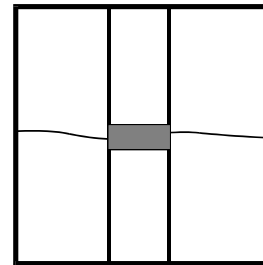
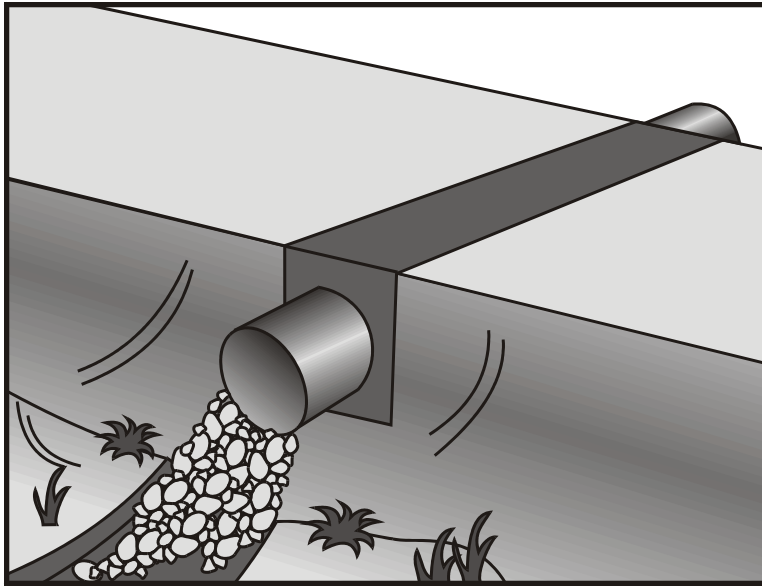
- Do not transfer or load bituminous material near drain inlets, the storm water drainage system or watercourses.
- Melting tanks shall be loaded with care and not filled to beyond six inches from the top to leave room for splashing.
- When servicing or filling melting tanks, ensure all pressure is released 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.
- Waste shall be disposed of in accordance with Standard Specifications Section 107 and 202.
- Inspect and maintain machinery regularly to minimize leaks and drips.
- Ensure that employees and subcontractors are implementing appropriate measures during paving operations.

Maintenance and Inspection

Temporary Stream Crossing

NS-4

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose A temporary stream crossing is a structure placed across a waterway that allows vehicles to cross the waterway during construction minimizing (or reducing or managing) erosion and downstream sedimentation caused by the vehicles.

Appropriate Applications Temporary stream crossings are installed at sites:

- Where appropriate permits have been secured.
- Where construction equipment or vehicles need to frequently cross a waterway.
- When alternate access routes are infeasible or impose significant constraints.
- When crossing perennial streams or waterways causes erosion.

Limitations

- Will usually disturb the waterway during installation and removal.
- May require NDEP 401 Certification and/or U.S. Army Corps of Engineers 404 Permit. If numerical-based water quality standards are mentioned in any of these and other related permits, testing and sampling may be required. If monitoring related to these numerical-based water quality standards is not addressed in the contract documents, contact the Engineer.
- Installation may require dewatering or temporary diversion of the stream. See BMP NS-2, "Dewatering Operations", and NS-5, "Clear Water Diversion".
- May become a constriction in the waterway, which can obstruct flood flow and cause flow backups or washouts. If improperly designed,

flow backups can cause flooding and 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.
- CCS should not be used in excessively high or fast flows.
- The use of soil stabilizers within 60 ft of a stream or other receiving water is typically prohibited by regulatory and permit restrictions.
- Upon completion of construction activities, CCS blocks must be removed from stream.

Standards and Specifications

General Considerations

Location of the temporary stream crossing shall address:

- Site selection where erosion potential is low.
- Areas where the side slopes from highway runoff will not spill into the side slopes of the crossing.

The following types of temporary stream crossings shall be considered:

- Culverts - Used on perennial and intermittent streams.
- 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.
- Bridges - Appropriate for streams with high flow velocities, steep gradients and/or where temporary restrictions in the channel are not allowed.

Design and installation requires knowledge of stream flows and soil strength. Designs shall be prepared under direction of, and approved by, a registered civil and/or structural engineer. Both hydraulic and construction loading requirements shall be considered with the following:

- Comply with the requirements for culvert and bridge crossings, as contained in the NDOT's Drainage Manual and Bridge Manual, 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 shall be selected based

on careful evaluation of the risks due to over topping, flow backups, or washout.

- Avoid oil or other potentially hazardous waste materials for surface treatment.

Construction Considerations:

- 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 sediment control BMPs in accordance with guidance in Section 4 to minimize erosion of embankment into flow lines.
- Vehicles and equipment shall 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, except as authorized by the Engineer, as necessary to complete the work. Review the "Temporary Permit for Working in Waterways" for additional project specific requirements.
- Temporary water body crossings and encroachments shall be constructed to minimize scour. Cobbles used for temporary water body crossings or encroachments shall be clean, rounded river cobble.
- The exterior of vehicles and equipment that will encroach on the water body within the project shall be maintained free of grease, oil, fuel, and residues in accordance with the "Temporary Permit for Working in Waterways".
- Disturbance or removal of vegetation shall be minimized to complete operations. Precautions shall be taken to avoid damage to vegetation by people or equipment. Disturbed vegetation shall be replaced with the appropriate soil stabilization measures.
- Riparian vegetation, when removed pursuant to the provisions of the work, shall be cut off no lower than ground level to promote rapid re-growth. Access roads and work areas built over riparian vegetation shall be covered by a sufficient layer of clean river run cobble to prevent damage to the underlying soil and root structure. The cobble shall be removed upon completion of project activities.
- Any temporary artificial obstruction placed within flowing water shall only be built from material, such as clean gravel that will cause little or

no siltation.

- Drip pans shall 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.
- Conceptual temporary stream crossings are shown in figures at the end of this section.

Specific Considerations:

- 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.
- Temporary fords are not appropriate if construction will continue through rainy season, if thunderstorms are likely, or if the stream is perennial.
- 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 holds the gravel in place and provides the stability.
- Bridges are generally more expensive to design and construct, but provides the least disturbance of the streambed and constriction of the waterway flows.

Maintenance and Inspection

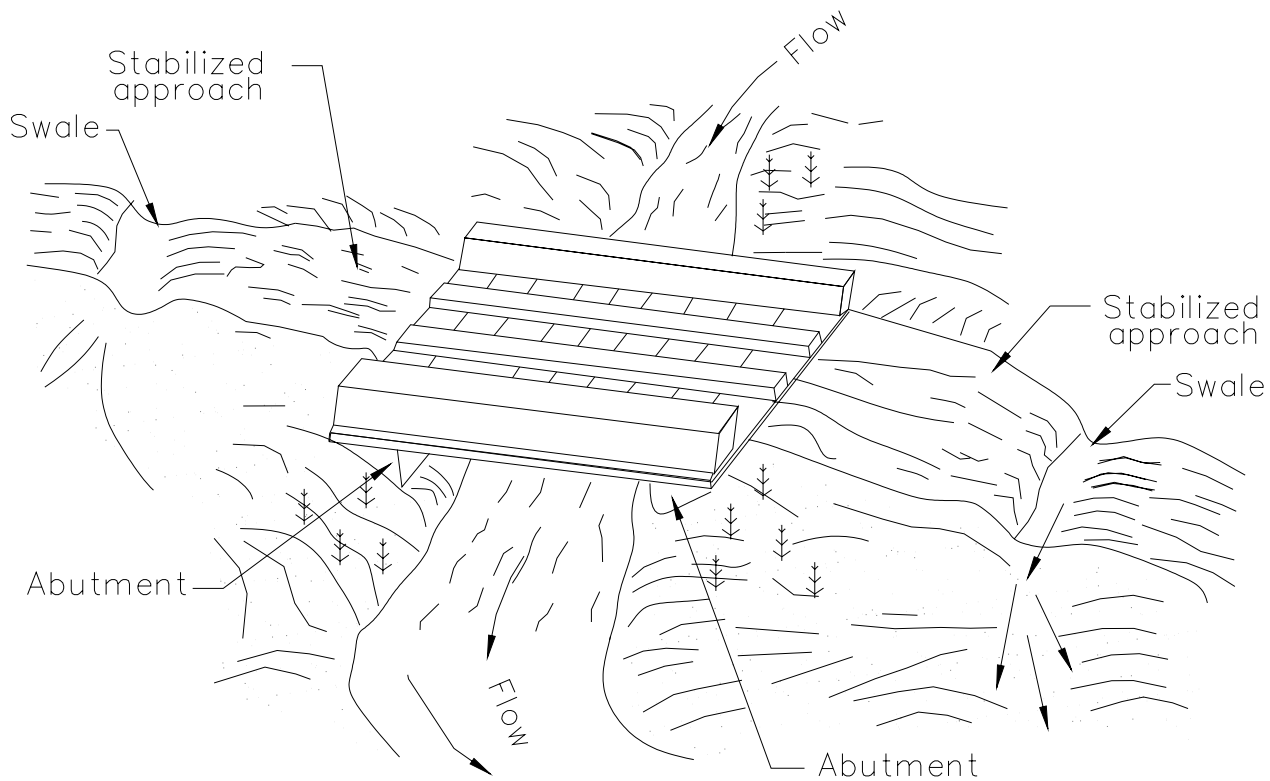
Maintenance provisions shall include:

- Periodic removal of debris behind fords, in culverts, and under bridges.
- Replacement of lost protective aggregate from inlets and outlets of culverts.
- Removal of temporary crossing promptly when it is no longer needed.

After removing the crossing structure, restore stream channel to its original condition as required in the contact documents and applicable permits. In some cases it may be allowable to leave gravel in place.

Inspection shall, at a minimum, occur weekly and before, during and immediately after each significant rainfall, and include:

- Checking for blockage in the channel, debris buildup in culverts or behind fords, and under bridges.
- Checking for erosion of abutments, channel scour, riprap displacement, or piping in the soil.
- Checking for structural weakening of the temporary crossing, such as cracks, and undermining of foundations and abutments.



NOTE:

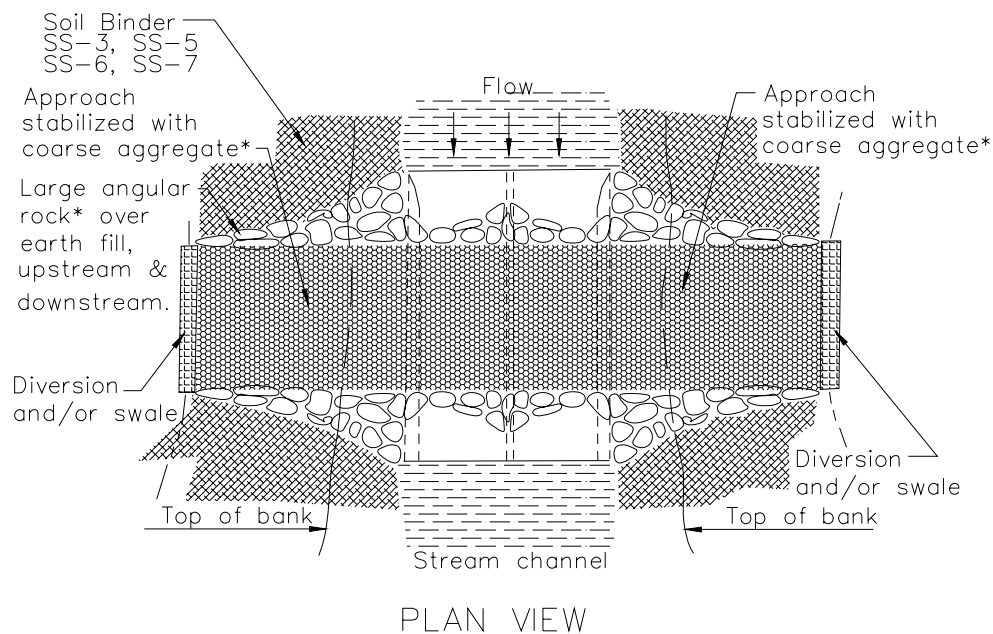
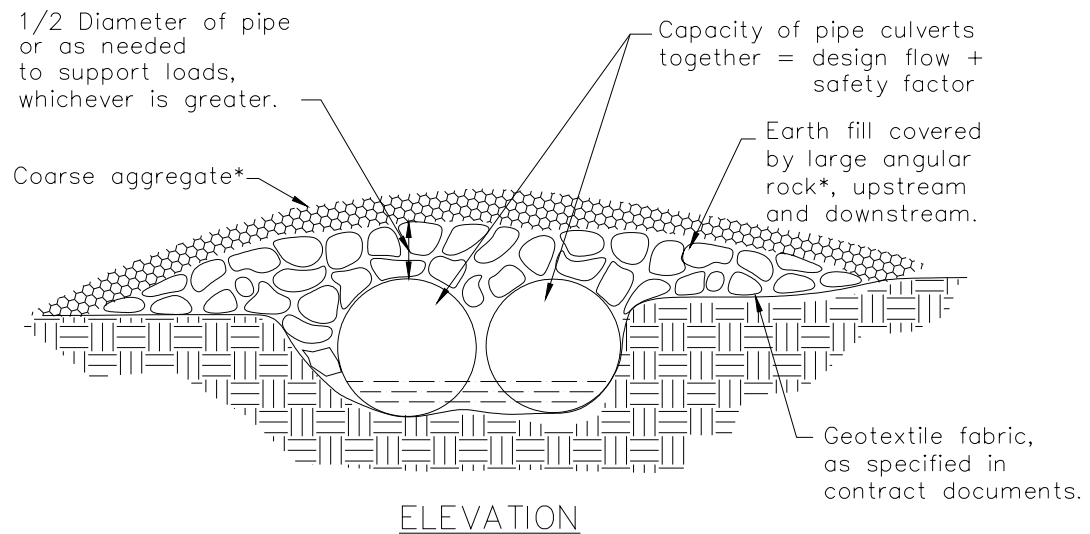
Surface flow of road diverted by swale and/or dike.

TYPICAL BRIDGE CROSSING
NOT TO SCALE

Temporary Stream Crossing

NS-4

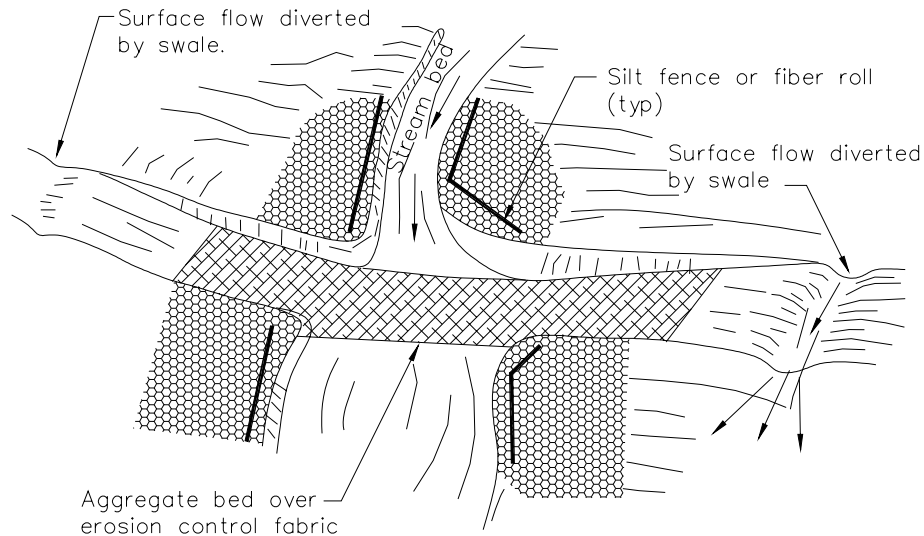
Adapted from Caltrans Construction Site BMPs



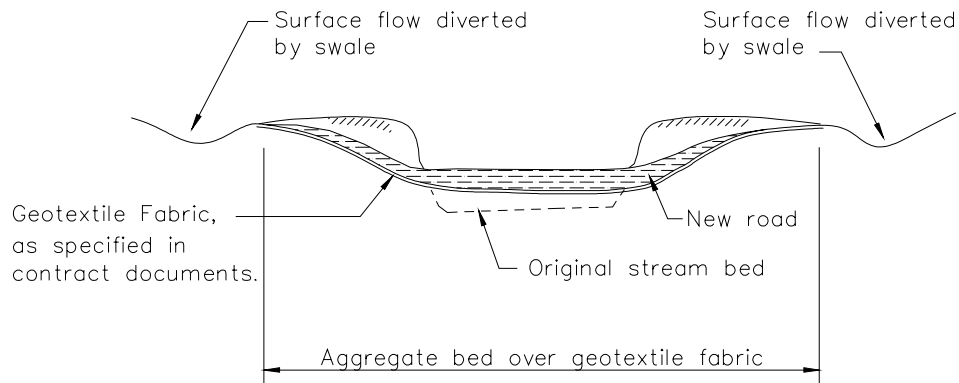
TYPICAL CULVERT CROSSING
NOT TO SCALE

NOTE

* UNLESS SPECIFIED OTHERWISE, FOR COARSE AGGREGATE, USE CLASS 150 RIRRAP BEDDING. FOR LARGE ANGULAR ROCK USE CLASS 150 RIRAP.

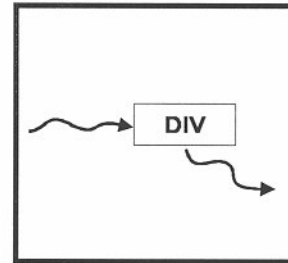
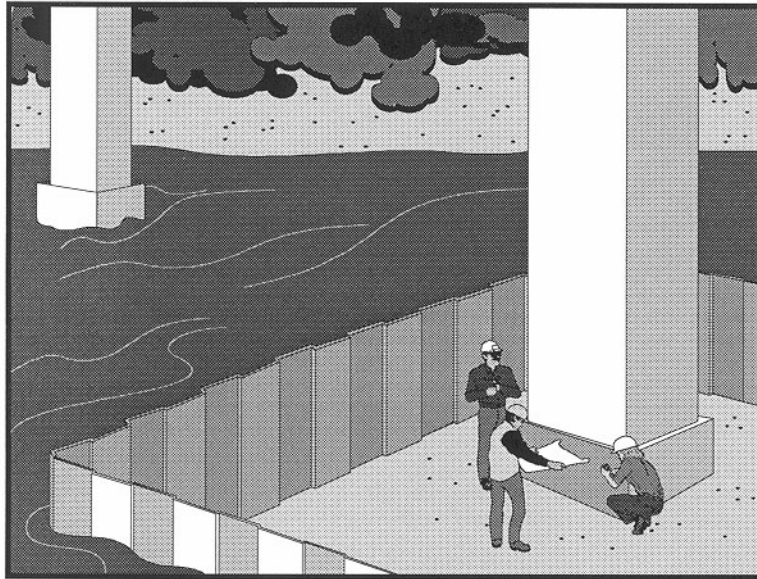


Aggregate approach
5:1 (H:V) Maximum slope on road



TYPICAL FORD CROSSING
NOT TO SCALE

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

Clear water diversions consists of various structures and measures that intercept clear surface water runoff upstream of a project site, transport it around the work area, and discharge it downstream with minimal water quality degradation by 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. Isolation techniques are methods that isolate near shore work from a water body. Structures commonly used as part of this system include diversion ditches, berms, dikes, slope drains, rock, gravel bags, wood, aqua barriers, cofferdams, silt fence fabric or turbidity curtains, drainage and interceptor swales, pipes, or flumes.

Appropriate Applications

- A clear water diversion is typically implemented where appropriate USACE, NDEP, and other local permits have been secured and work must be performed in a live 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 flume is appropriate for the diversion of streams less than 20 ft. wide, with flow rates less than 99 ft³/sec.
- Clear water diversions incorporating clean washed gravel may be appropriate for use in salmon spawning streams.

- Limitations**
- Diversion/encroachment activities will usually disturb the waterway during installation and removal of diversion structures.
 - Specific permit requirements or mitigation measures, such as the USACE, U.S. Fish and Wildlife Service (USFWS), NDEP, etc. may be included in contract documents because of clear water diversion/encroachment activities.
 - Diversion/encroachment activities may constrict the waterway, which can obstruct 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 inappropriate in deep water unless designed or reviewed by a Hydraulic engineer.
 - Diversion or isolation activities should not completely dam stream flow.
 - Dewatering and removal may require additional sediment control or water treatment (See NS-2).

Standards and Specifications

General

- Implement guidelines presented in SS-12, Streambank Stabilization to minimize impacts to streambanks.
- Where working areas encroach on live streams, barriers adequate to prevent the flow of muddy water into streams shall be constructed and maintained between working areas and streams. During construction of the barriers, muddying of streams shall be held to a minimum.
- Where possible, avoid or minimize diversion/encroachment impacts by scheduling construction during periods of low flow or when the stream is dry. See also the project special provisions for scheduling requirements. Scheduling shall also consider seasonal releases of water from dams, fish migration and spawning seasons, and water demands due to crop irrigation.
- Diversion structures must be adequately designed to accommodate fluctuations in water depth or flow volume due to storms, flash floods, etc.
- Heavy equipment driven in wet portions of a water body to accomplish work shall be completely clean of dirt and petroleum residue, and water levels shall be below the gearboxes of the equipment in use, or lubricants and fuels are sealed such that inundation by water shall not result in leaks. Review the project's "Temporary Permit for Working Waterways/Discharge Permit" for

additional project specific requirements.

- 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 shall 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, shall be positioned over drip pans.
- When any artificial obstruction is being constructed, maintained, or placed in operation, sufficient water shall, at all times, be allowed to pass downstream to maintain aquatic life downstream.
- The exterior of vehicles and equipment that will encroach on a water body within the project shall be maintained free of grease, oil, fuel, and residues.
- Equipment shall not be parked below the high water mark overnight unless allowed by a permit.
- Disturbance or removal of vegetation shall not exceed the minimum necessary to complete operations. Precautions shall be taken to avoid damage to vegetation by people or equipment. Disturbed vegetation shall be replaced with the appropriate soil stabilization measures.
- Riparian vegetation, when removed pursuant to the provisions of the work, shall be cut off no lower than ground level to promote rapid re-growth. Access roads and work areas built over riparian vegetation shall be covered by a sufficient layer of clean river run cobble to prevent damage to the underlying soil and root structure. The cobble shall be removed upon completion of project activities.
- Drip pans shall 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.
- Construct diversion structures with materials free of potential pollutants such as soil, silt, sand, clay, grease, or oil.

Temporary Diversions/Encroachments

- Construct diversion channels in accordance with BMP SS-9, "Earth Dikes/Drainage Swales, and Ditches".
- In high flow velocity areas, stabilize slopes of embankments and diversion ditches using an appropriate liner, such as riprap in accordance with Standard Specifications Section 610 or with geotextile fabrics or erosion control mats as described in BMP SS-7,

“Geotextiles, Mats, Plastic Covers and Erosion Control Blankets”, and in Standard Specifications Section 211, or combinations of these measures.

- Where appropriate, use natural streambed materials such as large cobbles and boulders for temporary embankment/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 BMP SS-10, “Outlet Protection/Velocity Dissipation Devices”.

Temporary Dry Construction Areas

- When dewatering behind temporary structures to create a temporary dry construction area, such as coffer dams, 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 BMP NS-2, “Dewatering Operations”.
- If the presence of polluted water or sediment is identified in the contract, the contractor shall implement dewatering pollution controls as required by the contract documents. If the quality of water or sediment to be removed while dewatering is not identified as polluted in the contract documents, but is later determined by observation or testing to be polluted, the contractor shall notify the Engineer and comply with NDEP requirements.
- Any substance used to assemble or maintain diversion structures, shall be non-toxic and non-hazardous.
- Any material used to minimize seepage underneath diversion structures, such as grout, shall be EPA-approved, non-toxic, non-hazardous, and as close to a neutral pH as possible.

Isolation Techniques:

Isolation techniques are methods that isolate near shore work from a water body. Techniques include sheet pile enclosures, water filled geotextile (Aqua Dam), gravel berm with impermeable membrane, gravel bags, cofferdams, and Portable Precast Concrete Barrier Rails (PPCBR).

Comparison of Diversion/Isolation Techniques:

- Gravel bags are relatively inexpensive, but installation and removal can be labor intensive. It is also difficult to dewater the isolated area.

- Gravel bag berms (SC-6) used in conjunction with an impermeable membrane are cost effective, not labor intensive to install, 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 per USACE and USFWS permit only. Contact NDOT biologists for jobsite specific requirements.
- Aqua Barriers and cofferdams are relatively expensive, but frequently allow full dewatering. Also, many options now available are relatively easy to install. Sealants used in these structures shall be non-toxic.
- 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. Also they are useful for a water body with a sandy, non-cobble substrate.
- Portable Precast Concrete Barrier Rails (PPCBR) is an isolation method that does not allow full dewatering, but can be used in small to large watercourses, and in fast water situations.
- 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. Turbidity curtains should be used with floatation collars and recommended for use in calm, slow moving water; must be properly anchored.
- Diversion structures should be installed following manufacturer's specification.
- Some diversions may require the acquisition of additional right-of-way or easements and could therefore add significant cost to the project. Diversion requirements must be identified early in the planning process so that all alternatives can be accurately assessed and additional costs can be minimized.
- When used in watercourses or streams, cofferdams must be used in accordance with permit requirements and/or the contract documents. Materials for cofferdams should be selected based on ease of maintenance, and complete removal following construction activities. Soil cofferdams are not permitted.

Silt Fence Fabric Isolation Technique

Definition and Purpose:

A silt fence 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 silt fence fabric, gravel bags, and steel t-posts in accordance with Standard Specifications Section 724.

Appropriate Applications:

- Silt fence 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.
- 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 can be spread out and left as salmonid spawning habitat. 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 is a method that should be used in relatively calm water, and can be used in smaller streams

Limitations:

- Do not use if the installation, maintenance and removal of the structures will disturb sensitive aquatic species of concern.
- Not appropriate for projects where dewatering is necessary.
- Not appropriate to completely dam stream flow.

Standards and Specifications:

- For the silt fence 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 silt fence 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.
- 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 20 ft. for ease of handling.

Installation

- 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

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. (See SC-1)
- 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:

- During construction, inspect daily during the workweek.
- Perform additional inspections before, during and after storm events.
- Immediately repair any gaps, holes or scour.
- Remove sediment buildup in accordance with Standard Specifications Section 107.
- Remove BMP upon completion of construction activity.
- Re-vegetate areas disturbed by BMP removal if needed.

Turbidity Curtain Isolation Technique

Definition and purpose:

A turbidity curtain is a relatively impervious 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. This method is very good in isolating fine as well as coarse sediment.

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, lagoons, bays, 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 soil 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 re-suspension of particles and by accidental dumping by the removal equipment. Caution must be taken in removal.

Standards and Specifications:

- 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 silt fence fabric may be used for the bottom 1 ft.
- The top of the curtain should consist of flexible flotation buoys, and the bottom shall be held down by a load line incorporated into the curtain fabric. The fabric shall be a brightly colored impervious mesh.
- The curtain shall be held in place by anchors placed per manufacturer's specifications or closer as situation dictates (i.e. currents). See turbidity curtain detail.
- 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.
- Sediment that has been deflected and settled out by the curtain should be removed; however, consideration must be given to the probable outcome of the removal procedure. It must be asked 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 accumulated by the turbidity curtain be removed only if it is deemed necessary by NDEP or the Engineer.
- Check manufacturer's requirements when installing turbidity curtains.

Maintenance and Inspection:

- The curtain should be inspected daily for holes or other problems, and any repairs needed should be made promptly.
- Allow sediment to settle for prior to its removal or removal of the curtain. After removing sediment, wait at least 6-12 hours before removing the curtain.
- To remove, install furling lines along the curtain, detach from anchors, and tow out of the water.

Portable Precast Concrete Barrier Rail River Isolation

Definition and Purpose:

This is temporary sediment control, or stream isolation method that uses Portable Precast Concrete Barrier Rail (PPCBR) 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 also at their abutting ends to seal and prevent movement of sediment beneath or through the barrier walls. A typical PPCBR installation is illustrated at the end of this Section.

Appropriate Applications:

The PPCBR isolation can be used in streams with higher water velocities than many other isolation techniques.

Limitations:

- The PPCBR method does not allow for full dewatering, but can be used in small to large watercourses, and in fast-water situations.

Standards and Specifications:

- To create a floor for the PPCBR, move large rocks and obstructions. Place washed gravel or gravel-filled bags to create a level surface for PPCBR to sit on.
- Place the bottom two PPCBR adjacent to each other, and parallel to the direction of flow; fill the center portion with gravel bags. Then place the third PPCBR on top of the bottom two; there should be sufficient gravel bags between the bottom PPCBRs such that the gravel supports the top one. Place plastic sheeting around the PPCBRs, and secure at the bottom with gravel bags.
- Further support can be added by pinning and cabling the PPCBRs together. Also, large riprap and boulders can be used to support

either side of the PPCBR, especially where there is strong current.

Inspection and Maintenance:

- The barrier should be inspected at least once daily, and any damage, movement, or other problems shall be addressed immediately.
- Allow sediment to settle prior to its removal of the barrier. After removing sediment, wait at least 6-12 hours before removing the barrier.

Stream Diversions

Definition and Purpose

Stream diversions consists of a system of structures and measures that intercept an existing stream upstream of the project and transports it around the work area, and discharges it downstream. The selection of which stream diversion technique to use depends upon the type of work involved, physical characteristics of the site, and the volume of water flowing through the project.

Appropriate Applications:

- Pumped diversions are appropriate in areas where de-watering is necessary.
- Dam-type diversion may serve as temporary access to the site.
- Where work areas require isolations from flows.

Limitations:

- Pump diversions have limited flow capacity.
- Pumped diversions require frequent monitoring of pumps.
- Large flows during storm events can overtop dams.
- Flow diversion and re-direction with small dams involves in-stream disturbance and mobilization of sediment.

Standards and Specifications:

- Installation guidelines will vary based on existing site conditions and type of diversion used.
- Diversions shall be sized to convey design flood flows.
- Pump capacity must be sufficient for design flow; the upper limit is approximately 10 ft³/sec (the capacity of two 8 in. pumps).
- Adequate energy dissipation must be provided at the outlet to minimize erosion.

- 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.

Advantages of a pumped diversion include:

- Downstream sediment transport can be nearly eliminated.
- De-watering 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 are:

- Flow volume is limited by pump capacity.
- A pumped diversion may require 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 are:

- Excavated channels isolate work from water flow and allow dewatering.
- Excavated channels can handle larger flows than pumps.

Disadvantages of excavated channels and flumes are:

- 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.

- May require acquisition of additional right-of-way or easements.

Installation

- Installation guidelines will vary based on existing site conditions and type of diversion used.

Construction Guidelines:

- Pump capacity must be sufficient for design flow; the upper limit is about 10 ft³/s (the capacity of two 8 in. pumps).
- Dam materials used to create dams upstream and downstream of diversion should be erosion resistant; materials such as steel plate, sheet piles, 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 channels are stable, breach the upstream end and allow water to flow down the 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.

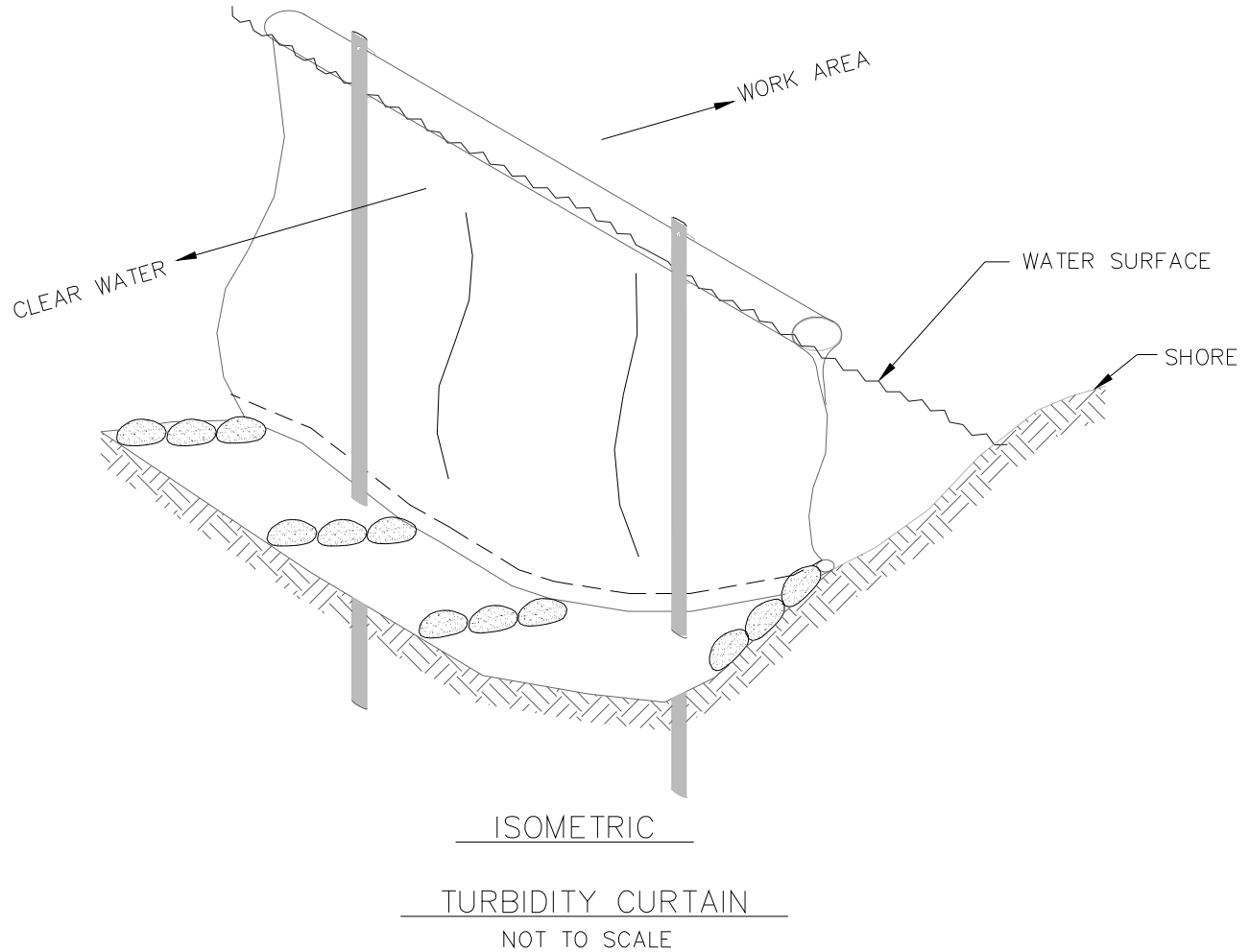
Maintenance and Inspection

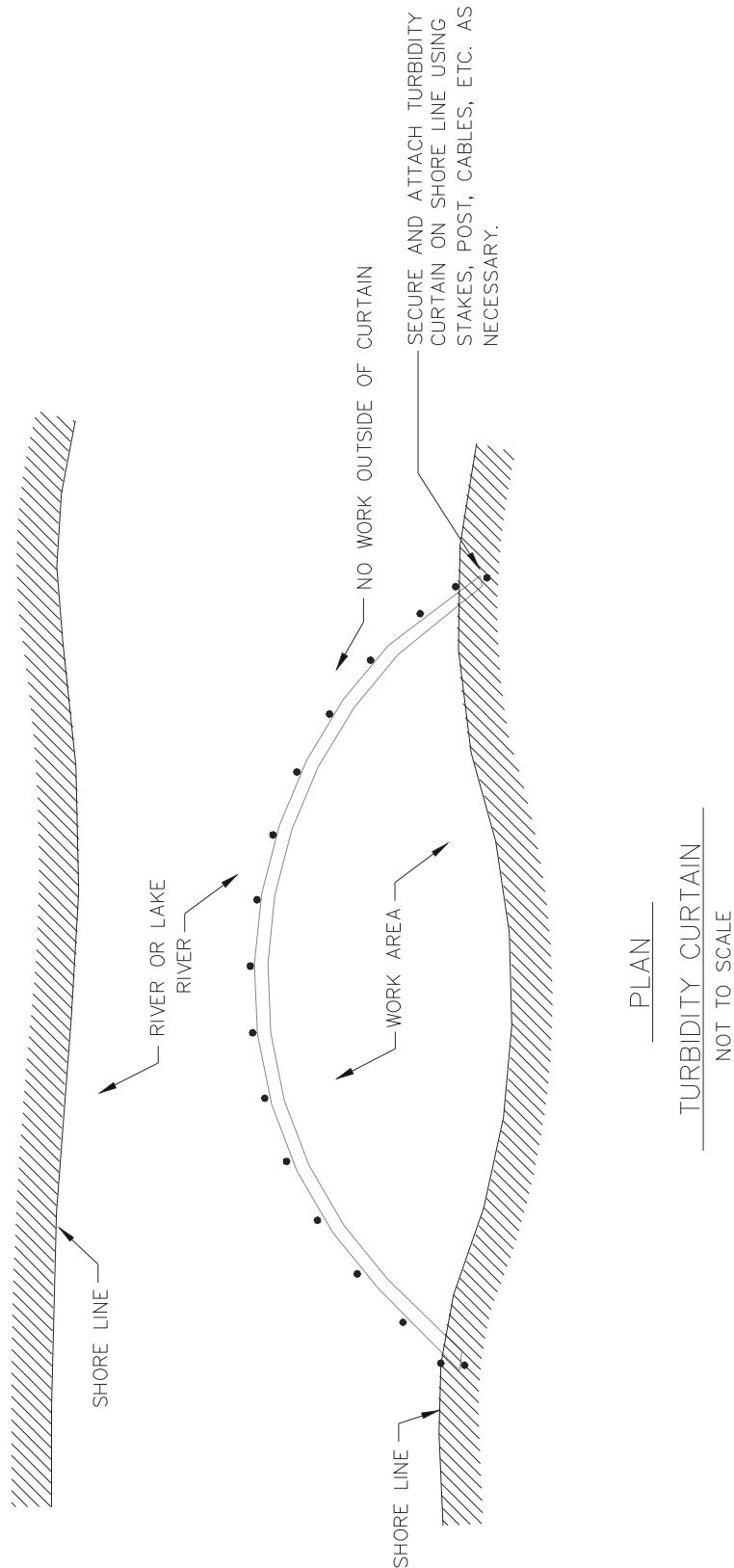
- Inspect diversion/encroachment structures before and after significant storms, and at least once per week while in service. Inspect daily during the construction.
- Pumped diversions may require frequent monitoring of pumps.
- Inspect embankments and diversion channels before, during and after significant storms, and at least once per week while in service 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. Repair holes, gaps, or scour.
- Upon completion of work, the diversion or isolation structure should be removed and flow should be re-directed through the new culvert or back into the original stream channel. Recycle or re-use if applicable.
- Re-vegetate areas disturbed by BMP removal if needed.

Clear Water Diversion

NS-5

Adapted from Caltrans Construction Site BMPs

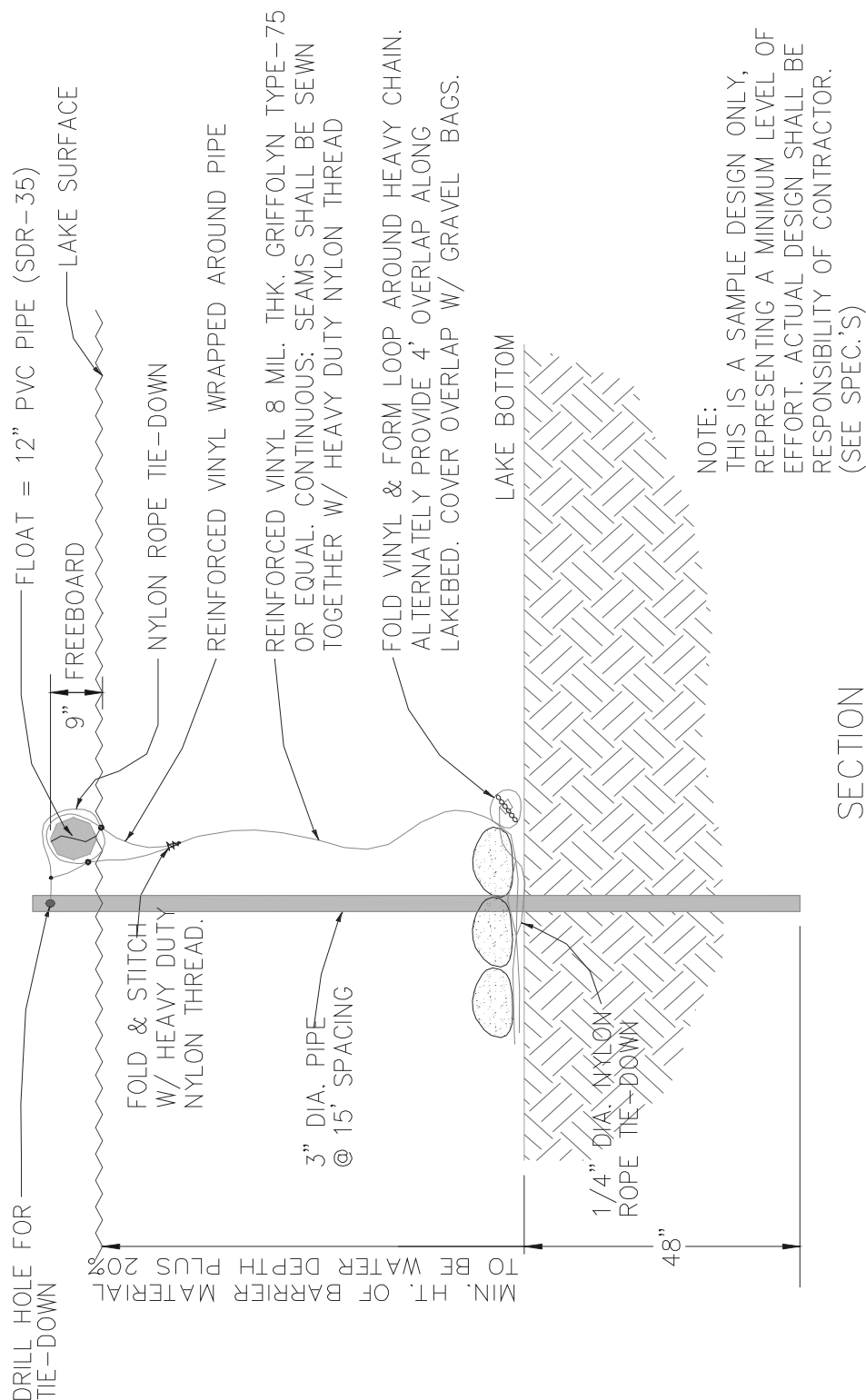




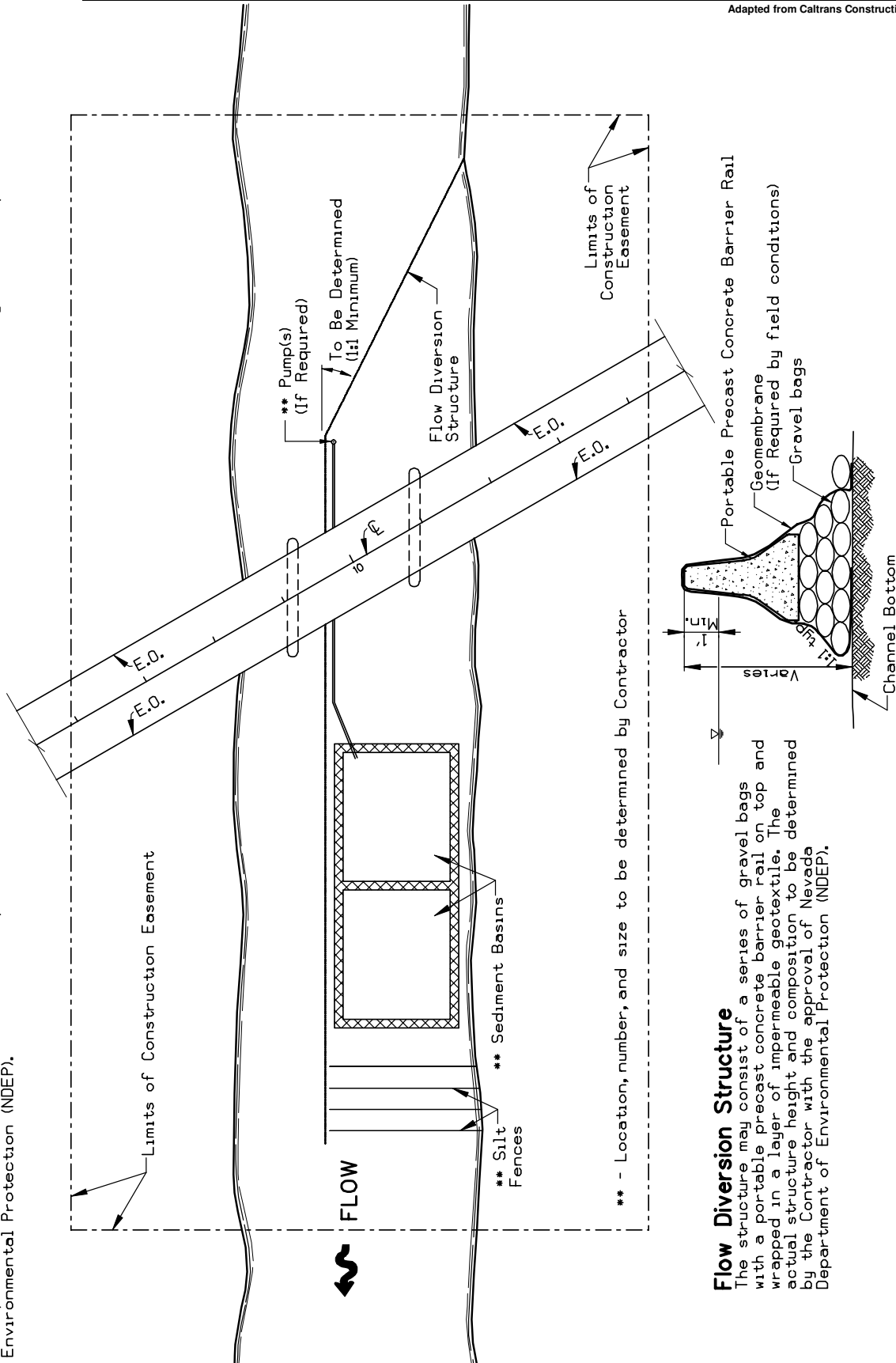
Clear Water Diversion

NS-5

Adapted from Caltrans Construction Site BMPs



The Contractor shall place a Diversion Structure to channel flow through the project. The flow will be diverted to one side of the structure so that the construction can be completed on the other side. The water can then be diverted to the opposite side so that the first side can be constructed. All sediment impacted water created by the construction activities will be transported to a sediment basin and treated prior to release. The level of treatment shall be determined by Nevada Department of Environmental Protection (NDEP).



CONCEPTUAL FLOW DIVERSION PLAN

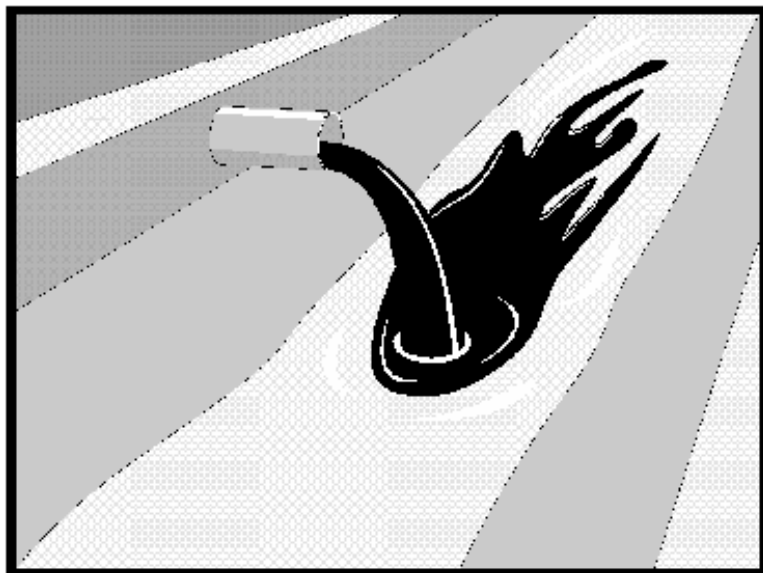
Flow Diversion Structure

Flow Diversion Structure
The structure may consist of a series of gravel bags with a portable precast concrete barrier rail on top and wrapped in a layer of impermeable geotextile. The actual structure height and composition to be determined by the Contractor with the approval of Nevada Department of Environmental Protection (NDEP).

Illicit Connection/Illegal Discharge Detection and Reporting

NS-6

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition 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 to the Engineer.
Appropriate Applications	<ul style="list-style-type: none">■ Illicit connection/illegal discharge detection and reporting is applicable anytime an illicit connection or discharge is discovered or illegally dumped material is found on the construction site.■ This best management practice (BMP) applies to all construction projects.
Limitations	<ul style="list-style-type: none">■ Unlabeled or non-identifiable material shall be assumed to be hazardous.■ 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.■ Procedures and practices presented in this BMP are general. Contractor shall use extreme caution, immediately notify the Engineer when illicit connections or illegal dumping or discharges are discovered.■ If pre-existing hazardous materials or wastes are known to exist on site, the contractor's responsibility will be detailed in separate special provisions.

Illicit Connection/Illegal Discharge Detection and reporting

Adapted from Caltrans Construction Site BMPs

Standards and Specifications

Planning

- Inspect site before beginning the job for evidence of illicit connections or illegal dumping or discharges.
- Inspect site regularly during project execution for evidence of illicit connections or illegal dumping or discharges.
- Observe site perimeter for evidence or potential of illicitly discharged or illegally dumped material that may enter the job site.

Identification of Illicit Connections and Illegal Dumping or Discharges.

- 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 subdrain 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 off-site 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 dry weather season.

Illicit Connection/Illegal Discharge Detection and Reporting

NS-6

Adapted from Caltrans Construction Site BMPs

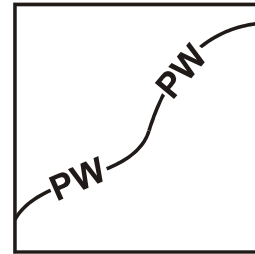
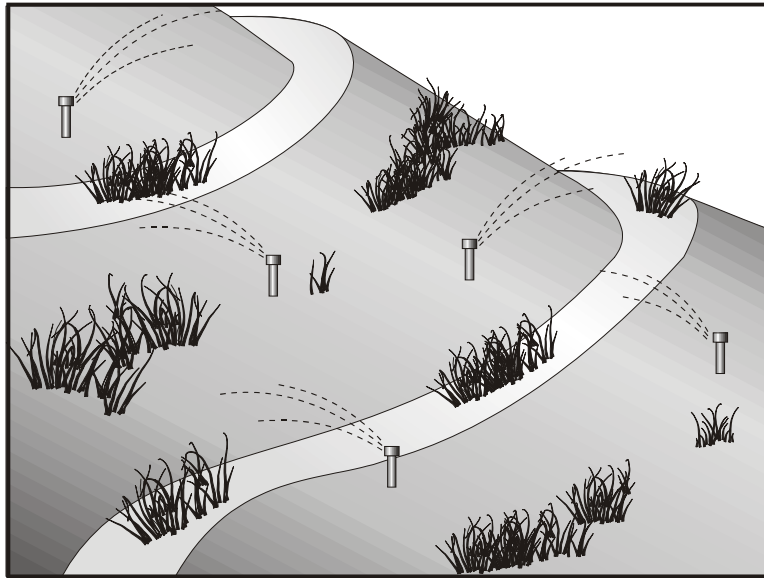
- Non-standard junction structures.
- Broken concrete or other disturbances at or near junction structures.

Reporting

- Notify the Engineer of any illicit connections and illegal dumping or discharge incidents at the time of discovery. The Engineer will notify NDOT Environmental Division who will in turn notify the appropriate agency or agencies.

Cleanup and Removal The contractor is not responsible for investigation and clean up of illicit or illegal dumping or discharges not generated by the contractor. NDOT may direct contractor to clean up non-hazardous dumped or discharged material on the construction site.

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose	Potable Water/Irrigation management 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.
Appropriate Applications	Implement this BMP whenever the above activities or discharges occur at or enter a construction site.
Limitations	None identified.
Standards and Specifications	<ul style="list-style-type: none"> ■ Inspect irrigated areas within the construction limits for excess watering. Minimize irrigation down time. Shut water off before cutting pipe. 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. ■ Where possible, direct water from off-site sources around or through a construction site in a way that minimizes contact with the construction site. ■ When possible, discharges from water line flushing shall be reused for landscaping purposes. ■ Shut off the water source to broken lines, sprinklers, or valves as soon as possible to prevent excess water flow. ■ Protect downstream storm water drainage systems and watercourses from water pumped or bailed from trenches excavated to repair water lines.

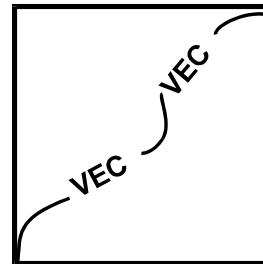
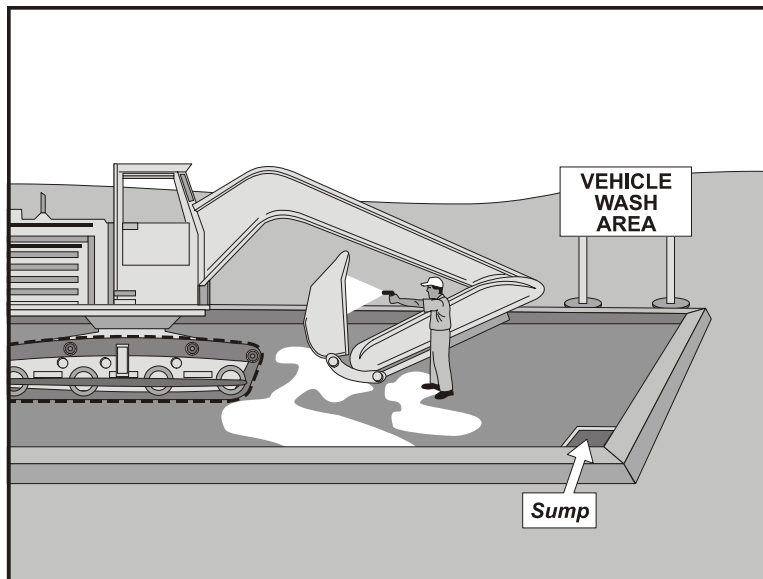
**Maintenance and
Inspection**

- Repair broken water lines as soon as possible or as directed by the Engineer.
- Inspect irrigated areas regularly for signs of erosion and/or discharge.

Vehicle and Equipment Cleaning

NS-8

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose Vehicle and equipment cleaning procedures and practices are used to minimize or eliminate the discharge of pollutants from vehicle and equipment cleaning operations to storm drain system or to watercourses.

Appropriate Applications These procedures are applied on all construction sites where vehicle and equipment cleaning is performed.

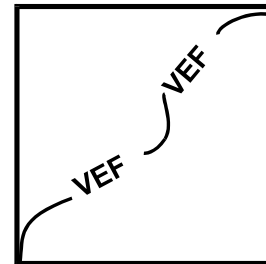
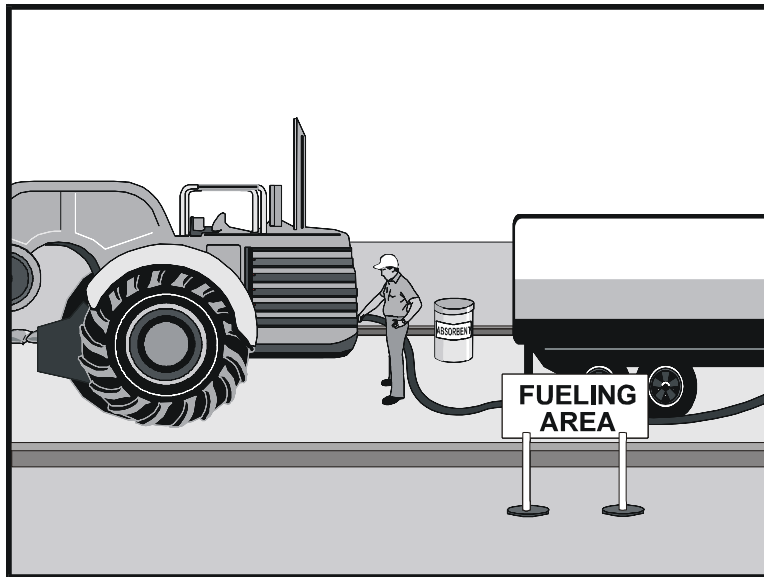
Limitations None.

- Standards and Specifications**
- On-site vehicle and equipment washing shall only be performed within contained areas where all wash water can be collected and treated. No washing shall occur over bare soil.
 - Cleaning of vehicles and equipment with detergents, solvents or steam shall not occur on the project site unless the Engineer has been notified in advance and the resulting wastes are fully contained and disposed of outside the highway right-of-way in conformance with the provisions in Standard Specifications Section 107.
 - Sediment laden wash water shall be captured for treatment prior to discharge. Wash water shall be treated using sediment control BMPs such as SC-2 or SC-3. Discharge of treated wash water to infiltration facilities or sewers must receive prior approval from NDOT's WQS.
 - Wash water containing solvents or hazardous substances shall be containerized and disposed of in accordance with Standard Specifications Section 107. Water containing hazardous materials shall not be percolated or evaporated.

- All vehicles/equipment that regularly enter and leave the construction site must be cleaned off-site in accordance with Standard Specifications Section 107.
- When vehicle/equipment washing/cleaning must occur on-site, and the operation cannot be located within a structure or building equipped with appropriate disposal facilities, the outside cleaning area shall have the following characteristics, and shall be arranged with the Engineer:
 - Located away from storm drain inlets, drainage facilities, or watercourses
 - Paved with concrete or asphalt and bermed with an impermeable material to contain wash waters and to prevent run-on and runoff
 - Configured with a sump to allow collection and disposal of wash water
 - Wash waters shall not be discharged to storm drains or watercourses
 - Used only when necessary
- When cleaning vehicles/equipment with water:
 - Use as little water as possible. High-pressure sprayers may use less water than a hose, and shall be considered.
 - Use positive shutoff valve to minimize water usage.
 - Facility wash racks shall discharge to a sanitary sewer, recycle system or other approved discharge system and shall not discharge to the storm drainage system or watercourses.

Maintenance and Inspection

- The control measure shall be inspected at a minimum of once a day.
- 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 to ensure intended use and function is maintained.



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose Vehicle and equipment fueling procedures and practices are designed to prevent the discharge of fuel spills and leaks into storm drain systems or to watercourses.

Appropriate Applications These procedures are applied on all construction sites where vehicle and equipment fueling takes place.

Limitations

- On-site vehicle and equipment fueling shall only be used where it's impractical to send vehicles and equipment off-site for fueling.

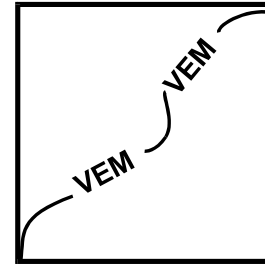
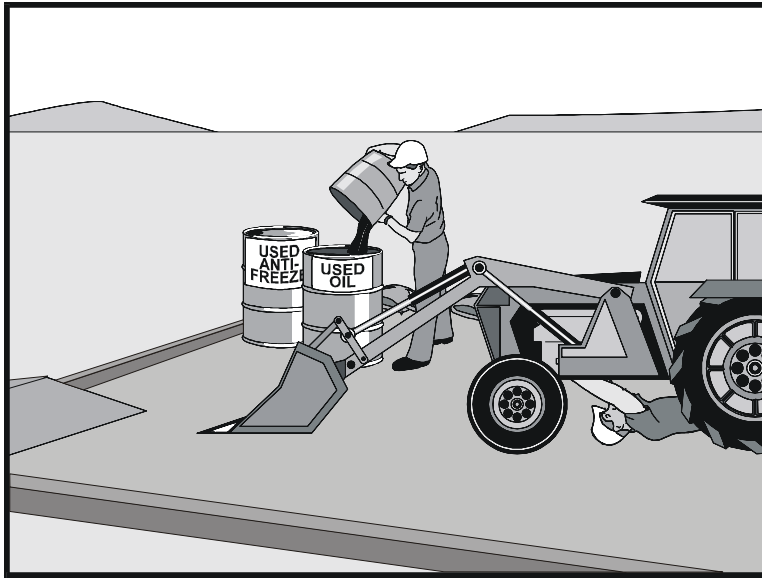
Standards and Specifications

- When fueling must occur on-site, the contractor shall select and designate an area to be used.
- Absorbent spill clean-up materials and spill kits shall be available in fueling areas and on fueling trucks and shall be disposed of properly after use in accordance with Standard Specifications Section 107
- Drip pans or absorbent pads shall be used during vehicle and equipment fueling, unless the fueling is performed over an impermeable containment area in a dedicated fueling area.
- Dedicated fueling areas shall be protected from storm water run-on and runoff, and shall be located at least 100 ft. from downstream drainage facilities and watercourses per the Temporary Work in Waterways/Discharge Permit. Fueling must be performed on level-grade areas.
- Nozzles used in vehicle and equipment fueling shall be equipped with an automatic shut-off to control drips. Fueling operations shall not be left unattended.

Maintenance and
Inspection

- Protect fueling areas with impermeable berms and/or dikes to prevent storm water run-on, runoff, and to contain spills.
- Use vapor recovery nozzles to help control drips as well as air pollution where required by air quality permits and regulations. Ensure the nozzle is secured upright when not in use.
- Fuel tanks shall not be "topped-off."
- Vehicles and equipment shall be inspected on each day of use for leaks. Leaks shall be repaired immediately on problem vehicles or equipment shall be removed from the project site.
- Absorbent spill clean-up materials shall be available and appropriately identified in fueling and maintenance areas and used on small spills instead of hosing down or burying techniques. The spent absorbent material shall be removed promptly and disposed of properly in accordance with Standard Specifications Section 107.
- Federal, state, and local requirements shall be observed for any fueling facility and stationary above ground storage tanks. Refer to WM-1 "Material Delivery and Storage."
- Fueling areas and storage tanks shall be inspected daily.
- Keep an ample supply of spill cleanup material on the site.
- Immediately clean up spills and properly dispose of contaminated soil and cleanup materials.

Adapted from Caltrans Construction Site BMPs



BMP Objectives

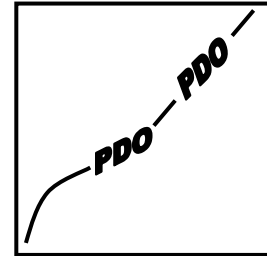
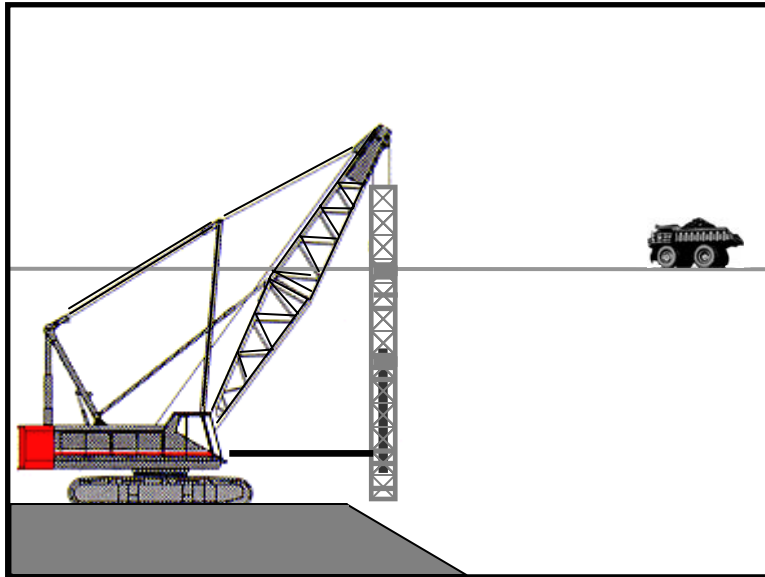
- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose	Procedures and practices to prevent the discharge of pollutants to the storm drain systems or to watercourses from vehicle and equipment maintenance procedures.
Appropriate Applications	These procedures are applied on all construction projects where an on-site yard area is necessary for storage and maintenance of heavy equipment and vehicles.
Limitations	None identified.
Standards and Specifications	<ul style="list-style-type: none"> ■ Drip pans or absorbent pads shall be used during vehicle and equipment maintenance work that involves fluids, unless the maintenance work is performed over an impermeable surface in a contained, dedicated maintenance area. ■ Dedicated maintenance areas shall be protected from storm water run-on and runoff, and shall be located at least 100 ft. from downstream drainage facilities and watercourses per the Temporary Work in Waterways/Discharge Permit. ■ Drip Pans or plastic sheeting shall 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. ■ Absorbent spill clean-up materials shall be available and clearly identified in maintenance areas and shall be disposed of properly after use in accordance with Standard Specifications Section 107. ■ Use off-site maintenance facilities whenever practical.

Maintenance and Inspection

- For long-term projects, consider constructing roofs or using portable tents over maintenance areas.
- Properly dispose of or recycle tires, batteries, petroleum products and spill cleanup materials in accordance with Standard Specifications Section 107.
- Repair fluid leaks immediately.
- Provide impermeable spill containment dikes or secondary containment around stored oil and chemical drums.
- Vehicle and equipment maintenance areas, and storage areas for new and used products, shall be inspected weekly.
- Vehicles, equipment, and storage containers shall be inspected on each day of use. Leaks shall be repaired immediately or the vehicle, equipment, or container shall be removed from the project site or replaced.
- Inspect equipment for damaged hoses and leaky gaskets on each day of use. Repair or replace as needed.

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose	The construction and retrofit of bridges and retaining walls sometimes includes driving piles for foundation support and shoring operations. Driven piles are typically constructed of concrete, steel, or timber. Driven sheet piles are used for shoring and cofferdam construction. Proper control and use of equipment, materials, and waste products from pile driving operations will reduce the discharge of potential pollutants to the storm drain system or watercourses.
Appropriate Applications	These procedures apply to construction sites near or adjacent to a watercourse or groundwater where permanent and temporary pile driving operations (impact and vibratory) take place, including operations using pile shells for construction of cast-in-steel-shell and cast-in-drilled-hole drilled shaft piles.
Limitations	Drilled shafts often use drilling fluid.
Standards and Specifications	<ul style="list-style-type: none"> ■ Use drip pans or absorbent pads during vehicle and equipment maintenance, cleaning, fueling, and storage. Refer to BMPs NS-9 "Vehicle and Equipment Fueling" and NS-10 "Vehicle and Equipment Maintenance." ■ Have spill kits and cleanup materials available at all locations of pile driving. Refer to BMP WM-4 "Spill Prevention and Control." ■ Keep equipment that is stored or in use in streambeds; or on docks, or other structures over water bodies, leak free. ■ Park equipment over plastic sheeting or equivalent where possible. Plastic sheeting is not a substitute for drip pans or absorbent pads.

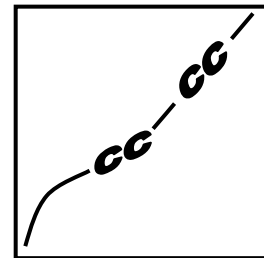
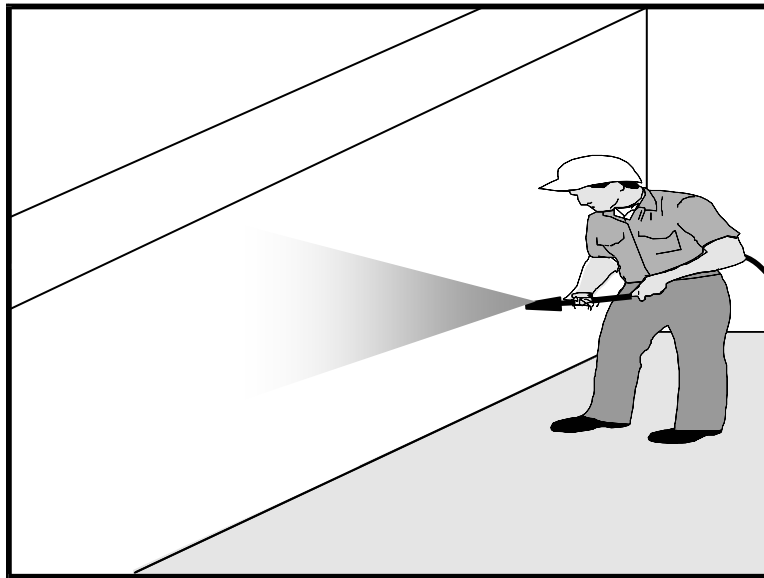
The storage or use of equipment in streambeds or other bodies of water shall comply with all applicable permits.

- Implement other BMPs as applicable, such as NS-2 “Dewatering Operations,” WM-5 “Construction Debris and Litter Management,” and WM-08 “Liquid Waste Management.”
- When not in use, store pile driving equipment away from concentrated flows of storm water, drainage courses, and inlets. Protect hammers and other hydraulic attachments from run-on by placing them on plywood and covering them with plastic or a comparable material prior to the onset of rain.

Maintenance and Inspection

- Inspect pile driving areas and equipment for leaks and spills on a daily basis.
- Inspect equipment routinely and repair equipment as needed (i.e., worn or damaged hoses, fittings, gaskets).

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose Concrete and pavement curing is used in the construction of structures such as bridges, retaining walls, and pump houses. Concrete curing includes the use of both chemical and water methods. Proper procedures minimize pollution of runoff during concrete curing.

Appropriate Applications All concrete elements of a structure (i.e., footings, columns, abutments, stems, soffit, and deck) and concrete pavements are subject to curing requirements in accordance with Standard Specifications Section 501.

Limitations None identified.

Standards and Specifications

Chemical Curing

- Avoid over-spray of curing compounds.
- Minimize the drift of chemical cure as much as possible 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 BMP WM-1 "Material Delivery and Storage."
- Protect drain inlets prior to the application of curing compounds. Refer to BMP SC-08 "Storm Drain Inlet Protection."
- 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 disposal in accordance with all applicable permits.
- When practical, collect cure water and transport or dispose of water in a non-erodible manner. See BMPs SS-9 "Earth Dikes/Drainage Swales & Lined Ditches," SS-10 "Outlet Protection/Velocity Dissipation Devices," and SS-11 "Slope Drains."
- Utilize wet blankets or a similar method that maintains moisture while minimizing the use and possible discharge of water.

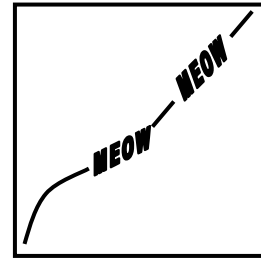
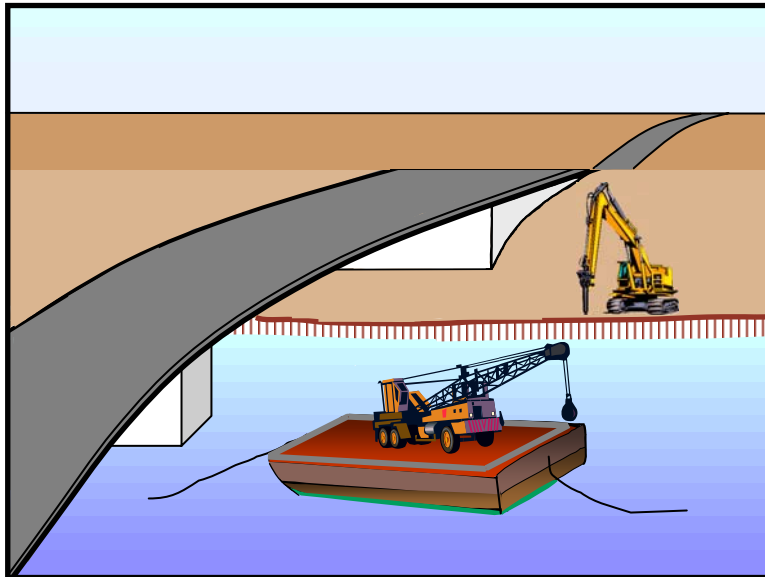
**Maintenance and
Inspection**

- Ensure that employees and subcontractors implement appropriate measures for storage, handling, and use of curing compounds.
- Inspect any temporary diversion devices, lined channels, or swales for washouts, erosion, or debris. Replace lining and remove debris as necessary.
- Inspect cure containers and spraying equipment for leaks.

Material and Equipment Use Over Water

NS-13

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition 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.
Appropriate Applications	These procedures shall be implemented for construction materials and wastes (solid and liquid) and any other materials that may be detrimental if released. Applies where materials and equipment are used on barges, boats, docks, and other platforms over or adjacent to a watercourse.
Limitations	None identified.
Standards and Specifications	<ul style="list-style-type: none">■ Refer to BMPs WM-1 "Material Delivery and Storage" and WM-4 "Spill Prevention and Control" and review the project's "Temporary Work in Waterways/Discharge Permit" for specific equipment maintenance requirements.■ Use drip pans and absorbent materials for equipment and vehicles and ensure that an adequate supply of spill cleanup materials is available.■ Drip pans shall be placed under all vehicles and equipment placed on docks, barges, or other structures over water bodies when the vehicle or equipment is expected to be idle for more than one hour.■ Maintain equipment in accordance with BMP 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

Material and Equipment Use Over Water

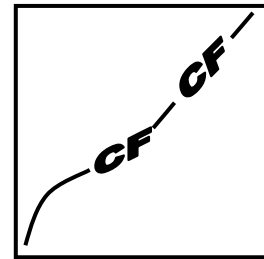
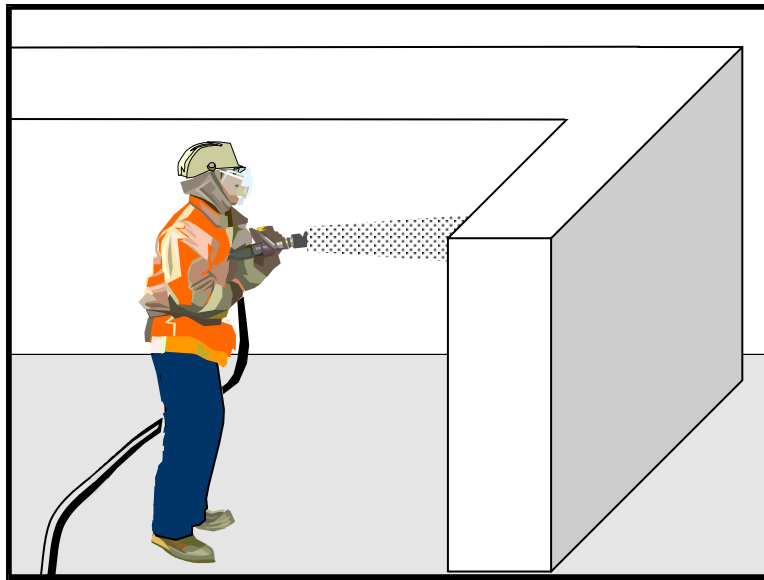
Adapted from Caltrans Construction Site BMPs

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 deployment and access of control measures and those measures are being used.
- Ensure the timely and proper removal of accumulated wastes.
- Refer to BMPs WM-5 "Construction Debris and Litter Management" (non-hazardous) and Standard Specification Section 107.
- Comply with all necessary permits required for construction within or near the watercourse, such as Nevada Division of State Lands, U.S. Army Corps of Engineers, NDEP, and other local permitting agencies.
- Refer to BMP NS-15 "Structure Demolition/Removal Over or Adjacent to Water."

Maintenance and Inspection

- Inspect equipment for leaks and spills on a daily basis, and make necessary repairs.
- Ensure that employees and subcontractors implement 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 watercourse.



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose Concrete finishing methods are used for bridge deck rehabilitation; sound walls, paint removal, curing compound removal, and final surface finish appearances. Methods include sand blasting, shot blasting, grinding, or high pressure water blasting. Proper procedures minimize the impact that concrete-finishing methods may have on runoff.

Appropriate Applications These procedures apply to all construction locations where concrete finishing operations are performed.

Limitations Specific permit requirements may be included in the contract documents for certain concrete finishing operations.

- Standards and Specifications**
- Follow containment requirements stated in the project special provisions, if any.
 - Collect and properly dispose of water and solid waste from high-pressure water blasting operations.
 - Collect water from blasting operations and transport or dispose of water in a non-erodible manner. Refer to BMPs SS-9 "Earth Dikes/Drainage Swales & Lined Ditches," SS-10 "Outlet Protection/Velocity Dissipation Devices," and SS-11 "Slope Drains."
 - Direct water from blasting operations away from inlets and watercourses to collection areas for infiltration or other means of removal (dewatering) in accordance with applicable permits.
 - Protect inlets during sandblasting operations. Refer to BMP SC-08 "Storm Drain Inlet Protection."
 - Refer to BMP WM-06 "Concrete Waste Management."

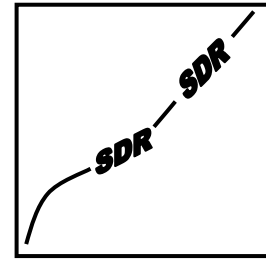
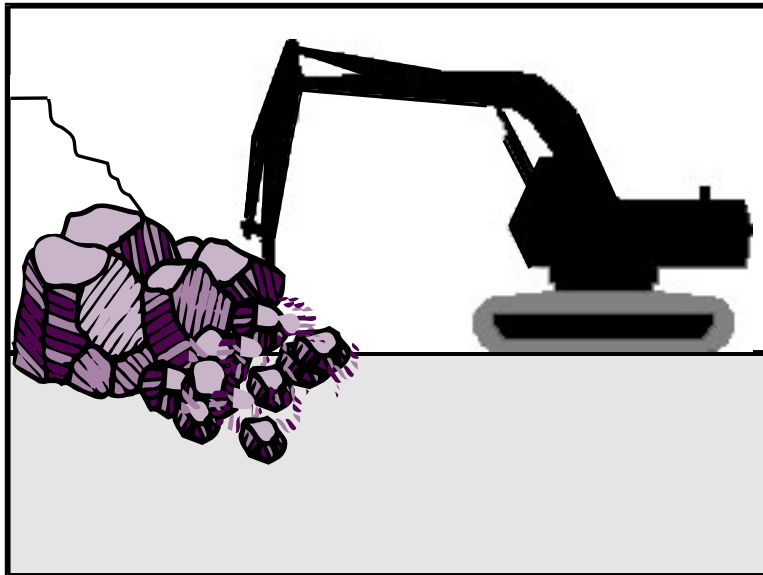
Maintenance and Inspection

- 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 potentially hazardous waste, refer to Standard Specification Section 107.
- Follow inspection procedure as required in the project special provisions.
- At a minimum, inspect containment structures, if any, for damage or voids prior to use each day and prior to the onset of rain.
- At the end of each work shift, remove and contain the liquid and solid wastes from containment structures, if any, and from the general work area.

Structure Demolition/Removal Over or Adjacent to Water

NS-15

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose	Procedures to protect water bodies from debris and wastes associated with structure demolition or removal over or adjacent to watercourses.
Appropriate 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	Specific permit requirements may be included in the contract documents.
Standards and Specifications	<ul style="list-style-type: none">■ Do not allow demolished material to enter waterway.■ Refer to BMP 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. NDOT may require that a Licensed Engineer design these structures.■ Stockpile accumulated debris and waste generated during demolition away from watercourses and in accordance with BMP WM-3 "Stockpile Management."■ Ensure safe passage for wildlife.■ Contractors are responsible for reporting any discharges to a waterway immediately upon discovery to the Engineer. The Engineer will then report the discharge to the NDOT Water Quality

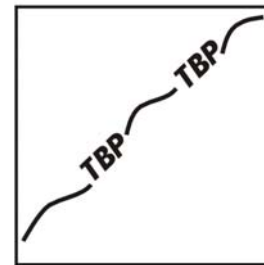
Structure Demolition/Removal Over or Adjacent to Water

Adapted from Caltrans Construction Site BMPs

Specialist. If determined necessary by NDOT, written notification from the Contractor describing the discharge may also be required.

Maintenance and Inspection

- For structures containing hazardous materials, (i.e., lead paint or asbestos) refer to Standard Specification Section 107.
- Contractor must inspect demolition areas over or near adjacent watercourses on a daily basis.
- Any debris-catching devices shall be emptied regularly. Collected debris shall be removed and stored away from the watercourse and protected from run-on and runoff.



Standard Symbol

BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

The construction of roads, bridges and retaining walls often requires temporary batch plant facilities to crush rock, manufacture asphalt concrete (AC) or Portland cement concrete (PCC) near construction projects. Temporary batch plant facilities typically consist of silos containing fly ash, lime and cement; sand and gravel material storage areas; a mixing plant/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.

Temporary concrete, asphalt, and material plants or operations require coverage under the General Permit. If the plant or operation is dedicated to a permitted construction project, the permit covers storm water discharge. However, a separate SWPPP must be prepared to address storm water controls specific to the plant or operations. The BMPs presented in this fact sheet offer guidelines for complying with the permit requirements. Other methods may also be available.

Appropriate Applications

These procedures typically apply to onsite and offsite construction sites where temporary batch plant facilities are used.

Limitations

- Specific permit requirements by Clark and Washoe Counties, NDEP and local noise ordinances, may be included in contract documents because of air emissions, storm and non-storm water discharges, and/or noise.

Standards and Specifications**Planning**

- Temporary Batch Plants dedicated to a construction project are covered by the General Permit for Storm Water Discharges Associated with Construction Activity (General Permit). However, a separate Storm Water Pollution Prevention Plan must be prepared to address storm water control for the temporary batch plant. If the temporary batch plant serves multiple projects, then permit coverage must be obtained under the General Permit.
- 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.
- Construct temporary batch plants down-wind of existing developments whenever possible.
- Placement of access roads should be planned to minimize water and air quality impacts.

Layout and Design

- Temporary batch plants should be properly located and designed to minimize 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 storm water run-on to the site.
- Temporary batch plant facilities (including associated stationary equipment and stockpiles) should be located at least 300 feet from any recreational area, school, residence, or other structure not associated with the construction project.
- Continuous interior AC or PCC berms around batch plant equipment (mixing equipment, silos, concrete drop points, conveyor belts, admixture tanks, etc.) can facilitate proper containment and cleanup of releases. Rolled curb or dikes should be placed at ingress and egress points, and loading areas.
- Direct storm water and non-storm water runoff from paved or unpaved portions of the batch plant facility to catchment ponds, tanks, or a lined washout area or baker tank.
- Construct and remove concrete washout facilities in accordance with Concrete Waste Management (WM-06).

Operational Procedures

- Washout of concrete trucks should be conducted in a designated area in accordance with Concrete Waste Management (WM-06).

- Do not dispose of concrete into drain inlets, the storm water drainage system or watercourses.
- Washing equipment, tools, or vehicles to remove PCC shall be conducted in accordance with Potable Water/Irrigation (NS-7) and Vehicle and Equipment Cleaning (NS-8) and Concrete Waste Management (WM-6).

There should be no visible emissions beyond the boundary (or perimeter) of the property on which the equipment is being operated. The following procedures should be considered if visible emissions are occurring and require abatement.

- All dry material transfer points should be ducted through 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 a visible and/or audible warning mechanism to warn operators that the silo or trailer is full.
- Equip silos and auxiliary bulk storage trailers with dust-tight service hatches.
- Fabric dust collection system should be capable of controlling particulate matter in compliance with the project's Air Quality Permit.
- 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 or equipped with spray systems, unless the material being transferred results in no visible emissions.
- 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.
- All open-bodied vehicles transporting unmixed, unconsolidated, or dry material should be sprayed with water, loaded with a final layer of wet sand or covered with a tarp to reduce emissions.

Tracking Control

- Plant roads (batch truck and material delivery truck roads) and areas between stockpiles and conveyor hoppers should be stabilized (TC-2), watered (SS-13), treated with dust-palliative, or paved with a cohesive hard surface that can be repeatedly swept, washed, and maintained intact and cleaned as necessary to control dust emissions.
- Trucks should not track PCC from plants onto the NDOT right of way or other public roads. Use appropriate practices from Stabilized Construction Entrance/Exit (TC-1) to prevent tracking.

Materials Storage

- Material Delivery and Storage (WM-1) should be implemented at all batch plants using concrete components or compounds. An effective strategy is to cover and contain.
- Material Use (WM-2) should be conducted in a way to minimize or eliminate the discharge of materials to storm drain system or watercourse.
- Minimize dispersion of finer materials into the air during operations, such as unloading cement delivery trucks.
- Stockpiles should be covered and enclosed with perimeter sediment barriers per Stockpile Management (WM-3). Uncovered stockpiles should be sprinkled with water and/or dust-palliative as necessary to control dust emissions, unless the stockpiled material results in no visible emissions per Standard Specifications Section 501. An operable stockpile water system should be onsite at all times.
- Store bagged and boxed materials on pallets and cover on non-working days or prior to rain.
- Provide secondary containment for liquid materials (WM-1) per CFR (Code of Federal Regulations) Sections 110, 117, and 302. Containment should provide sufficient volume to contain precipitation from a 24-hour 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 Construction Debris and Litter Management (WM-5), Liquid Waste Management (WM-08), and Concrete Waste Management (WM-06).
- 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.

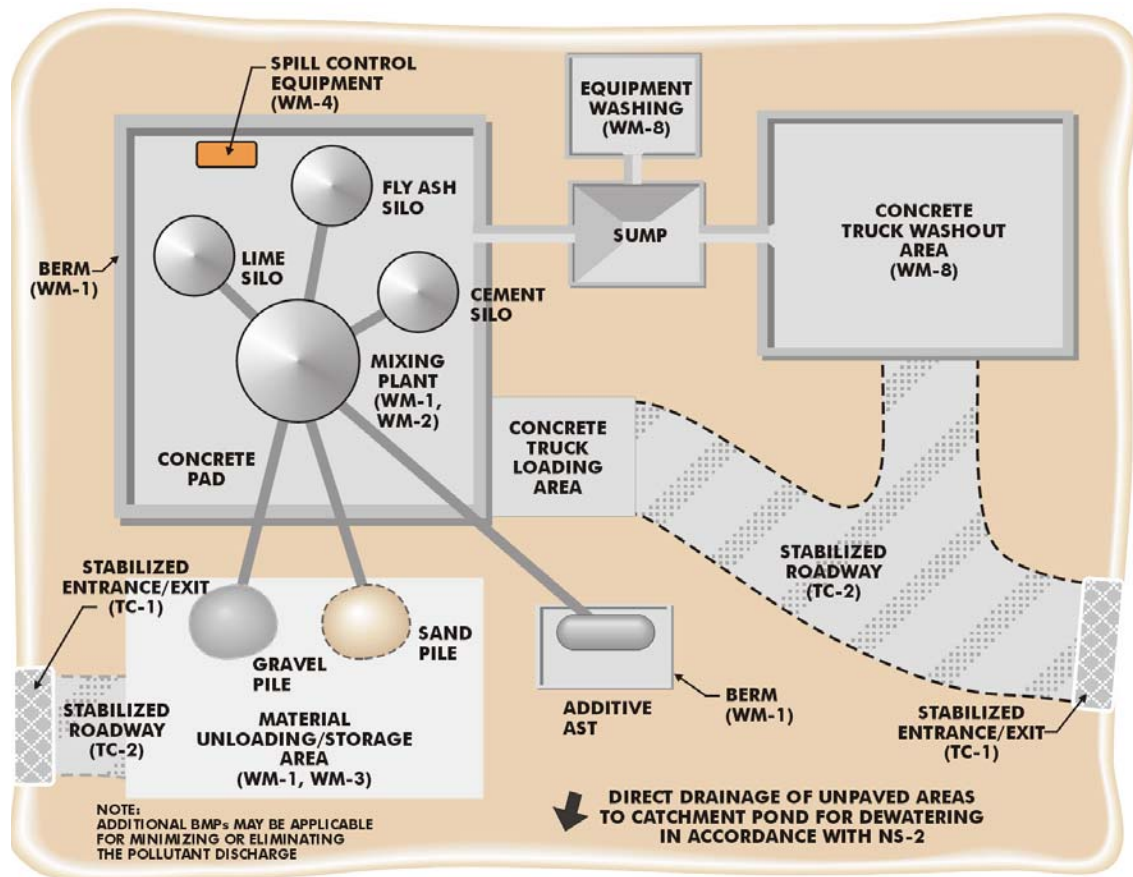
Equipment Maintenance

- Equipment should be maintained to prevent fluid leaks and spills per Vehicle and Equipment Fueling (NS-9) and Vehicle and Equipment Maintenance (NS-10).
- Maintain adequate supplies of spill cleanup materials and train staff to respond to spills per Spill Prevention and Control (WM-4).
- Incorporate other BMPs such as Construction Debris and Litter Management (WM-5) and Liquid Waste Management (WM-08).

Maintenance and Inspection

- Inspect batch plant components daily during batch plant construction and operation.
- Inspect and repair equipment (for damaged hoses, fittings, and gaskets).
- Inspect and maintain Stabilized Construction Entrance/Exit (TC-1) as needed.

Typical Temporary Batch Plant Layout



Section 7

Waste Management and Materials Pollution Control Best Management Practices

7.1 Definitions

Waste management and materials pollution control best management practices (BMPs), like non-storm water management BMPs, are source control BMPs that prevent pollution by limiting or reducing potential pollutants at their source before they come in contact with storm water. These BMPs also involve day-to-day operations of the construction site and are under the control of the Contractor, and are additional “good housekeeping practices”, which involve keeping a clean, orderly construction site.

These BMPs are intended to prevent the release of waste materials to receiving waters through storm water runoff. They do not cover all regulations related to waste handling. It is imperative that all contractors and other users of this manual are also knowledgeable of, and follow, all federal, state and local regulations related to waste handling.

7.1.1 Waste Management BMPs

Waste management consists of implementing procedural and structural BMPs for handling, storing, and disposing of wastes generated by a construction project to prevent the release of waste materials into storm water discharges. Waste management includes the following BMPs:

- Spill Prevention and Control
- Construction Debris and Litter Management
- Concrete Waste Management
- Sanitary/Septic Waste Management
- Liquid Waste Management

7.1.2 Materials Pollution Control BMPs

Materials pollution control (also called materials handling) consists of implementing procedural and structural BMPs for handling, storing, and using construction materials to prevent the release of those materials into storm water discharges. The objective is to reduce the opportunity for rainfall to come in contact with these materials. These controls shall be implemented for all applicable activities, material usage and site conditions. Materials handling practices include the following BMPs:

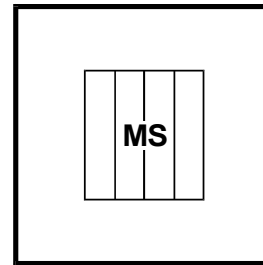
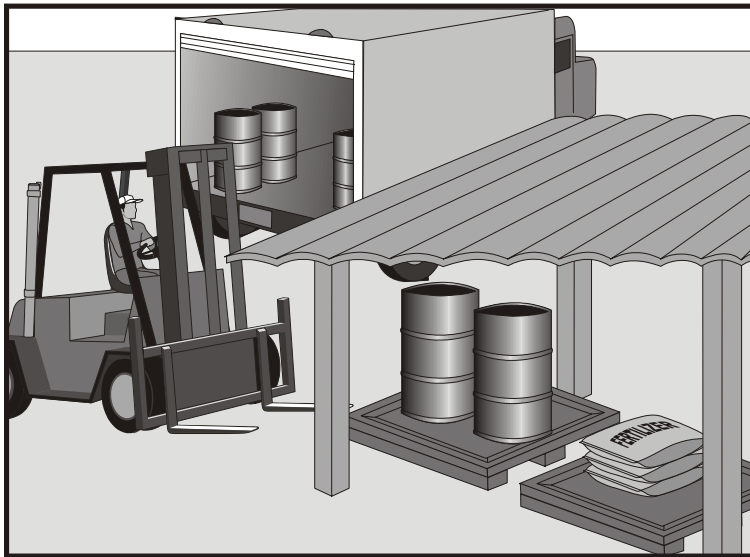
- Material Delivery, and Storage
- Material Use
- Stockpile Management

Table 7-1 lists the waste management and materials pollution control BMPs. It is important to note that all these BMPs have been approved by NDOT for statewide use and they shall be implemented depending on the conditions/applicability of deployment described as part of the BMP.

Table 7-1 WASTE MANAGEMENT AND MATERIALS POLLUTION CONTROL BMPs	
ID	BMP NAME
WM-1	Material Delivery and Storage
WM-2	Material Use
WM-3	Stockpile Management
WM-4	Spill Prevention and Control
WM-5	Construction Debris and Litter Management
WM-6	Concrete Waste Management
WM-7	Sanitary/Septic Waste Management
WM-8	Liquid Waste Management

The remainder of this Section shows the working details for each of the waste management and materials pollution control BMPs.

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose Procedures and practices for the proper handling and storage of materials in a manner that minimizes or eliminates the discharge of these materials to the storm drain system or to watercourses.

Appropriate Applications These procedures are implemented at all construction sites with delivery and storage of the following:

- Pesticides and herbicides (see QPL 401)
- Soil stabilizers and binders (see QPL 726)
- Fertilizers (see QPL 726)
- Detergents
- Plaster
- Petroleum products such as fuel, oil, and grease
- Asphalt and concrete related compounds (see QPL 401, 496 and 609)
- Solid or liquid materials that may contain hazardous substances
- Other materials that may be released to the environment

Limitations

- Space limitation may preclude indoor storage.
- Storage sheds must meet building & fire code requirements.

Standards and
Specifications**General**

- Train employees and subcontractors on the proper material delivery and storage practices.
- Materials storage areas should be designated per the contract documents and must comply with all federal, state, and local regulations. Storage areas should be located away from vehicular traffic.
- Material Safety Data Sheets (MSDS) shall be available on site for all materials stored.
- Secure storage areas with fencing, locked sheds or trailers to prevent unwarranted access.

Material Storage Areas and Practices

- Liquids, petroleum products, and substances listed in 40 CFR Parts 110, 117, or 302 shall be stored in appropriate containers and drums and shall not be overfilled. Containers and drums shall be placed in temporary containment facilities for storage.
- A temporary containment facility shall provide sufficient spill containment volume to contain precipitation from a 24-hour, 2-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 shall be impervious to the materials stored therein for a minimum contact time of 72 hours and its integrity inspected daily.
- A temporary containment facility shall be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills shall be collected and placed into DOT approved drums. Handle and dispose of these liquids in accordance with applicable federal, state, or local laws.
- Allow access in storage areas for spill cleanup and emergency response access.
- Incompatible materials shall not be stored in the same temporary containment facility.
- Each temporary containment facility shall be covered.
- Materials shall be stored in their original containers and the original product labels shall be maintained in place in a legible condition. Damaged or otherwise illegible labels shall be replaced immediately.

- Bagged and boxed materials shall be stored on pallets off of the ground and covered to provide protection from wind and rain.
- Stockpiles shall be protected in accordance with BMP WM-3, "Stockpile Management".
- Store materials indoors within existing structures or sheds. A storage facility having a solid cover and sides is preferred to a temporary tarp. Storage facilities shall be equipped with proper ventilation.
- Have proper storage instructions posted at all times in an open and conspicuous location.
- Do not store hazardous chemicals, drums, or bagged materials directly on the ground. When not in use, store these items on a pallet, under cover in secondary containment.
- Appropriate spill clean up material shall be readily identified and placed near storage areas.

Material Delivery Practices

- Keep an accurate, up-to-date inventory of material delivered and stored on-site.
- Personnel appropriately trained emergency spill clean-up procedures shall be present when solid or liquid-hazardous materials are unloaded.

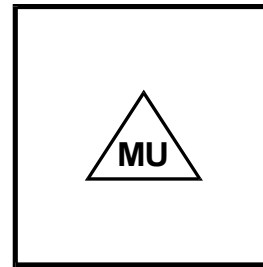
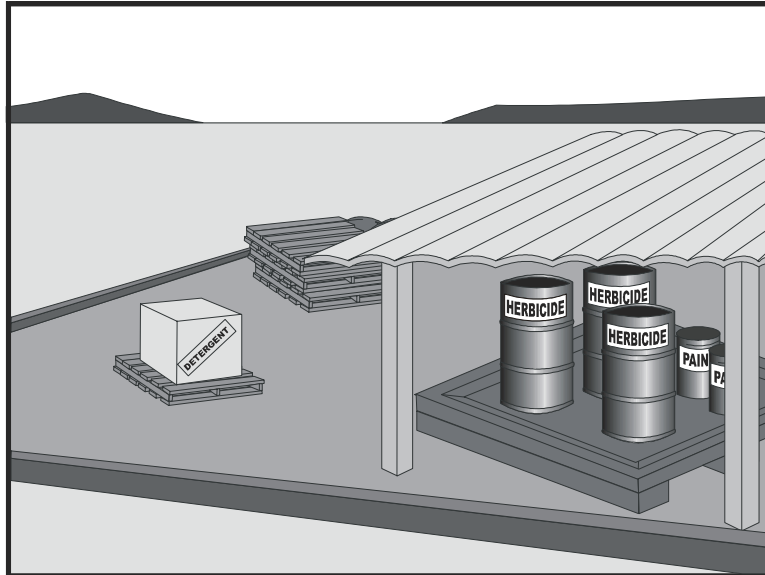
Spill Clean-up

- Contain and clean up any spilled immediately.
- Properly remove and dispose of any spilled hazardous materials in accordance with federal, state, or local laws.
- See BMP WM-4, "Spill Prevention and Control", for spills of chemicals and/or hazardous materials.

Maintenance and Inspection

- Storage areas shall be kept clean, well organized, and equipped with sufficient clean-up supplies as appropriate for the materials being stored.
- Perimeter controls, containment structures, covers, and liners shall be repaired or replaced as needed to maintain proper function.
- Inspect storage areas before and after rainfall events, and daily during other times.

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose These are procedures and practices for use of construction material in a manner that minimizes or eliminates the discharge of these materials to the storm drain system or to watercourses.

Appropriate Applications This BMP applies to all construction projects. These procedures apply when the following materials are used or prepared on site:

- Pesticides and herbicides (see QPL 401)
- Fertilizers (see QPL 726)
- Detergents
- Plaster
- Petroleum products such as fuel, oil, and grease
- Asphalt and other concrete related compounds (see QPL 401, 496 and 609)
- Solid or liquid materials that may contain hazardous substances (see QPL 633, 728 and 729)
- Other materials that may be to the environment

Limitations ■ Safer alternative building and construction products may not be available or suitable in every instance.

Standards and Specifications

- Material Safety Data Sheets (MSDS) for all materials shall be readily available on site.
- Do not remove the original product label; it contains important safety and disposal information. Use the entire product before disposing of the container.
- 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, in accordance with Standard Specifications Section 107.
- For water-based paint, clean brushes to the extent practical, and rinse to a drain leading to a sanitary sewer where permitted, or into a concrete washout pit or other containment. For oil-based paints, clean brushes to the extent practical and filter and reuse thinners and solvents.
- Use recycled and alternative products free of hazardous materials (source reduction) when practical. Recycle residual paints, solvents, non-treated lumber, and other materials (waste minimization).
- Fertilizers and pesticides (e.g. herbicides and insecticides) shall be applied per manufacturer's instructions and in compliance with any applicable laws and regulations.
- Application of pesticides shall be performed by a State of Nevada licensed applicator.
- Allow sufficient drying or application time to avoid exposing uncured applied materials to rainfall and runoff.

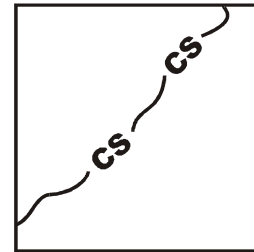
Maintenance and Inspections

- Periodically and regularly inspect employees and subcontractors throughout the duration of the project to ensure appropriate practices are being employed.

Stockpile Management

WM-3

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose	Stockpile management procedures and practices are designed to reduce or eliminate air and storm water pollution from stockpiles of soil, and paving materials such as portland cement, aggregate sub-base or pre-mixed aggregate and pressure treated wood.
Appropriate Applications	Implemented in all projects that stockpile soil and other materials that contain fine particles or other materials that have the potential to release into storm water runoff.
Limitations	None identified
Standards and Specifications	<ul style="list-style-type: none">■ Protection of stockpiles is a year-round requirement.■ Locate stockpiles a minimum of 100 ft. away from concentrated flows of storm water, drainage courses, and inlets wherever possible. See Standard Specification Section 107 for additional information.■ Protect stockpiles from storm water run-on using a temporary perimeter sediment barrier such as berms, dikes, sediment logs, gravel bag berm, silt fences or gravel bags.■ Implement wind erosion control practices, as appropriate, on all stockpiled material. For specific information see BMP SS-13, "Wind Erosion Control."■ Stockpiles of soil should be managed in accordance with Standard Specification Section 107.■ Bagged materials should be placed and stored in a manner consistent with BMP WM-1, "Material Delivery and Storage".

Protection of Non-Active Stockpiles

Non-active stockpiles, defined as stockpiles not in use for two or more weeks, of the identified materials should be protected further as follows:

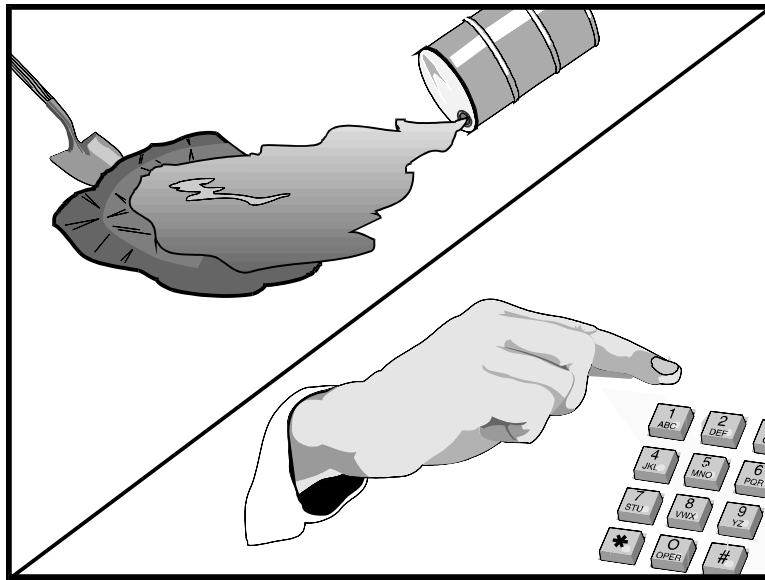
- ***Soil stockpiles:***
 - May not be applicable to pits, batch plants, or commercial sources.
 - Soil stockpiles should be covered or protected with soil stabilization measures (See SS fact sheets) and a temporary perimeter sediment barrier at all times.
- ***Stockpiles of Portland Cement concrete aggregate, aggregate base, or aggregate sub-base:***
 - Stockpiles should be covered or protected with a temporary perimeter sediment barrier at all times.
- ***Stockpiles/Storage of pressure treated wood with copper, chromium, and arsenic or ammonical, copper, zinc, and arsenate:***
 - Treated wood stockpiles should be placed on and covered with plastic or comparable material at all times.

Protection of Active Stockpiles

Active stockpiles of the identified materials should be protected further as follows:

- Stockpiles should be covered, stabilized, or protected with a temporary linear sediment barrier prior to the onset of precipitation.
- Repair and/or replace perimeter controls and covers as needed, or as directed by the Resident Engineer (RE), to keep them functioning properly.

Maintenance and
Inspections

**BMP Objectives**

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

These are procedures and practices implemented to prevent and control spills in a manner that minimizes or prevents the discharge of spilled material to the drainage system or watercourses.

Appropriate Application

This BMP applies to all construction projects. Spill control procedures are implemented anytime solid or liquid materials that may contain hazardous chemicals are stored. Substances may include, but are not limited to:

- Soil stabilizers/binders
- Dust Palliatives
- Herbicides
- Growth inhibitors
- Fertilizers
- Deicing/anti-icing chemicals
- Fuels
- Lubricants
- Other petroleum distillates

To the extent that the work can be accomplished safely, spills of oil, petroleum products, substances listed under 40 CFR (Code of Federal Regulations) parts 110, 117, and 302, and sanitary and septic wastes shall be contained and cleaned up immediately either by onsite personnel (dependant on level of training), local agencies (e.g. fire department), or by engaging a private emergency response company, as necessary and determined herein.

- Limitations**
- Procedures and practices presented in this BMP are general. The Contractor must identify appropriate practices for the specific materials used or stored on-site and comply with all federal, state and local regulations.

- Standards and Specifications**
- To the extent that it does not compromise clean up activities, spills should be covered and protected from storm water run-on during rainfall.
 - Spills shall not be buried or washed with water, unless as part of emergency response activities.
 - Used clean up materials, materials impacted from the effect of a spill, and recovered product that is no longer suitable for the intended purpose shall be stored and disposed of in conformance with Standard Specifications Section 107.
 - Water used for cleaning and decontamination shall not be allowed to enter storm drains or watercourses and shall be collected and disposed of in accordance with BMP WM-08, "Liquid Waste Management".
 - Proper storage, clean-up and spill reporting instruction for hazardous materials stored or used on the project site shall be posted near the materials.
 - Waste storage areas shall be kept clean, well organized and equipped with ample clean-up supplies as appropriate for the materials being stored. Perimeter controls, containment structures, covers and liners shall be inspected daily and repaired or replaced as needed to maintain proper function.

Education

- Educate employees and subcontractors on what a "reportable spill" is for each material they use, and what is the appropriate response for "reportable" and "non-reportable" 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.
- The Contractor's Water Pollution Control Manager (WPCM) shall oversee and enforce proper spill prevention and control measures.

Spill Classification, Reportable, and Non-Reportable Spills

A spill can be described as any pollutant, hazardous waste or contaminate that has been spilled, leaked, pumped, poured, emitted, emptied, discharged, injected, escaped, leached, dumped, or disposed into the environment.

The reportable quantity for petroleum products such as oil, diesel, gasoline, and hydraulic fluid is 25 gallons or 3 cubic yards of impacted material, or the presence on or in groundwater.

The reportable quantity for hazardous waste is based upon Federal EPA guidelines established under Title III List of Lists (40CFR Part 302). A spill of any quantity that affects a waterway within the State of Nevada must be reported, regardless of the quantity.

Contact NDEP at 1-888-331-NDEP (6337) to report a Reportable Spill and NDOT's Environmental Division at (775) 888-7013 as soon as possible but no later than the end of the first working day of the release.

Spill Clean up and Storage Procedures

■ Non-Reportable Spills

- Non-reportable spills may be controlled by the first individual, adequately trained and with the responsibility to act, to arrive on the scene of the spill.
- Use absorbent materials on small spills rather than hosing down or burying the spill.
- Remove the absorbent materials promptly and dispose of properly in accordance with Standard Specifications Section 107.
- The practice commonly followed for a non-reportable spill is:
 1. Contain the spread of the spill.
 2. Recover spilled materials.
 3. Clean the impacted area and/or properly dispose of affected materials.

■ Petroleum Product Reportable Spills

- Petroleum Product Reportable spills may be controlled by the first responder along with the aid of other personnel such as laborers and the foreman, dependent on level of training. This response may require the cessation of all other activities.

- Clean up spills immediately:
 1. Contain spread of the spill.
 2. 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.
 3. If the spill occurs in dirt areas, immediately contain the spill by constructing an earthen dike.
 4. If the spill occurs during rain, cover spill with tarps or other material to prevent impacting runoff.
 5. Notify the NDOT Resident Engineer immediately and follow up with a written report.
 6. Notify NDEP and contact NDOT Environmental Services Division.

- Hazardous Material Reportable Spills

- For hazardous Material Reportable Spills that cannot be controlled by appropriately trained personnel in the immediate vicinity, the following steps shall be taken:
 1. Notify the local emergency response by dialing 911, as necessary. In addition to 911, the contractor will notify the NDOT Resident Engineer, NDOT Environmental Services Division, the NDEP and the appropriate federal agencies. It is the contractor's responsibility to have all emergency phone numbers at the construction site.
 2. The services of a spills contractor or HazMat team shall be obtained immediately. Construction personnel shall not attempt to clean up the spill.
 3. Notification shall first be made by telephone and followed up with a written report.
 4. Other agencies which may need to be consulted include, but are not limited to, the Fire Department, the Public Works Department, the Highway Patrol, the City/County Police Department, Department of Toxic Substances, Nevada Division of Oil and Gas, OSHA, etc.

Spill Prevention and Control

WM-4

Adapted from Caltrans Construction Site BMPs

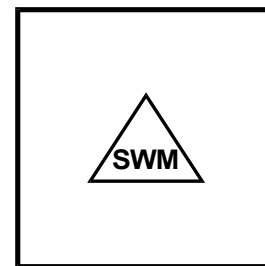
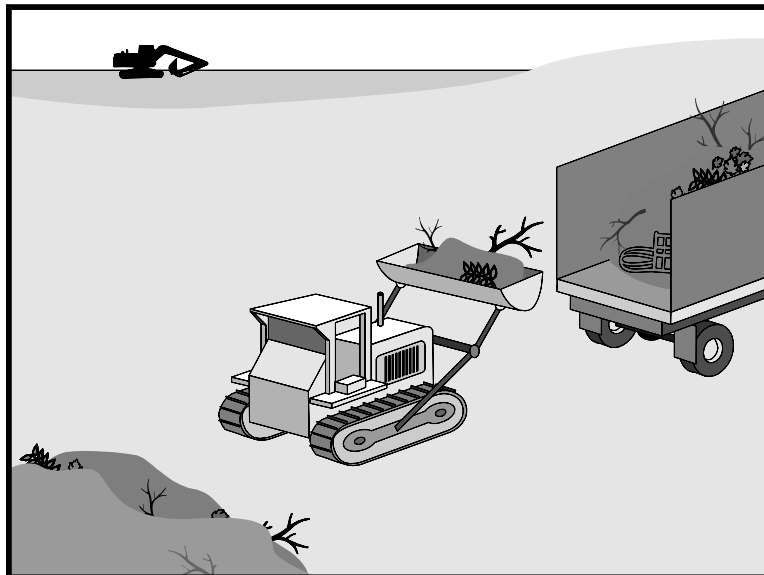
Maintenance and Inspection

- Verify weekly that spill control clean up materials are properly identified and are located near material storage, unloading, and use areas.
- Update spill prevention and control plans and stock appropriate clean-up materials whenever changes occur in the types of chemicals on site.

Construction Debris and Litter Management

WM-5

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

Solid waste management procedures and practices are designed to minimize or eliminate the discharge to the drainage system or to watercourses as a result of the creation, stockpiling, or removal of construction site wastes.

Appropriate Applications

Solid waste management procedures and practices are implemented on all construction projects that generate solid wastes. All disposal practices shall conform to the requirements of the Solid Waste Disposal Act (SWDA) as amended by the Resource Conservation and Recovery Act (RCRA).

Solid wastes include but are not limited to:

- Construction wastes including brick, mortar, timber, steel and metal scraps, sawdust, 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.
- Litter, including food containers, beverage cans, coffee cups, paper bags, plastic wrappers, and smoking materials, including litter generated by the public.

This BMP is not intended to address hazardous or toxic 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.

Construction Debris and Litter Management

Adapted from Caltrans Construction Site BMPs

Standards and Specifications

Education

- The Contractor's Water Pollution Control Manager (WPCM) shall oversee and enforce proper solid waste procedures and practices.
- Instruct employees and subcontractors on identification of solid waste and hazardous waste.
- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).
- Require that employees, subcontractors, and visitors follow solid waste handling, storage, and disposal procedures.
- Wherever possible, minimize production of solid waste materials.

Collection, Storage, and Disposal

- Littering on or off of the project site is prohibited per Nevada State Antilitter law.
- To prevent clogging of the storm drainage system litter and debris removal from drainage grates, trash racks, and ditch lines shall be a priority.
- Trash receptacles shall be provided in the Contractor's yard, field trailer areas, and at locations where workers congregate for lunch and break periods.
- Construction debris and litter from work areas within the construction limits of the project site shall be collected and placed in watertight debris box (dumpsters) at least weekly regardless of whether the litter was generated by the Contractor, the public, or others. Collected litter and debris shall not be placed in or next to drain inlets, storm water drainage systems or watercourses.
- Watertight dumpsters of sufficient size and number shall be provided to contain the solid waste generated by the project and properly serviced.
- Full dumpsters shall be removed from the project site and the contents shall be disposed of outside the highway right of way in conformance with the provisions in Standard Specifications Section 107.
- Litter stored in collection areas and containers shall be handled and disposed of in accordance with Standard Specifications Section 107
- Construction debris and waste shall be removed from the site biweekly or as appropriate.

Construction Debris and Litter Management

WM-5

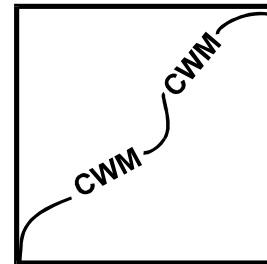
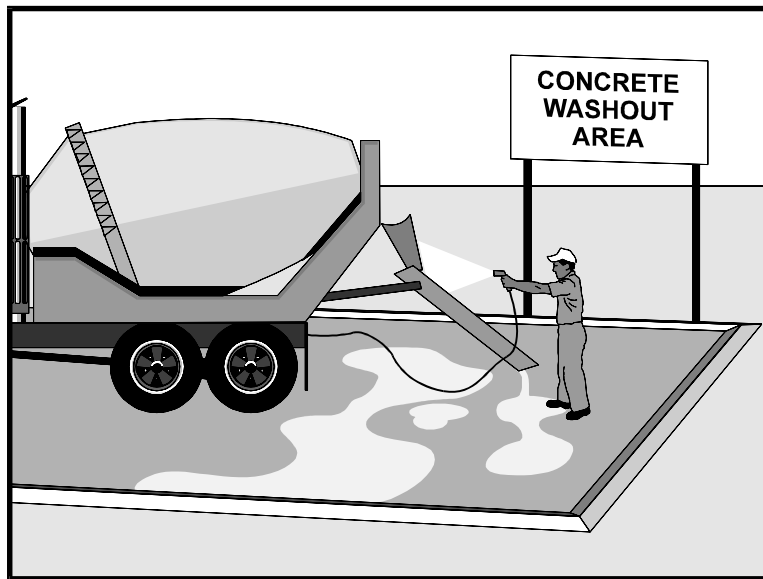
Adapted from Caltrans Construction Site BMPs

- Construction material visible to the public shall be stored or stacked in an orderly manner to the satisfaction of the Engineer.
 - Storm water run-on shall 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 shall be located at least 45 ft. from drainage facilities and watercourses and shall not be located in areas prone to flooding or ponding.
 - Construction and highway planting waste not stored in watertight dumpsters shall be securely covered from wind and rain by covering the waste with tarps or plastic sheeting or other appropriate BMPs.
 - Dumpster washout on the project site is not allowed.
 - Plan for additional containers during the demolition phase of construction.
 - Plan for more frequent pickup during the demolition phase of construction.
 - Construction waste shall be stored in a designated area.
 - Segregate potentially hazardous waste from non-hazardous construction site waste.
 - Keep the site clean of litter debris.
 - Make sure that potentially hazardous liquid wastes (used oils, solvents, paints, acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.
 - Dispose of non-hazardous and hazardous waste in accordance with Standard Specifications Section 107.
 - Salvage or recycle useful vegetation debris, packaging and/or surplus building materials when practical. For example, trees and shrubs from land clearing can be converted into wood chips, and then used as mulch on graded areas. Wood pallets, cardboard boxes, and construction scraps can also be recycled.
- Maintenance and Inspection
- The WPCM shall monitor on-site solid waste storage and disposal procedures.

Concrete Waste Management

WM-6

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose These procedures and practices are designed to minimize or eliminate the discharge of concrete waste materials to the storm drain systems or to watercourses.

Appropriate Applications

- Concrete waste management procedures and practices are implemented on construction projects where concrete or mortar is used as a construction material or where concrete dust and debris result from demolition activities.
- Where slurries containing portland cement concrete (PCC) or asphalt concrete (AC) are generated, such as from sawcutting, coring, grinding, grooving, and hydro-concrete demolition.
- Where concrete trucks and other concrete-coated equipment are washed on site. See also NS-8, Vehicle and Equipment Cleaning.

Limitations

Standards and Specifications

- Site may constrain location of an appropriate washout area.
- Educate employees, subcontractors, and suppliers on the concrete waste management techniques described herein.
- The Contractor's Water Pollution Control Manager (WPCM) shall oversee and enforce concrete waste management procedures.
- PCC and AC waste shall not be allowed to enter storm drains or watercourses.
- PCC and AC waste shall be collected and properly disposed of outside the highway right-of-way in conformance with Standard Specifications Section 107 or placed in a temporary concrete washout facility. See also BMP NS-3, "Paving and Grinding Operations," and

WM-8, "Liquid Waste Management."

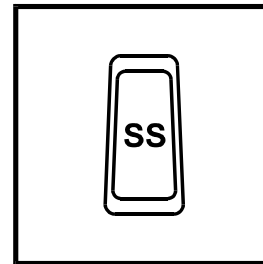
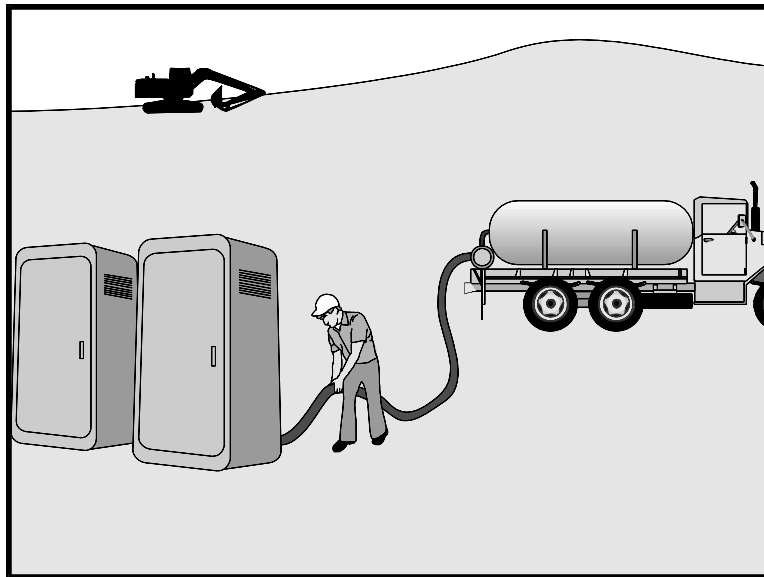
- Collect slurry residue and dispose in a temporary pit and allow slurry to dry.
- Temporary concrete washout facilities shall be located a minimum of 100 ft., where practical, from storm drain inlets, open drainage facilities, and watercourses, unless determined unfeasible by the Engineer. Each facility shall be located away from construction traffic or access areas to prevent disturbance or tracking.
- A sign shall be installed adjacent to each washout facility to inform concrete equipment operators to utilize the proper facilities. The sign shall be installed as shown on the plans and in conformance with the provisions in Standard Specifications Section 625, "Construction Signs".
- Temporary concrete washout facilities shall be constructed above grade or below grade at the option of the Contractor. Temporary concrete washout facilities shall be constructed and maintained in sufficient quantity and size to contain all liquid and concrete waste generated by washout operations.
- Temporary washout facilities shall have a temporary pit or bermed areas of sufficient volume to completely contain all liquid and waste concrete materials generated during washout procedures. The volume must also be designed to contain any runoff that drains to the facility and the rain falling directly into the facility during the 2-yr, 24-hr storm event.
- Wash concrete only from mixer truck chutes into approved designated concrete wash out facility.
- Concrete washout facilities shall not be used for disposal of excess concrete and trucks shall not be allowed to back turn and dispose of residual loads.
- Once concrete wastes are washed into the designated area and allowed to harden, the concrete shall be broken up, removed, and disposed of per BMP WM-5, "Construction Debris and Litter Management."
- Concrete washout facilities may need to be lined if the area is located near a stream or waterbody or in an area of shallow groundwater. Plastic lining material shall be a minimum of 10-mil polyethylene sheeting and shall be free of holes, tears or other defects that compromise the impermeability of the material
- The soil base shall be prepared free of rocks or other debris that may

cause tears or holes in the plastic lining material.

Maintenance and Inspection

- The Contractor's Water Pollution Control Manager (WPCM) shall monitor on site concrete waste storage and disposal procedures at least weekly.
- Temporary concrete washout facilities shall 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 shall include removing and disposing of hardened concrete and returning the facilities to a functional condition.
- When the washout is 75% full, it must be cleaned or a new washout must be constructed.

Adapted from Caltrans Construction Site BMPs



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose Procedures and practices to minimize or eliminate the discharge of construction site sanitary/septic waste materials to the storm drain system or to watercourses.

Appropriate Applications Sanitary/septic waste management practices are implemented on all construction sites that use temporary or portable sanitary/septic waste systems.

Limitations Not applicable.

Standards and Specifications

Education

- Educate employees, subcontractors, and suppliers on sanitary/septic waste storage and disposal procedures.
- Educate employees, subcontractors, and suppliers of potential dangers to humans and the environment from sanitary/septic wastes.
- Instruct employees, subcontractors, and suppliers in identification of sanitary/septic waste.
- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).
- Establish a continuing education program to indoctrinate new employees.

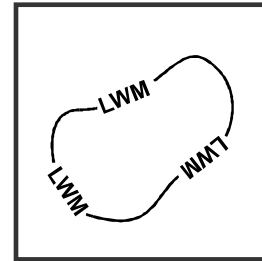
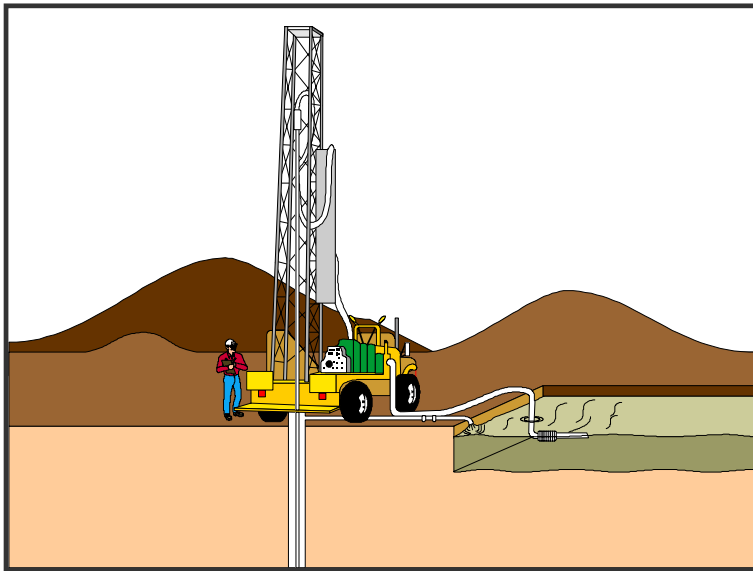
Storage and Disposal Procedures

- Temporary sanitary facilities shall be located as far away as practicable from drainage facilities given site conditions,

watercourses, and from traffic circulation. When subjected to high winds or risk of high winds, temporary sanitary facilities shall be secured to prevent overturning.

- Wastewater shall not be discharged or buried within the highway right-of-way.
- Sanitary and septic systems that discharge directly into sanitary sewer systems, where permissible, shall comply with the local health agency, city, county, and sewer district requirements.
- If using an on site disposal system, such as a septic system, comply with local health agency requirements.
- Properly connect temporary sanitary facilities that discharge to the sanitary sewer system to avoid illicit discharges.
- Ensure that sanitary/septic facilities are maintained in good working order by a licensed service.
- Use only reputable, licensed sanitary/septic waste haulers.
- The Contractor's Water Pollution Control Manager (WPCM) shall monitor on site sanitary/septic waste storage and disposal procedures at least weekly.

Maintenance and Inspection



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose 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 materials.

Appropriate Applications This BMP is applicable to construction projects that generate any of the following non-hazardous byproducts, residuals, or wastes, such as:

- Drilling slurries and drilling fluids
- Grease-free and oil-free wastewater and rinse water
- Dredgings
- Other non-storm water liquid discharges not permitted by separate permits.

- Limitations**
- Disposal of some liquids may be subject to specific laws and regulations, or to requirements of other permits secured for the construction project (e.g., National Pollutant Discharge Elimination System [NPDES] permits, Army Corps permits, etc.).
 - This fact sheet does not apply to dewatering operations (see BMP NS-2 Dewatering Operations”), solid waste management (see BMP WM-5, “Construction Debris and Litter Management”), hazardous wastes (see Standard Specifications Section 107), or concrete slurry residue (see BMP WM-06, “Concrete Waste Management”).
 - This fact sheet does not apply to non-stormwater discharges permitted by any NPDES permit held by NDOT. Typical permitted non-stormwater discharges can include: water line flushing; landscape irrigation; diverted stream flows; rising ground waters; 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.

Standards and Specifications

General Practices

- Follow all applicable federal, state and local regulations.
- The Contractor's Water Pollution Control Manager (WPCM) shall oversee and enforce proper liquid waste management procedures and practices.
- Instruct employees and subcontractors how to safely differentiate between non-hazardous liquids and potential or known hazardous liquids.
- Instruct employees, subcontractors, and suppliers that it is unacceptable for any sediment laden liquid to enter any storm drainage device, waterway, or receiving water without treatment.
- Educate employees and subcontractors on the proper handling procedures for all liquids generated during construction activities.
- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).
- Verify which non-stormwater discharges are permitted by the NDOT Statewide NPDES permit. Some listed discharges may require pre-treatment or treatment.
- Manage wash water and rinse water from vehicle and equipment cleaning operations (see BMP NS-8, "Vehicle and Equipment Cleaning").

Containing Liquid Wastes

- Drilling residue and drilling fluids shall not be allowed to enter storm drains and watercourses and shall be disposed of outside the highway right-of-way in conformance with the provisions in Standard Specifications Section 107.
- If an appropriate location is available, drilling residue and drilling fluids may be dried in a containment facility constructed in conformance with the provisions detailed in BMP WM-06, "Concrete Waste Management".
- Liquids generated as part of an operational procedure, such as water-laden dredged material and drilling mud shall be contained and not allowed to flow into drainage channels or receiving waters prior to treatment.

- Contain all liquids generated during construction 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.
- Take precautions to avoid spills or accidental releases of contained liquids. Apply the education measures and spill response procedures outlined in BMP WM-04, "Spill Prevention and Control".
- Do not locate containment areas or devices where accidental release of the contained liquid can threaten health or safety, or discharge to water bodies, channels, or storm drains.

Capturing Liquid Materials

- Capture all liquid materials running off of a surface, which have the potential to affect the storm drainage system.
- Do not allow liquid materials to flow or discharge uncontrolled. Use temporary dikes or berms to intercept flows and direct them to a containment area or device for capture.
- If the liquid is sediment laden, use a sediment trap (see BMP SC-03, "Sediment Trap") for capturing and treating the liquid stream, or capture in a containment device and allow sediment to settle.

Disposing of Liquid Materials

- Typical method is to dewater the contained liquid waste, using procedures such as described in BMP NS-02, "Dewatering Operations", and BMP SC-02, "Sediment/Desilting Basin"; and dispose of resulting solids per BMP WM-5, "Construction Debris and Litter Management", in conformance with Standard Specifications Section 107.
- Method of disposal for some liquids may be prescribed in Water Quality Reports, NPDES permits, Environmental Impact Reports, 404 permits, etc., and may be defined elsewhere in the Special Provisions.
- Some liquids, such as from dredged material, may require testing and/or review by the NDEP to determine whether it is hazardous before a disposal method can be determined.
- For disposal of hazardous waste, see Standard Specifications Section 107.
- If necessary, further treat non-hazardous liquid materials prior to

disposal. Treatment may include, though is not limited to, sedimentation, filtration, and chemical neutralization.

Maintenance and Inspection

- Spot check employees and subcontractors at least monthly throughout the job to ensure appropriate practices are being employed.
- 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 BMP WM-05, "Construction Debris and Litter Management".
- Inspect containment areas and capturing devices frequently for damage, and repair as needed.

Appendix A

Appendix A

Abbreviations, Acronyms, and Definition of Terms

Abbreviations

ac	acre
°C	Degrees Celsius
cfs	cubic feet per second
cy	cubic yards
°F	Degrees Fahrenheit
ft	feet
g	gram
gal	gallon
gpm	gallons per minute
ha	hectares
hr	hour
in	inches
kg	kilogram
kN	Kilo-Newton
kPa	Kilo-Pascal
l	liter
lbs	pound
lf	linear feet
m	meter
m ²	square meters
m ³	cubic meters
mm	millimeter
N	Newton
psi	pounds per square inch
s	second
yd	yard
y ²	square yards
y ³	cubic yards

Acronyms

AASHTO	American Society of State Highway and Transportation Officials
AC	Asphalt Concrete
ABS	Acrylonitrile Butadiene Styrene
APCD	Air Pollution Control District
AQMD	Air Quality Management District
ARB	Air Resources Board
ASCA	American Society of Certified Arborists
ASTM	American Society of Testing Materials
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
CCS	Cellular Confinement System
CMP	Corrugated Metal Pipe
CFR	Code of Federal Regulations
DSA	Disturbed Soil Area
ESA	Environmentally Sensitive Area
FEMA	Federal Emergency Management Agency
L:W	Length versus Width
MSDS	Material Safety Data Sheet
NDEP	Nevada Division of Environmental Protection
NPDES	National Pollutant Discharge Elimination System

OSHA	Occupation Safety and Health Association	USDA	United States Department of Agriculture
PCC	Portland Cement Concrete	USDOT	United States Department of Transportation
PPCBR	Portable Precast Concrete Barrier Rail	US EPA	United States Environmental Protection Agency
PVC	Polyvinyl Chloride	USFWS	United Fish and Wildlife Services
QPL	Qualified Product List	USLE	Universal Soil Loss Equation
RE	Resident Engineer	WOUS	Waters of the United States
ROW	Right of Way	WPCM	Water Pollution Control Manager
SSP	Standard Special Provisions	WPCP	Water Pollution Control Plan
SWPPP	Storm Water Pollution Prevention Plan	WQS	Water Quality Specialist (NDOT Environmental)
TRPA	Tahoe Regional Planning Agency		
V:H	Vertical versus Horizontal		
USACE	United States army Corps of Engineer		

Definition of Terms

Active Construction Area: Construction areas where soil-disturbing activities have already occurred and continue to occur or will occur during the ensuing 21 days. This may include areas where soils have been disturbed as well as areas where soil disturbance has not yet occurred.

Antecedent Moisture: Amount of moisture present in soil prior to the application of a soil stabilization product.

Best Management Practice (BMP): Any program, technology, process, siting criteria, operating method, measure, or device that controls, prevents, removes, or reduces pollution.

Construction Activity: Includes clearing, grading, or excavation and contractor activities that result in soil disturbance.

Construction Site: The area involved in a construction project as a whole.

Contamination: An impairment of the quality of the waters of the state by waste to a degree that creates a hazard to the public health through poisoning or through the spread of disease including any equivalent effect resulting from the disposal of waste, whether or not waters of the state are affected.

Contractor: Party responsible for carrying out the contract per plans and specifications. The Standard Specifications and Special Provisions contain storm water protection requirements the contractor must address.

Degradability: Method by which the chemical components of a soil stabilization product are degraded over time.

Discharge: Any release, spill, leak, pump, flow, escape, dumping, or disposal of any liquid, semi-solid or solid substance.

Disturbed Soil Areas (DSAs): Areas of exposed, erodible soil, including stockpiles, that are within the construction limits and that result from construction activities

Drying Time: Time it takes for a soil stabilization product to dry or cure for it to become erosion control effective.

Environmental Protection Agency (EPA): Agency that issued the regulations to control pollutants in storm water runoff discharges (The Clean Water Act and NPDES permit requirements).

Erosion: The wearing away of land surface primarily by wind or water. Erosion occurs naturally as a result of weather or runoff but can be intensified by clearing, grading, or excavation of the land surface.

Erosion Control Effectiveness: The ability of a particular product to reduce soil erosion relative to the amount of erosion measured for bare soil. Percentage of erosion that would be reduced as compared to an untreated or control condition.

Exempt Construction Activities: Activities exempt from the General Permit, including routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of the facility; and emergency construction activities required to protect public health and safety. Local permits may not exempt these activities.

Existing vegetation: Any vegetated area that has not already been cleared and grubbed.

Fair Weather Prediction: When there is no precipitation in the forecast between the current calendar day and the next working day. The National Weather Service NOAA Weather Radio forecast shall be used. The contractor may propose an alternative forecast for use if approved by the Resident Engineer.

Feasible: Economically achievable or cost-effective measures, which reflect a reasonable degree of pollutant reduction achievable through the application of available nonpoint pollution control practices, technologies, processes, site criteria, operating methods, or other alternatives.

General Permit: The General Permit for Storm Water Discharges Associated with Construction Activity (Stormwater General Permit NVR100000) issued by the Nevada Division of Environmental Protection.

Good Housekeeping: A common practice related to the storage, use, or cleanup of materials, performed in a manner that minimizes the discharge of pollutants.

Local permit: An NPDES storm water permit issued to a District by the NDEP having jurisdiction over the job site. Requirements of the local permit are generally similar to, but supersede the requirements of the General Permit.

Longevity: The time the soil erosion product maintains its erosion control effectiveness.

Mode of Application: Type of labor or equipment that is required to install the product or technique.

National Pollutant Discharge Elimination System (NPDES) Permit: A permit issued pursuant to the Clean Water Act that requires the discharge of pollutants to waters of the United States from storm water be controlled.

Native: Living or growing naturally in a particular region. Compatibility and competitiveness of selected plant materials with the environment.

Non-active Construction Area: Any area not considered to be an active construction area. Active construction areas become non-active construction areas whenever construction activities are expected to be discontinued for a period of 21 days or longer.

Non-Storm Water Discharge: Any discharge to a storm drain system or receiving water that is not composed entirely of storm water.

Pollution: The man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water. An alteration of the quality of the water of the state by waste to a degree, which unreasonably affects either the waters for beneficial uses or facilities that serve these beneficial uses.

Rainy Season: The dates of the rainy season shall be as specified: use dates in the local permit if a local permit is applicable to the project site and rainy season dates are specified therein; or, if the local permit does not specify rainy season dates and/or in areas of the state not subject to a local permit, the rainy season dates shall be determined using Figure 2-1.

Receiving Waters: All surface water bodies within the permit area.

Resident Engineer (RE): The NDOT representative charged with administration of construction contracts. The RE decides questions regarding acceptability of material furnished and work performed. The RE has "contractual authority" to direct the contractor and impose sanctions if the contractor fails to take prompt and appropriate action to correct deficiencies. The following contractual sanctions can be imposed by the RE: (a) withholding payments (or portions of payments), (b) suspending work, (c) bringing in a separate contractor to complete work items (the contractor is billed for such costs), (d) assessing liquidated damages including passing along fines for permit violations, (e) initiating cancellation of the construction contract.

Residual Impact: The impact that a particular practice might have on construction activities once they are resumed on the area that was temporarily stabilized.

Runoff Effect: The effect that a particular soil stabilization product has on the production of storm water runoff. Runoff from an area protected by a particular product may be compared to the amount of runoff measured for bare soil.

Sediment: Organic or inorganic material that is carried by or suspended in water and that settles out to form deposits in the storm drain system or receiving waters.

Storm Drain System: Streets, gutters, inlets, conduits, natural or artificial drains, channels and watercourses, or other facilities that are owned, operated, maintained and used for the purpose of collecting, storing, transporting, or disposing of storm water.

Storm Water: Rainfall runoff, snow melt runoff, and surface runoff and drainage. It excludes infiltration and runoff from agricultural land.

Storm Water Inspector: NDOT staff member who provides support to the Resident Engineer. Coordinates activities and correspondence related to SWPPP implementation.

Storm Water Pollution Prevention Plan (SWPPP): A plan required by the General Permit that includes site map(s), an identification of construction/contractor activities that could cause pollutants in the storm water, and a description of measures or practices to control these pollutants. It must be prepared and approved before construction begins. A SWPPP prepared in accordance with the special provisions and the Handbooks will satisfy Standard Specifications Section 637.01.02 - Water Pollution Control Plan, requirement for preparation of a program to control water pollution.

Temporary Construction Site BMPs: Construction Site BMPs that are required only temporarily to address a short-term storm water contamination threat. For example, silt fences are located near the base of newly graded slopes that have a substantial area of exposed soil. Then, during rainfall, the silt fences impound water, allowing sediment to settle out of runoff flowing off the slope.

Waters of the United States (WOUS): Jurisdictional bodies of water as defined in 40 CFR § 122.2. WOUS are navigable or non-navigable ephemeral (typically dry), intermittent, and perennial drainages and/or associated wetlands under the jurisdiction of the U.S. Environmental Protection Agency who granted regulatory authority to the U.S. Army Corps of Engineers. Environmental Services Division works with the appropriate regulatory agency to make a jurisdictional WOUS determination generally for permitting purposes.

Appendix B

Appendix B

SWPPP Template and Information

The following runoff coefficient values may be incorporated into the SWPPP development:

- An estimate of the construction site area in acres (refer to section 1.3);
- An estimate of the runoff coefficient of the construction site before and after construction (the form shown in Table B-1 may be used to develop the necessary information for runoff coefficients; Tables B-2 and B-3 provide supporting information for the calculation of runoff coefficients); and an estimate of the percentage of the area of the construction site that is impervious (e.g., pavement, building, etc.) before and after construction.

Table B-1
Computation Sheet for Determining Runoff Coefficients

Total Site Area _____	= _____ (A)
Existing Site Conditions	
Impervious Site Area ¹	= _____ (B)
Impervious Area Runoff Coefficient ^{2,4}	= _____ 0.95 _____ (C)
Pervious Site Area ³	= _____ (D)
Pervious Site Area Runoff Coefficient ⁴	= _____ (E)
Existing Runoff Coefficient = $\frac{(B \times C) + (D \times E)}{A}$	= _____ (F)
Proposed Site Conditions (After Construction)	
Impervious Site Area ¹	= _____ (G)
Impervious Site Runoff Coefficient ^{2,4}	= _____ (H)
Pervious Site Area ³	= _____ (I)
Pervious Site Runoff Coefficient ⁴	= _____ (J)
Proposed Runoff Coefficient = $\frac{(G \times H) + (I \times J)}{A}$	= _____ (K)

- (1) Includes paved areas, areas covered by buildings, and other impervious surfaces.
- (2) Use 0.95 unless lower or higher runoff coefficients can be verified.
- (3) Includes areas of vegetation, most unpaved or uncovered soil surfaces, and other pervious areas.
- (4) See Table B-2 and B-3 for runoff coefficients

Table B-2
Runoff Coefficients for Undeveloped Areas Watershed Types

	Extreme	High	Normal	Low										
Relief	0.28 - 0.35 Steep, rugged terrain with average slopes above 30%	0.20 - 0.28 Hilly, with average slopes of 10 to 30%	0.14 - 0.20 Rolling, with average slopes of 5 to 10%	0.08 - 0.14 Relatively flat land, with average slopes of 0 to 5%										
Soil Infiltration	0.12 – 0.16 No effective soil cover, either rock or thin soil mantle of negligible infiltration capacity	0.08 – 0.12 Slow to take up water, clay or shallow soils of low infiltration capacity, imperfectly or poorly drained	0.06 – 0.08 Normal; well drained light or medium textured soils, sandy loams, silt and silt loams	0.04 – 0.06 High; deep sand or other soil that takes up water readily, very light well drained soils										
Vegetal Cover	0.12 – 0.16 No effective plant cover, bare or very sparse cover	0.08 – 0.12 Poor to fair; clean cultivation crops, or poor natural cover, less than 20% of drainage area over good cover	0.06 – 0.08 Fair to good; about 50% of area in good grassland or woodland, not more than 50% of area in cultivated crops	0.04 – 0.06 Good to excellent; about 90% of drainage area in good grassland, woodland or equivalent cover										
Surface storage	0.10 – 0.12 Negligible surface depression few and shallow; drainage-ways steep and small, no marshes	0.08 – 0.10 Low; well defined system of small drainage ways; no ponds or marshes	0.06 – 0.08 Normal; considerable surface depression storage; lakes and pond marshes	0.04 – 0.06 High; surface storage, high; drainage system not sharply defined; large flood plain storage or large number of ponds or marshes										
Given: An undeveloped watershed consisting of: 1) Rolling terrain with average slopes of 5%, 2) Clay type soils, 3) Good grassland area, and 4) Normal surface depressions Find: The runoff Coefficient, C, for the above watershed Solution: <table><tr><td>Relief</td><td>0.14</td></tr><tr><td>Soil Infiltration</td><td>0.08</td></tr><tr><td>Vegetal Cover</td><td>0.04</td></tr><tr><td>Surface Storage</td><td><u>0.06</u></td></tr><tr><td>C=</td><td>0.32</td></tr></table>					Relief	0.14	Soil Infiltration	0.08	Vegetal Cover	0.04	Surface Storage	<u>0.06</u>	C=	0.32
Relief	0.14													
Soil Infiltration	0.08													
Vegetal Cover	0.04													
Surface Storage	<u>0.06</u>													
C=	0.32													

Table B-3
Runoff Coefficients for Developed Areas

Type of Drainage Area	Runoff Coefficient
Business:	
Downtown areas	0.70 – 0.95
Neighborhood areas	0.50 – 0.70
Residential:	
Single-family areas	0.30 – 0.50
Multi-units, detached	0.40 – 0.60
Multi-units attached	0.60 – 0.75
Suburban	0.25 – 0.40
Apartment dwelling areas	0.50 – 0.70
Industrial:	
Light areas	0.50 – 0.80
Heavy areas	0.60 – 0.90
Parks, cemeteries:	0.10 – 0.25
Playgrounds:	0.20 – 0.40
Railroad yard areas:	0.20 – 0.40
Unimproved areas:	0.10 – 0.30
Lawns:	
Sandy soil, flat, 2%	0.05 – 0.10
Sandy soil, average, 2-7%	0.10 – 0.15
Sandy soil, steep, 7%	0.15 – 0.20
Heavy soil, flat, 2%	0.13 – 0.17
Heavy soil, average, 2-7%	0.18 – 0.25
Heavy soil, steep, 7%	0.25 – 0.35
Streets:	
Asphaltic	0.70 – 0.95
Concrete	0.80 – 0.95
Brick	0.70 – 0.85
Drives and Walks	0.75 – 0.85
Roofs:	0.75 – 0.95

STORM WATER POLLUTION PREVENTION PLAN (SWPPP) FOR CONSTRUCTION ACTIVITIES

Name and Location of Project:

Operator: Name, Address, and Phone Number

Person Responsible for Implementing SWPPP:

Name, Address, and Phone Number

Notice of Intent Filing Date:

NOTE: A WORKING COPY OF THIS SWPPP MUST BE KEPT AT THE CONSTRUCTION SITE OR BE LOCALLY AVAILABLE FOR REVIEW BY NDEP and LOCAL REGULATORY AGENCIES

A COPY OF STORMWATER GENERAL PERMIT NVR100000 AND THE NOTICE OF INTENT FOR THIS PROJECT MUST BE ATTACHED TO THIS SWPPP

GUIDANCE FOR SELECTING AND IMPLEMENTING BMPs IS AVAILABLE IN THE TRUCKEE MEADOWS CONSTRUCTION SITE BMP HANDBOOK. ATTACH ADDITIONAL PAGES WHEN NECESSARY TO PROVIDE THE REQUIRED INFORMATION

Table of Contents

	Page #
I. Notice of Intent.....	___
II. Project Description	___
III. Existing Soil and Water Quality Data	___
IV. Site Maps.....	___
A. General Location Map	___
B. Detailed Site Map	___
C. Discharges Associated with Industrial Activity	___
V. Receiving Waters	___
VI. Erosion and Sediment Controls	___
A. Sequence of BMPs and Contractors.....	___
B. Temporary Stabilization Practices	___
C. Permanent Stabilization Practices	___
D. Structural Practices	___
VII. Stormwater Management.....	___
VIII. Other Controls	___
A. Material Storage, Spill Prevention and Response	___
B. Offsite Vehicle Tracking Controls.....	___
C. Construction Waste Storage and Disposal.....	___
D. Hazardous and Sanitary Waste Storage and Disposal	___
E. Offsite Discharges	___
F. Non-stormwater Discharges.....	___
IX. Inspection/Maintenance Procedures.....	___
A. Inspection and Maintenance of Stabilization and Structural Practices	___
B. Inspection and Maintenance of Other Controls	___
X. Certification of Compliance	___
A. Owner/Operator Certification Statement.....	___
B. Contractor's Certification Statement	___
XI. Record of Construction Activities	___

II. PROJECT DESCRIPTION

Description of the Proposed Construction Activity [§ I.B.1a.(6)]	
Intended Sequence of Major Soil Disturbing Activities [§ I.B.1a.(7)]	
1.	9.
2.	10.
3.	11.
4.	12.
5.	13.
6.	14.
7.	15.
8.	16.
Total Area of Site (acres) [§ I.B.1a.(8)]	Total Area to be Disturbed (acres)
Runoff Coefficients [§ I.B.1a.(9)]: Use the following worksheet for sites with only 1 or 2 land uses, such as an undeveloped site with a proposed parking lot. For sites with 3 or more land uses (pre and/or post-project) attach a separate worksheet.	
Describe Pre-Project Conditions and Land Use(s)	
Pre-Project Land Use 1	
_____ acres X _____ = _____ (C1)	
Pre-Project Land Use 2	
_____ acres X _____ = _____ (C2)	
Average Pre-Project Runoff Coefficient	
(C1 + C2) / Total area =	
Post-Project Land Use 1	
_____ acres X _____ = _____ (C3)	
Post-Project Land Use 2	
_____ acres X _____ = _____ (C4)	
Average Post-Project Runoff Coefficient	
(C3 + C4) / Total area =	

III. EXISTING SOIL AND WATER QUALITY DATA

Provide a description of the existing soil and/or water quality data of any discharges from the site [§ I.B.1a.(9)] Existing water for adjacent waterways that may receive discharges from the site is also recommended, if available.

IV. SITE MAPS

Attach A. a General Location Map and B. a Detailed Site Map [§ I.B.1a.(10)] . Note that site maps must be updated and revised as site conditions change and new BMPs are implemented.

The Detailed Site Map must indicate the following:

1. Existing and proposed topography and drainage patterns drawn to scale with north arrow.
2. Areas of soils that will be disturbed and areas that will not be disturbed.
3. Locations of structural and non-structural controls identified in SWPPP.
4. Locations where stabilization practices will be applied.
5. Locations where vehicles and equipment will be stored and maintained.
6. Locations where materials and wastes will be stored (including concrete washout areas).
7. Location(s) and aerial extent of nearby receiving waters (including wetlands).
8. Location(s) where stormwater discharges will enter receiving waters and/or the municipal stormdrain system.
9. Legend identifying all symbols, BMP numbers or abbreviations used.

C. Location and description of any discharge(s) associated with Industrial Activity other than construction, including any stormwater discharges from dedicated asphalt or concrete plants covered under General Permit NVR100000 [§ I.B.1a.(11)].

V. RECEIVING WATERS

Receiving Water(s): Identify the name and location of the streams, rivers, ditches, drainages, lakes or wetlands (both perennial and intermittent) that will receive runoff from the construction site. If the site will drain to the municipal storm drain system, identify the receiving water to which the system discharges [§ I.B.1a.(12)].

VI. EROSION AND SEDIMENT CONTROLS

A. Best Management Practices (BMPs) [§ I.B.1b]

Describe each control measure and the general sequence of implementation during the construction process. Clearly identify below the BMPs that will be used for each of the major activities identified in 3) above. Also indicate each Contractor that will be responsible for installing and maintaining each control measure.

Control measures must be properly selected, installed, and maintained in accordance with the manufactures specifications and good engineering practices. Controls must be inspected at least weekly and sediments must be removed from when the design capacity has been reduced to 50%. Construction materials, chemicals, wastes, litter and debris must be prevented from becoming a stormwater pollutant source. Offsite material storage areas used solely by the permitted project must also be addressed.

Control Measures

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.
- 11.
- 12.
- 13.
- 14.
- 15.
- 16.

Contractors

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.
- 11.
- 12.
- 13.
- 14.
- 15.
- 16.

B. Temporary Stabilization Practices [§ I.B.1b.(2)]

Describe the temporary stabilization BMPs (e.g. soil binders, revegetation and/or mulching) that will be provided on stockpiles and disturbed portions of the site where construction activity is expected to cease for 14 days or more and will not be resumed within 21 days.

C. Permanent Stabilization Practices [§ I.B.1b.(2)]

Describe the permanent stabilization BMPs (e.g. permanent revegetation and/or rolled erosion control products) that will be provided on disturbed portions of the site where construction activities have permanently ceased. Permanent stabilization measures must be applied no later than 14 days from the last construction activity in that area. Final stabilization with vegetation must achieve a uniform cover with a minimum density of 70% of what was on the site prior to commencement of construction activities. Permanent stabilization must be achieved prior to NDEP issuing a Notice of Termination.

D. Structural Practices [§ I.B.1b.(3)]

Provide a description of the temporary and permanent structural BMPs (e.g. temporary diversion dikes, silt fences, fiber rolls, check dams, sediment traps, storm drain inlet protection, etc.) that will be used during construction to divert or filter flows from exposed soils, reduce flow velocities or temporarily store flows and limit runoff from the exposed areas of the site. All sediment basins must be designed to the criteria outlined in the Truckee Meadows Construction Site BMP Handbook. From May to October, water must not be allowed to pond in any structural practice in excess of 7 days.

VII. STORMWATER MANAGEMENT

Stormwater Management Controls [§ I.B.1c.]

Provide a description of the measures installed during construction that will be used to control pollutants in stormwater discharges between the time construction has ceased and final site stabilization has been achieved. These stormwater management controls include but are not limited to sediment retention basins, infiltration trenches, vegetated swales and velocity dissipation measures, such as riprap aprons on culvert outfalls. Permittees are responsible for the installation and maintenance of these stormwater BMPs until an approved Notice of Termination is received by NDEP.

VIII. OTHER CONTROLS

A. Material Storage, Spill Prevention and Response [§ I.B.1d.(1)]

Provide a description of the construction materials and chemicals that are expected to be stored onsite, with updates as appropriate. Describe the BMPs that will be provided to ensure proper storage of these construction materials that will minimize their exposure to stormwater. Describe the response measures that will be provided if a spill occurs.

B. Offsite Vehicle Tracking Controls [§ I.B.1d.(2)]

Provide a description of the control measures that will be provided to prevent tracking or deposition of sediments offsite and the measures that will be used to remove any sediments that have been deposited on the paved roadways bordering the site.

C. Construction Waste Storage and Disposal [§ I.B.1d.(3)-(4)]

Describe the construction wastes that are expected to be generated onsite. Construction waste include concrete washout, excess building materials, chemicals, litter and debris. Describe the BMPs that will be used to temporarily store these wastes, how they will be collected and disposed, and the response measures that will be provided if a spill occurs.

D. Hazardous and Sanitary Waste Storage and Disposal [§ I.B.1d.(3)-(4)]

Provide a description of hazardous and sanitary or septic wastes that are expected to be generated onsite. Describe how these wastes will be temporarily stored, collected and the response measures that will be provided in the event of a spill. Describe the measures that will be used to ensure no contact with stormwater.

E. Offsite Discharges [§ I.B.1d.(5)]

Provide a description of potential offsite pollutant sources from dedicated sites such as asphalt or concrete plants and describe the BMPs that will be provided to minimize stormwater pollution.

F. Non-Stormwater Discharges [§ I.B.1h]

Provide a description of the activities that may produce non-stormwater discharges, such as water line flushings and dewatering from excavation. Describe the BMPs that will be used to minimize stormwater pollution.

IX. INSPECTION/MAINTENANCE PROCEDURES

The contractor or his qualified agent is required to inspect all disturbed areas, areas used for storage of materials and equipment that are exposed to precipitation, including vehicle entrance and exit locations and all erosion and sediment control BMPs. Inspections shall occur weekly, prior to forecasted rain events, and within 24 hours after any actual rain event. The following sources may be used to obtain weather forecasts:

- The National Weather Service: Telephone: (775) 673-8100
Website: <http://www.wrh.noaa.gov/Reno/>
- The Western Regional Climate Center
Website: <http://www.wrcc.dri.edu/CURRENTOBS.html>
- The Weather Channel
Website: <http://www.weather.com/weather/detail/USNV0076>

Once storms are imminent, a portable NOAA weather radio can also provide useful information. NOAA weather radio broadcasts are made on one of seven high-band FM frequencies. These frequencies are typically only on radios that provide a “weather band” as an added feature or portable weather radios that exclusively provide weather broadcasts. The local FM frequency for the Reno/Sparks area is 162.500 MHz. Taped weather messages are repeated every four to six minutes and are routinely revised at least once every one to three hours, 24 hours daily.

A. Inspection and Maintenance of Stabilization and Structural Practices
[§ I.B.1d.(f)-(g)]

Provide a description of the practices that will be used to inspect and maintain all Temporary and Permanent Stabilization Practices described in boxes 18) and 19) and all Structural Practices described in box 20).

B. Inspection and Maintenance of Other Controls [§ I.B.1d.(f)-(g)]

Provide a description of the practices that will be used to inspect and maintain all Other Controls described in Sections VIII. A. through F.

X. CERTIFICATIONS OF COMPLIANCE

A. This SWPPP must be certified that it is consistent with all applicable Federal, State and Local regulations, or other approved site plans or permits. It is to be prepared in accordance with the Truckee Meadows Construction Site Best Management Practices Handbook. This SWPPP must be updated as necessary to remain consistent with changes in other site plans that effect soil disturbing activities, site drainage patterns or any other activity that may impact stormwater runoff quality. It must also be re-certified annually by July 1 until the construction project is complete and a Notice of Termination has been submitted to NDEP.

OWNER/OPERATOR CERTIFICATION STATEMENT

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations [§ II.B.1d.].

Initial Certification:

Print Name

Title

Signature

Date

Annual Re-Certification:

Print Name

Title

Signature

Date

B. All contractors and subcontractors responsible for implementing pollution control measures must be identified in this SWPPP with the measures for which they are responsible. They must also sign the following certification statement that indicates they understand the requirements of the States General Permit for Construction Activities (Attach Copy of Permit).

CONTRACTOR'S CERTIFICATION STATEMENT

I certify under penalty of law that I understand the terms and conditions of the State's General Permit (NVR100000) that authorizes stormwater discharges associated with industrial activity from the construction site identified as part of this certification.

Company 1

Address

City

State

Phone No.

Print Name

Title

Signature

Date

Responsibilities

Company 1

Address

City

State

Phone No.

Print Name

Title

Signature

Date

Responsibilities

Company 3

Address

City

State

Phone No.

Print Name

Title

Signature

Date

Responsibilities

XI. RECORD OF CONSTRUCTION ACTIVITIES

Dates of Major Construction Activities and BMPs

Provide the dates of when major grading activities occur, the dates when construction activities on a portion of a site temporarily or permanently cease, and list the dates when temporary and permanent stabilization practices are implemented. Photo documentation of major construction activities and implementation of BMPs is strongly recommended.