Appendix C.6

Best Management Practices for Construction Activities

In accordance with Section F.2 of San Diego Regional Water Quality Control Board (RWQCB) Order 2001-01 (Permit), the City of La Mesa has developed an inventory of BMPs that will be implemented during construction activities. The following BMPs were obtained from the Caltrans Storm Water Quality Handbooks Construction Site BMP Manual (November 2000). Some of the selected Caltrans BMPs have been altered and are noted with an asterisk.

C.6.1 Soil Stabilization and Erosion Prevention

a. Planning and Scheduling (SS-1)*

b. Physical Stabilization
   - Preservation of Existing Vegetation (SS-2)*
   - Hydraulic Mulch (SS-3)*
   - Hydroseeding (SS-4)*
   - Soil Binders (SS-5)*
   - Straw Mulch (SS-6)*
   - Geotextiles, Plastic Covers, and Erosion Control Blankets/Mats (SS-7)*
   - Wood Mulching (SS-8)*
   - Earth Dikes/Drainage Swales and Lined Ditches (SS-9)*

c. Site Drainage
   - Outlet Protection/Velocity Dissipation (SS-10)*
   - Slope Drains (SS-11)*

C.6.2 Sediment Containment

a. Perimeter Protection
   - Silt Fencing (SC-1)*
   - Gravel Bag Berm (SC-6)*
   - Fiber Rolls (SC-5)*

b. Sediment Capture
   - Storm Drain Inlet Protection (SC-10)*
   - Sediment Trap (SC-3)*
   - De-silting Basins (SC-2)*
   - Gravelbag Barrier (SC-8)*

c. Sediment Tracking
    - Stabilize Construction Entrances and Exits (TC-1)*
    - Construction Road Stabilization (TC-2)
    - Entrance/ Outlet Tire Wash (TC-3)*
    - Street Sweeping (SC-7)*

C.6.3 Materials and Equipment Management

a. Materials Management
    - Material Delivery and Storage (WM-1)
    - Material Use (WM-2)
    - Stockpile Management (WM-3)*
    - Spill Prevention and Control (WM-4)

b. Waste Management
    - Solid (WM-5)*
    - Liquid (WM-10)*
    - Sanitary (WM-9)
    - Concrete (WM-8)*
    - Hazardous (WM-6)*
    - Contaminated Soil (WM-7)*

C.6.4 Non-Storm Water Discharge and Drainage Control

a. General
    - Paving and Grinding Operations (NS-3)*

b. Non-storm water discharges
    - Water Conservation Practices (NS-1)*
    - Dewatering Operations (NS-2)*
    - Potable Water/Irrigation and Flushing (NS-7)

c. Vehicle and Equipment Operations
    - Vehicle and Equipment Cleaning (NS-8)*
    - Vehicle and Equipment Fueling (NS-9)
    - Vehicle and Equipment Maintenance (NS-10)*

In addition to the information provided within this section, more specific BMP information can be obtained from the Caltrans Storm Water Quality Handbooks (November 2000) and the California Storm Water Best Management Practice Handbook for Construction Activities (March 1993). Table C.6-1 may also be used as a guidance for selecting specific BMPs for construction activities.

Seasonal Site Management Requirements

In addition to minimum BMPs, construction projects will also have to comply with the following seasonal requirements as stated in the Grading Ordinance:

Dry Season (May 1 through September 30)

- All exposed disturbed areas must have erosion prevention controls properly installed including building pads, unfinished roads and slopes. Slopes greater than 33.3% or 1:3 (vertical vs. horizontal) may use properly designed and installed de-silting basins at all discharge points in lieu of this requirement.
- Adequate perimeter protection BMPs must be installed and maintained.
- Adequate sediment control BMPs must be installed and maintained.
- Adequate BMPs designed to control off-site sediment tracking must be installed and maintained.
- At a minimum, 125% of the materials needed to install standby BMPs necessary to completely protect exposed portions of the site from erosion and prevent sediment discharges must be stored on the site.
- An approved "weather triggered" response plan is mandated for implementation in the event that a predicted storm event has a 50% chance of rain. The proponent must have the capacity to deploy the standby BMPs within 48 hours of the predicted storm event.
- All slopes must be equipped with erosion prevention BMPs as soon as slopes are completed for any portion of the site.
- Cleared or graded areas left exposed at any given time are limited to the amount of acreage that the project proponent can adequately protect prior to a predicted storm event.

Wet Season (October 1 through April 30)

In addition to the Dry Season Requirements:

- Perimeter protection and sediment control BMPs must be upgraded if necessary to provide sufficient protection for storms.
- Adequate erosion prevention BMPs must be installed and established for all completed slopes prior to October 1 and maintained throughout the wet season. If a BMP fails, it must be repaired, improved, or replaced with an acceptable alternate as soon as it is safe to do so.
- The amount of exposed soil allowed at one time shall not exceed standby erosion and sediment control BMP capacity.
- An incomplete disturbed area that is not being actively graded must be fully protected from erosion if left for 10 days or more.

All standard requirements presented in this BMP section must adhere to City Grading Ordinance requirements.

DEFINITIONS AND CONVERSIONS

Definitions

Certain Caltrans BMP descriptions included in this section use terms that may be vague or unfamiliar to the reader. Specific terms have been selected and are defined below.

Resident Engineer (RE):
Resident Engineer refers to the City Engineer or his duly authorized representation.

Contractor:
Contractor refers to the owner or developer of a construction site.

Gravel:
All references to gravel, including gravel bags, shall be interpreted as ¾-inch diameter washed gravel.

Conversions

Conversion Factors	
25.4 Millimeter	One Inch
One Meter	3.28 Feet
One Hectar	2.471 Acres
One Cubic Meter/Second	35.31 CFS

Millimeters	Inches
100	3.94
200	7.87
300	11.81
400	15.75
500	19.69
600	23.62
700	27.56
800	31.50
900	35.43
1000	39.37

Cubic Meter/second	Cubic feet/Second
1	35.31
2	70.62
3	105.93
4	141.24
5	176.55
6	211.86
7	247.17
8	282.48
9	317.79
10	353.1
20	706.2
30	1059.3
40	1412.4
50	1765.5
100	3531

Table C.6-1 (Page 1 of 2)

Storm Water Best Management Practices (BMP)	Must Be Shown on Plans	BMP Identification Number		Category of Activity																												
				Daily Activity	Site Preparation and Earthmoving			Construction or Relocation of Below Ground Structures and/or Utilities						Construction of Above Ground Structures				Roadways, Walkways, and Parking Lots			Earthwork			Waterways					Planting and Landscaping				
SELECTION GUIDE		CALTRANS Stormwater Quality Handbooks	California Stormwater BMP Handbook (Construction)	Daily Activities	Cleaning and Grubbing	Demolition of Pavement/Structures	Constructing Access Roads	Foundations	Saw Cutting	Trenching	Conduits (Open Cuts)	Drilling	Tunnels	Wood Frame	Structural Steel	Maonry and Concrete	Roofing and Coating	Concrete	Asphalt	Base and Subgrade	Grading	Stockpiling	Material Mining (Sand & Aggregate)	Channel Improvement	Water and Sediment Impoundment	Over Crossing	Under Crossing	Waterfront Construction	Irrigation Facilities	Seeding and Sodding	Mulching	Planting	Habitat Restoration
GENERAL SITE MANAGEMENT																																
Employee & Subcontractor Training			CA40	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Materials Management																																
Material Delivery / Storage	*	WM-1	CA10					x			x		x	x	x	x	x	x	x	x				x		x	x	x		x	x	x	x
Material Use		WM-2	CA11					x			x		x	x	x	x	x	x	x	x				x		x	x	x		x	x	x	x
Spill Prevention and Control		WM-4	CA12													x	x		x														
Waste Management																																
Solid Waste Mgmt	*	WM-5	CA20	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Sanitary / Septic Waste Mgmt	*	WM-9	CA24	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Concrete Waste Mgmt	*		CA23					x	x	x			x			x		x						x	x	x	x		x			
Hazardous Waste Mgmt	*		CA21													x	x	x	x													
Contaminated Soil Mgmt	*	WM-7	CA22		x	x	x	x		x	x	x	x								x	x	x	x	x							
Offsite Sediment Tracking Control																																
Entrance/Exit Inspection, Cleaning				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Stabilized Construction Entrance	*	TC-1	ESC24	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Construction Road Stabilization	*	TC-2	ESC23	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Entrance/Exit Tire Wash	*	TC-3		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Vehicle & Equipment Management																																
Vehicle & Equipment Cleaning	*	NS-8	CA30	x	x	x	x	x	x	x	x	x	x					x	x	x	x	x	x	x				x					
Vehicle & Equipment Fueling	*	NS-9	CA31	x	x	x	x	x	x	x	x	x	x					x	x	x	x	x	x	x				x					
Vehicle & Equipment Maintenance	*	NS-10	CA32	x	x	x	x	x	x	x	x	x	x					x	x	x	x	x	x	x				x					
Construction Practices																																
Water Conservation		NS-1		x	x	x	x	x	x	x	x	x	x					x		x	x		x						x	x	x	x	x
Structure Construction & Painting		WM-6	CA03					x					x	x	x	x	x									x	x	x					
Paving Operations		NS-3	CA02															x	x	x				x		x	x						
Dewatering Operations		NS-2	CA01					x		x	x	x	x											x	x	x	x	x					
EROSION CONTROL																																
Site Planning Considerations																																
Scheduling		SS-1	ESC01	x	x	x	x		x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Table C.6-1 (Page 2 of 2)

Stormwater Best Management Practices (BMP)	Must Be Shown on Plans	BMP Identification Number		Category of Activity																												
				Daily Activity	Site Preparation and Earthmoving			Construction or Relocation of Below Ground Structures and/or Utilities						Construction of Above Ground Structures				Roadways, Walkways, and Parking Lots			Earthwork			Waterways					Planting and Landscaping				
SELECTION GUIDE		CALTRANS Stormwater Quality Handbooks	California Stormwater BMP Handbook (Construction)	Daily Activities	Cleaning and Grubbing	Demolition of Pavement/Structures	Constructing Access Roads	Foundations	Saw Cutting	Trenching	Conduits (Open Cuts)	Drilling	Tunnels	Wood Frame	Structural Steel	Maonry and Concrete	Roofing and Coating	Concrete	Asphalt	Base and Subgrade	Grading	Stockpiling	Material Mining (Sand & Aggregate)	Channel Improvement	Water and Sediment Impoundment	Over Crossing	Under Crossing	Waterfront Construction	Irrigation Facilities	Seeding and Sodding	Mulching	Planting	Habitat Restoration
Preservation of Exist Vegetation		SS-2	ESC02		x	x	x			x	x	x	x					x	x	x	x	x	x	x	x	x	x	x	x		x		
Vegetation Stabilization																																	
Temp Seeding and Planting		SS-4	ESC10		x		x														x	x	x	x	x	x	x	x					
Temp Mulching		SS-3,6,8	ESC11		x		x														x	x	x	x	x	x	x	x					
Hydroseeding					x		x														x	x	x	x	x	x	x	x					
Vegetation Buffer Strips		NA			x		x														x	x	x	x	x	x	x	x					
Physical Stabilization																																	
Dust Control			ESC21	x	x	x	x	x	x	x	x	x						x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Geotextiles, Mats, and Fiber Rolls		SS-7	ESC20		x		x														x	x	x	x	x	x	x	x					
Soil Stabilizers		SS-5			x		x														x	x	x	x	x	x	x	x					
Temp Stream Crossing		NS-4	ESC22		x	x	x	x		x	x	x	x	x	x					x	x	x	x	x	x	x	x		x	x	x	x	x
Diversion of Runoff																																	
Earth Dikes		SS-9	ESC30		x	x	x		x	x	x										x	x	x	x	x		x	x		x	x		
Ditches and Berms		SS-9			x	x	x		x	x	x										x	x	x	x	x		x	x					
Temp Drains and Swales		SS-9	ESC31		x	x	x			x	x										x	x	x	x	x		x	x					
Slope Drains		SS-11	ESC32		x	x	x		x	x											x	x	x	x	x		x	x					
Velocity Reduction																																	
Outlet Protection		SS-10	ESC40		x	x	x		x	x											x	x	x	x	x		x	x					
Check Dams		SC-4	ESC41		x	x	x		x	x											x	x	x	x	x			x					
Flared Culvert End Sections		SS-10			x	x	x		x	x											x	x	x	x	x			x					
Slope Roughering & Terracing		NA	ESC42		x	x	x		x	x											x	x	x	x	x			x					
SEDIMENT CONTROL																																	
Silt Fence		SC-1	ESC50		x	x	x	x			x	x									x	x	x	x	x		x	x					
Straw Bale Barrier		SC-9	ESC51		x	x	x	x			x	x									x	x	x	x	x		x	x					
Sand Bag Barrier		SC-8	ESC52		x	x	x	x		x	x	x									x	x	x	x	x		x	x					
Brush or Rock Filter		NA	ESC53		x	x	x	x			x	x									x	x	x	x	x		x	x					
Storm Drain Inlet Protection		SC-10	ESC54		x	x	x	x		x	x	x									x	x	x	x	x		x	x					
Sediment Trap		SC-3	ESC55		x	x	x	x		x	x	x									x	x	x	x	x		x	x					
Sediment Basin		SC-2	ESC56		x	x	x	x			x	x									x	x	x	x	x		x	x					

Appendix C.6.1

Soil Stabilization and Erosion Prevention

Planning and Scheduling (SS-1)*

Physical Stabilization

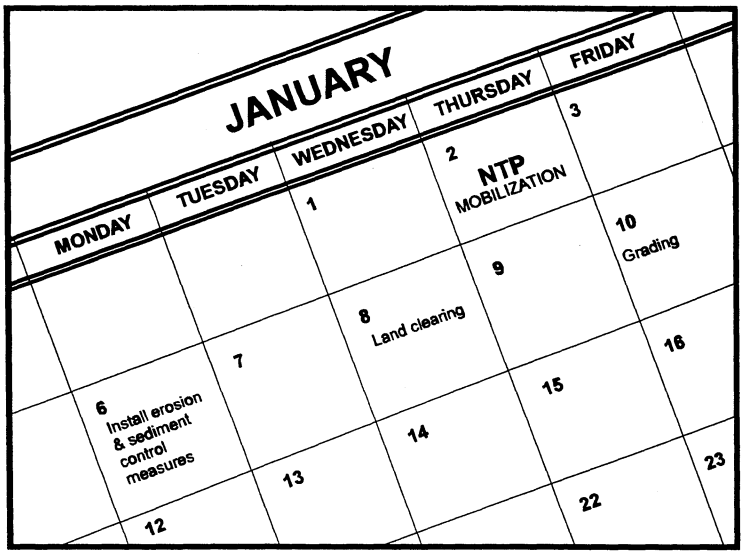
- Preservation of Existing Vegetation (SS-2)*
- Hydraulic Mulch (SS-3)*
- Hydroseeding (SS-4)*
- Soil Binders (SS-5)
- Straw Mulch (SS-6)*
- Geotextiles, Plastic Covers, and Erosion Control Blankets/Mats (SS-7)*
- Wood Mulching (SS-8)*
- Earth Dikes/Drainage Swales and Lined Ditches (SS-9)*

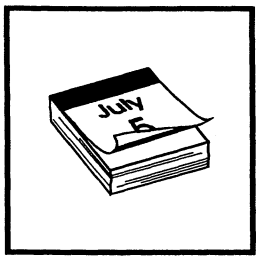
Site Drainage

- Outlet Protection/Velocity Dissipation (SS-10)*
- Slope Drains (SS-11)*

Scheduling

SS-1





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 season.

Limitations

None identified.

Standards and Specifications

- Plan the project and develop a schedule or to layout the construction plan. 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 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.

- Stabilize non-active areas as soon as practical.

- 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.

- Incorporate staged seeding and re-vegetation of graded slopes with the City approved mix as work progresses.

- 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.

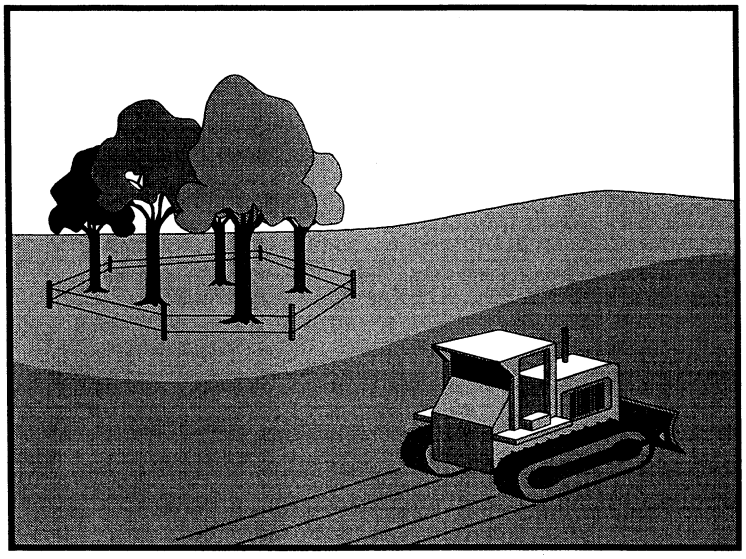
* Altered by D-MAX Engineering, Inc.

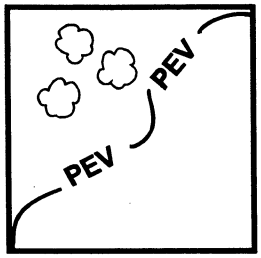
Maintenance and Inspection

- Verify that work is progressing in accordance with the schedule. If progress deviates, take corrective actions.
- Amend the schedule when changes are warranted or when directed by the Resident Engineer (RE).
- The Special Provisions require annual submittal of rainy season implementation schedule. Amend the schedule prior to the rainy season to show updated information on the deployment and implementation of construction site BMPs.

Preservation of Existing Vegetation

SS-2





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.
- On a year-round basis, temporary fencing shall be provided prior to clearing and grubbing operations or other soil-disturbing activities in areas where no construction activity is planned or will occur at a later date.
- No grading or disturbances shall occur in areas identified on the plans to be preserved, especially on areas designated as Environmentally Sensitive Areas (ESAs).

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.

Design and Layout

- Mark areas to be preserved with temporary fencing made of orange polypropylene that is stabilized against ultraviolet light. The temporary fencing shall be at least one meter wide and shall have openings not larger than 50mm by 50mm.
- Fence posts shall be either wood or metal, at the Contractor's discretion, as appropriate for the intended purpose. The post spacing and depth shall be adequate to completely support the fence in an upright position.
- 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.

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.
- 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. Removed trees shall not be felled, pushed, or pulled into any retained trees. Fires shall not be permitted within 30 m (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 15 m (50 ft) of the drip line of any retained trees, nor disposed of in any way which would injure vegetation.

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 450 mm (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 cut off smoothly.
- 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.
- Remove any trees intended for retention if those trees are damaged seriously enough to affect their survival. If replacement is desired or required, the new tree shall be of similar species, and of at least 50 mm (2 in) caliper, unless otherwise required by the contract documents.
- 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:

- Serious tree injuries shall be attended to by an arborist.
- Any damage to the crown, trunk, or root system of a retained tree shall be repaired immediately.
- Damaged roots shall be immediately cut clean.
- 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.
- Soil which has been compacted over a tree's root zone shall be aerated by punching holes 300 mm (12 in) deep with an iron bar, and moving the bar back and forth until the soil is loosened. Holes shall be placed 450 mm (18 in) apart throughout the area of compacted soil under the tree crown.
- Stressed or damaged broadleaf trees shall be fertilized to aid recovery.
- Trees shall be fertilized in the late fall or early spring.
- Fertilizer shall be applied to the soil over the feeder roots and in accordance with label instructions, but never closer than 1 m (3 ft) to the trunk. The

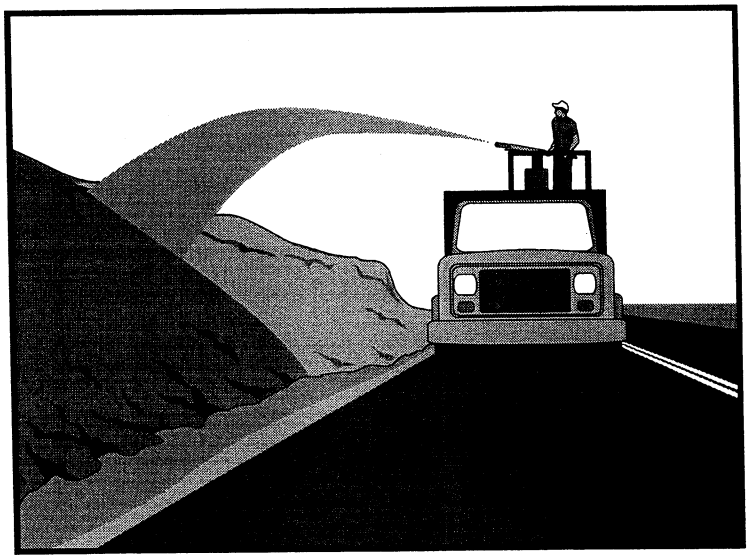
fertilized area shall be increased by one-fourth of the crown area for conifers that have extended root systems.

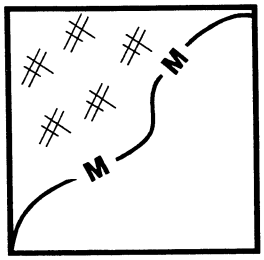
- During construction, the City Planner shall be contacted to ensure that ESAs are protected.

* Altered by D-MAX Engineering, Inc.

Hydraulic Mulch

SS-3





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 shredded wood fiber or a hydraulic matrix, and a stabilizing emulsion or tackifier with hydro-mulching equipment. This will protect 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.
- Avoid use in areas where the mulch would be incompatible with immediate earthwork activities and would have to be removed.

Limitations

- 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.
- Hydraulic matrices need 24 hours to dry before rainfall occurs to be effective.

Standards and Specifications

- 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.
- Avoid mulch over-spray onto the traveled way, sidewalks, lined drainage channels, and existing vegetation.
- Selection of hydraulic mulches by the Contractor must be approved by the Resident Engineer (RE).

Hydraulic Mulches

- Hydraulic Mulch is an erosion control system of long strand virgin wood fibers, produced by the thermo-mechanical defibration of clean whole wood chips, and bound together by pre-blended, high-strength, non-toxic adhesive binder to form a bonded fiber matrix that adheres to the soil surface. The erosion control system is hydraulically applied to the soil as a viscous mixture to provide 100% soil coverage. The resulting matrix is insoluble and non-dispersible upon drying, and retains its form if rewetted. The product meets or exceeds California Department of Transportation (Caltrans) specifications for Erosion Control (Type BFM).

- The hydraulic mulch's bonded fiber matrix is manufactured to the following minimum specifications.

Characteristic Properties

• Composition (by weight):	90% virgin wood fiber, 9% adhesive binder, no recycled materials
• Fiber Color:	Natural with biodegradable color agent (green)
• Moisture Content:	12%(±3%)
• Package Weight:	50 pounds

Performance Properties

- Application Rate: 4,000 pounds/acre.
- Does not dissolve or disperse when rewetted.
- Forms no water insensitive crust.
- Contains no germination or growth inhibiting factors.
- Bonded fiber matrix is 100% biodegradable and non-toxic to fish and wildlife

Maintenance and Inspections

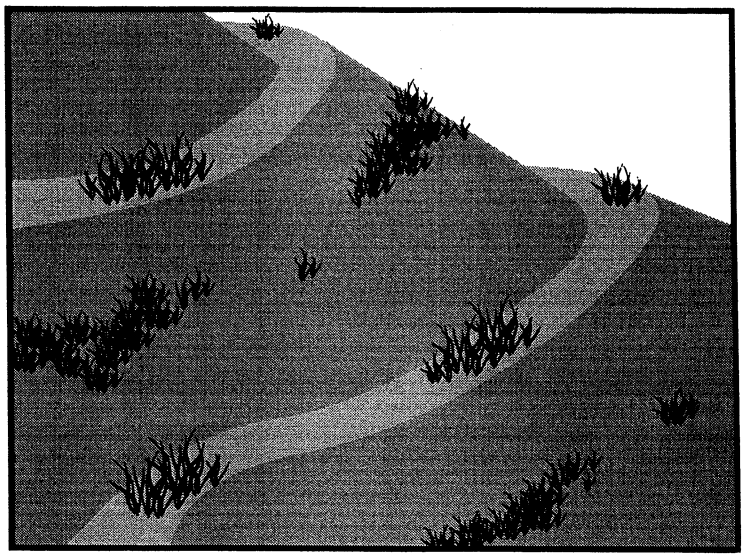
- Maintain an unbroken, temporary mulched ground cover throughout the period of construction the soils are not being reworked. Inspect before expected rain storms and repair any damaged ground cover and re-mulch exposed areas of bare soil.

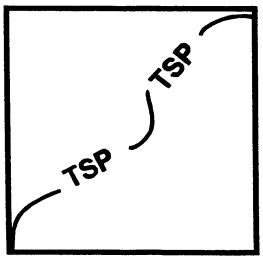
- After any rainfall event, the Contractor is responsible for maintaining all slopes to prevent erosion.

* Altered by D-MAX Engineering, Inc.

Hydroseeding *

SS-4





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 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.

Appropriate Applications

- Temporary Irregated hydroseeding is applied on disturbed areas requiring protection until permanent vegetation is established, or disturbed areas that must be re-disturbed following an extended period of inactivity. However, hydroseeding alone is not an acceptable method.

Limitations

- Rice Straw mulching may be necessary in addition to hydroseeding during the establishment of vegetation because temporary vegetation takes several weeks to establish.
- Steep slopes are difficult to protect with temporary seeding.
- Temporary vegetation may have to be removed before permanent vegetation is applied.
- Temporary vegetation is not appropriate for short-term inactivity.

Standards and Specifications

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

- Soil conditions
- Site topography
- Maintenance requirements
- Sensitive adjacent areas

* Altered by D-MAX Engineering, Inc.

- Season and climate
- Water availability
- Vegetation types
- Plans for permanent vegetation

• • The Resident Engineer (RE) shall approve hydroseeding selection.

The following steps shall be followed for implementation:

• • Avoid use of hydroseeding in areas where the best management practice (BMP) would be incompatible with future earthwork activities and would have to be removed.

• • Seed mix shall comply with the City's guide to landscape requirements.

• • Apply an approved mulch to keep seeds in place and to moderate soil moisture and temperature until the seeds germinate and grow.

• • All seeds shall be in conformance with the California State Seed Law of the Department of Agriculture. 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. 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-lb inoculant per 100-lb seed).

• • Commercial fertilizer shall conform to the requirements of the California 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.

• • Avoid over-spray onto the travel way, sidewalks, lined drainage channels and existing vegetation.

Maintenance and Inspection

• • 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 revegetated as required by the Resident Engineer (RE).

• • After any rainfall event, the Contractor is responsible for maintaining all slopes to prevent erosion.

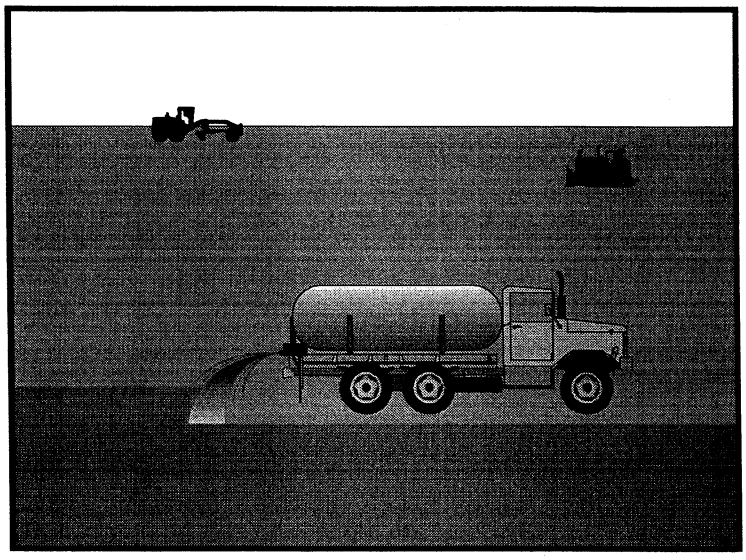
* Altered by D-MAX Engineering, Inc.

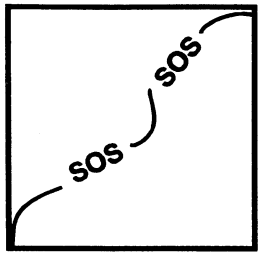
Maintenance and Inspection

- 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 revegetated as required by the Resident Engineer (RE).
- After any rainfall event, the Contractor is responsible for maintaining all slopes to prevent erosion.

Soil Binders

SS-5





BMP Objectives

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

Definition and Purpose

Soil binders consist of applying and maintaining polymeric or lignin sulfonate soil stabilizers or emulsions. Soil binders are materials applied to the soil surface to temporarily prevent water-induced erosion of exposed soils on construction sites. Soil binders typically also provide dust, wind and soil stabilization (erosion control) benefits. This is one of five temporary soil stabilization alternatives to consider.

Appropriate Applications

Soil binders are applied to disturbed areas requiring short-term temporary protection. Because soil binders can often be incorporated into the work, they may be a good choice for areas where grading activities will soon resume.

Limitations

- Soil binders are temporary in nature and may need reapplication.
- Soil binders require a minimum curing time until fully effective, as prescribed by the manufacturer, which may be 24 hours or longer.
- Soil binders will generally experience spot failures during heavy rainfall events. If runoff penetrates the soil at the top of a slope treated with a soil binder, it is likely that the runoff will undercut the stabilized soil layer and discharge at a point further down slope.
- Soil binders do not hold up to pedestrian or vehicular traffic across treated areas.
- Soil binders may not penetrate soil surfaces made up primarily of silt and clay, particularly when compacted.
- Some soil binders may not perform well with low relative humidity. Under rainy conditions, some agents may become slippery or leach out of the soil.

- May not cure if low temperatures occur within 24 hours of application.

Standards and Specifications

General Considerations

- Regional soil types will dictate appropriate soil binders to be used.
- A soil binder must be environmentally benign (non-toxic to plant and animal life), easy to apply, easy to maintain, economical, and shall not stain paved or painted surfaces.
- Some soil binders are compatible with existing vegetation.
- Performance of soil binders 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 Binder

Properties of common soil binders used for erosion control are provided on Table 1. Use Table 1 to select an appropriate soil binder.

Factors to consider when selecting a soil binder include the following:

- Suitability to situation - Consider where the soil binder will be applied; if it needs a high resistance to leaching or abrasion, and whether it needs to be compatible with any existing vegetation. Determine the length of time soil stabilization will be needed, and if the soil binder will be placed in an area where it will degrade rapidly. In general, slope steepness is not a discriminating factor for the listed soil binders. The soil binders in Table 1 may also be used for dust control using the provided dust control application rates. The dust control application rates will not be adequate to provide protection from water-induced erosion.
- Soil types and surface materials - Fines and moisture content are key properties of surface materials. Consider a soil binder's ability to penetrate, likelihood of leaching, and ability to form a surface crust on the surface materials.
- Frequency of application - The frequency of application can be affected by subgrade conditions, surface type, traffic volumes, climate, and maintenance schedule. Frequent applications could lead to high costs. Application frequency may be minimized if the soil binder has good penetration, low evaporation, and good longevity. Consider also that frequent application will require frequent equipment clean-up.

After considering the above factors, the soil binders in Table 1 will be generally appropriate as follows:

Copolymer: Appropriate for long term soil stabilization in areas where cross-traffic might occur, or where stabilization needs to be achieved in conjunction with preserving existing vegetation. Longevity can be up to 2 years, it has a high resistance to abrasion, and is compatible with existing vegetation. However, it is also relatively costly which makes it less desirable for short-term or frequent applications.

Lignin sulfonate: Appropriate for short- or medium-term soil stabilization applications in low traffic areas. The moderate relative cost makes it less desirable to reapply frequently, though it typically lasts longer than psyllium or guar. With only moderate penetration and a low resistance to abrasion, it would be more suited to areas which will not be disturbed frequently by construction activities.

Psyllium/Guar: Appropriate for typical soil stabilizing situations or short-term applications. Because of the relatively low cost, they can be applied more frequently. Their high penetration provides good stabilization but their moderate resistance to abrasion limits their longevity. They are not very compatible with vegetation.

Applying Soil Binders

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

- Follow manufacturer's recommendations for application rates, pre-wetting of application area, and cleaning of equipment after use.
- Prior to application, roughen embankment and fill areas. Track walking shall only be used where rolling is impractical.
- Soil binders 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.
- Do not apply soil binders to frozen soil, areas with standing water, under freezing or rainy conditions, or when the temperature is below 4°C (40°F).
- More than one treatment is often necessary, although the second treatment may be diluted or have a lower application rate.

- Generally, soil binders require a minimum curing time of 24 hours before they are fully effective. Refer to manufacturer's instructions for specific cure times.
- For liquid agents:
  - Crown or slope ground to avoid ponding.
  - Uniformly pre-wet ground at 0.14 to 1.4 l/m^2 (0.03 to 0.3 gal/yd^2) or according to manufacturer's recommendations.
  - Apply solution under pressure. Overlap solution 150 to 300 mm (6 to 12 in).
  - Allow treated area to cure for the time recommended by the manufacturer; typically, at least 24 hours.
  - Apply second treatment before first treatment becomes ineffective, using 50% application rate.
  - In low humidities, reactivate chemicals by re-wetting with water at 0.5 to 0.9 l/m^2 (0.1 to 0.2 gal/yd^2).

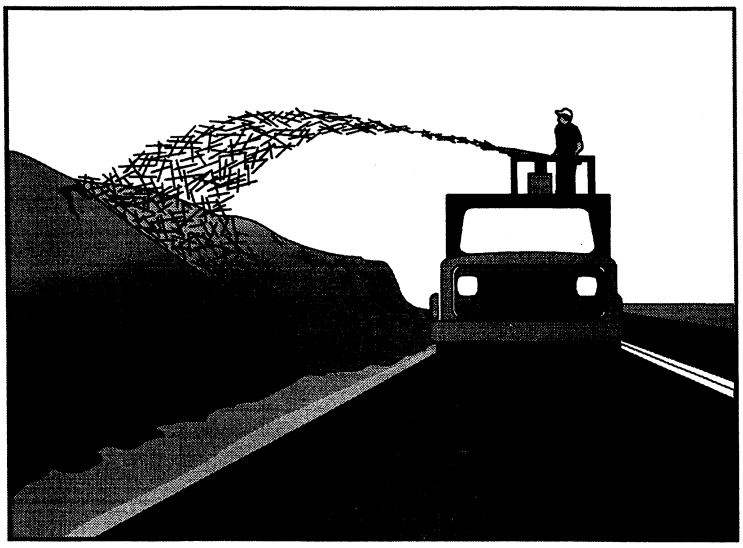
Maintenance and Inspection

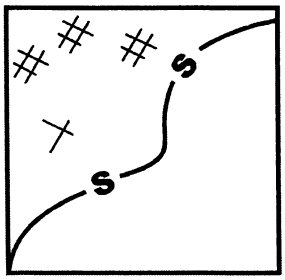
- Reapplying the selected soil binder may be needed for proper maintenance. High traffic areas shall be inspected on a daily basis, and lower traffic areas should be inspected on a weekly basis.
- After any rainfall event, the Contractor is responsible for maintaining all slopes to prevent erosion.

Table 1 *Properties of Soil Binders for Erosion Control*				
Chemicals	**Copolymer**	**Lignin Sulfonate**	**Psyllium**	**Guar**
Comments	- Forms semi-permeable transparent crust. - Resists ultraviolet radiation and moisture induced breakdown.	- Paper industry waste product - Acts as dispersing agent - Best in dry climates - Can be slippery	- Effective on dry, hard soils - Forms a crust	- Effective on dry, hard soils - Forms a crust
Relative Cost	High	Moderate	Low	Low
Environmental Hazard	Low	Low	Low	Low
Penetration	Moderate	Moderate	High	High
Evaporation	Moderate	Moderate	Moderate	Moderate
Resistance to Leaching	Low	High	High	High
Resistance to Abrasion	High	Low	Moderate	Moderate
Longevity	1 to 2 years	6 months to 1 year	3 to 6 months	3 to 6 months
Minimum Curing Time before Rain	24 hours	24 hours	24 hours	24 hours
Compatibility with Existing Vegetation	Good	Poor	Poor	Poor
Mode of Degradation	Chemically Degradable	Biologically/Physically/ Chemically Degradable	Biologically Degradable	Biologically Degradable
Labor Intensive	No	No	No	No
Specialized Application Equipment	Yes	Yes	Yes	Yes
Liquid/Powder	Liquid	Powder	Powder	Powder
Surface Crusting	Yes	Yes, but dissolves on rewetting	Yes, but dissolves on rewetting	Yes, but dissolves on rewetting
Clean-Up	Solvents	Solvents	Water	Water
Erosion Control Application Rate	Apply 800-1,000 l/ha (85-110 gal/ac).	Apply 5,600-6,500 l/ha (600-700 gal/ac).	Apply 170 kg/ha (150 lb./ac) with 560-2,200 kg/ha (500-2,000 lbs./ac) fiber mulch.	Apply 110-220 kg/ha (100-200 lbs./ac) with 560-2,200 kg/ha (500-2,000 lbs./ac) fiber mulch.
Dust Control Application Rate	Apply 280-520 L/ha (30-55 gal/ac).	Loosen surface 25-50mm (1-2 in). Need 4-8% fines. Apply 470-1,900 l/ha (50-200 gal/ac).	Apply 170 k/ha (150 lbs./ac).	Apply at 45-70 k/ha (40-60 lbs./ac).

Straw Mulch *

SS-6





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. This is one of five temporary soil stabilization alternatives to consider.

Appropriate Applications

- Rice straw mulch is 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 rice 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 45 m (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.
- "Punching" of straw does not work in sandy soils.

* Altered by D-MAX Engineering, Inc.

Standards and Specifications

- Straw shall be derived from rice.
- 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

- Apply loose straw at a minimum rate of 3,570 kg/ha (4,000 lb./acre), or as approved by the Resident Engineer (RE).
- The straw mulch must be evenly distributed on the soil surface.
- Anchor the mulch in place by using a tackifier and "punching" it into the soil mechanically.
- 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 140 kg/ha (125 lb./acre). In windy conditions, the rates are typically 200 kg/ha (178 lb./acres).
- 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:
  - On slopes with soils which are stable enough and of sufficient gradient to safely support construction equipment without contributing to compaction and instability problems, straw can be "punched" into the ground using a knife-blade roller or a straight bladed coulter, known commercially as a "crimper".
  - Erosion Control Blankets/mats may be used with City approval.

* Altered by D-MAX Engineering, Inc.

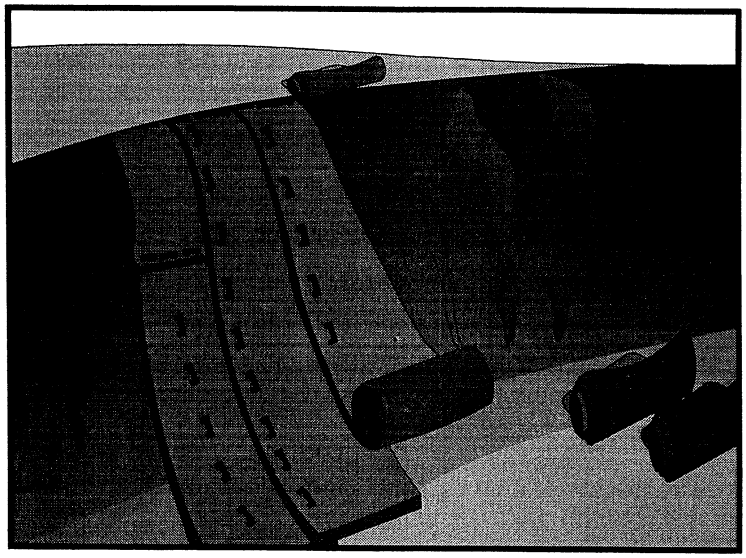
Maintenance and Inspections

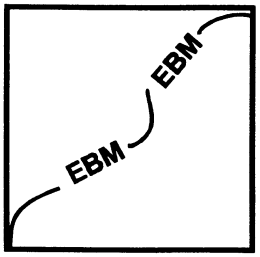
- The key consideration in maintenance and inspection is that the straw needs to last long enough to achieve erosion control objectives.
- Reapplication of straw mulch and tackifier may be required by the Resident Engineer to maintain effective soil stabilization over disturbed areas and slopes.
- After any rainfall event, the Contractor is responsible for maintaining all slopes to prevent erosion.

* Altered by D-MAX Engineering, Inc.

Geotextiles, Plastic Covers and * Erosion Control Blankets/Mats

SS-7





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, plastic covers, or erosion control blankets/mats to stabilize disturbed soil areas and protect soils from erosion by wind or water. This is one of five temporary soil stabilization alternatives to consider.

Appropriate Applications

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

- Steep slopes, generally steeper than 1:2 (V:H).
- Slopes where the erosion hazard is high.
- Slopes and disturbed soils where mulch must be anchored
- Disturbed areas where plants are slow to develop adequate protective cover.
- Channels with flows exceeding 1.0 m/s (3.3 ft/s).
- Channels intended 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.

* Altered by D-MAX Engineering, Inc.

- 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).
- Blankets and mats must be removed and disposed of prior to application of permanent soil stabilization measures.
- Plastic sheeting is easily vandalized, easily torn, photodegradable, and must be disposed of at a landfill.
- Plastic results in 100 percent runoff, which may cause serious erosion problems in the areas receiving the increased flow.
- The use of plastic shall 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.

Standards and Specifications

Material Selection

There are many types of erosion control blankets and mats, and selection of the appropriate type should be based on the specific type of application and site conditions. Selection(s) made by the Contractor must be approved by the Resident Engineer (RE). The following criteria shall be considered in selection of the appropriate material:

- Cost
  - Material cost
  - Preparation cost
  - Installation cost
  - Add-ons
- Effectiveness
  - Reduction of erosion
  - Reduction of flow velocity
  - Reduction of runoff
- Acceptability
  - Environmental compatibility
  - Institutional/regulatory acceptability
  - Visual impact

- Vegetation Enhancement
  - Native plant compatibility
  - Moisture retention
  - Temperature modification
  - Open space/coverage

- Installation
  - Durability
  - Longevity
  - Ease of installation
  - Safety

- Operation and Maintenance
  - Maintenance frequency

Geotextiles

- Material shall be a woven polypropylene fabric with minimum thickness of 15 mm, minimum width of 3.7 m and shall have minimum tensile strength of 0.67 kN (warp) 0.36 kN (fill) in conformance with the requirements in ASTM Designation: D 4632. The permittivity of the fabric shall be approximately 0.07 sec^{-1} in conformance with the requirements in ASTM Designation: D4491. The fabric shall have an ultraviolet (UV) stability of 70 percent in conformance with the requirements in ASTM designation: D4355. Geotextile blankets shall be secured in place with wire staples or gravelbags and by keying into tops of slopes to prevent infiltration of surface waters under Geotextile.

- Geotextiles may be reused if, in the opinion of the RE, they are suitable for the use intended.

Plastic Covers

- Temporary soil stabilization (Type plastic cover) material shall be polyethylene sheeting and shall have a minimum thickness of 6 mils. Plastic covers shall be anchored by gravelbags placed no more than 3 m (10 ft.) apart and by keying into the tops of slopes to prevent infiltration of surface waters under the plastic. All seams be taped or weighted down their entire length, and there shall be at least a 300 mm (12 in.) to 600 mm (24in.) overlap of all seams.

- Plastic covers may be reused if, in the opinion of the RE, they are suitable for the use intended.

* Altered by D-MAX Engineering, Inc.

Erosion Control Blankets/Mats

- Erosion control blankets/mats shall be either straw, coconut, straw/coconut or Excelsior blanket with approval of Resident Engineer (RE).

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 50 mm (2 in) to 75 mm (3 in) of topsoil.

Seeding

Seed the area before blanket installation for erosion control and revegetation. 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. Where soil filling is specified, seed the matting and the entire disturbed area after installation and prior to filling the mat with soil. The City must approve seed mix in advance of placement.

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 3.05 mm steel wire and shall be U-shaped with 200-mm legs and 50-mm crown. Wire staples shall be minimum of 11 gauge.
- Metal stake pins shall be 5 mm (0.188 in) diameter steel with a 40 mm (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 150 mm (6 in) to 450 mm (18 in) long and have sufficient ground penetration to resist pullout. Longer anchors may be required for loose soils.

* Altered by D-MAX Engineering, Inc.

Installation on Slopes

Always consult the manufacturer's recommendations for installation. In general, these will be as follows:

- Begin at the top of the slope and anchor the blanket in a 150 mm (6 in) deep by 150 mm (6 in) wide trench. Backfill trench and tamp earth firmly.
- Unroll blanket downslope in the direction of water flow.
- Overlap the edges of adjacent parallel rolls 50 mm (2 in) to 75 mm (3 in) and staple every 1 m (3 ft).
- When blankets must be spliced, place blankets end over end (shingle style) with 150 mm (6 in) overlap. Staple through overlapped area, approximately 300 mm (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 (V:H) to 1:2 (V:H), require a minimum of 2 staples/m^2 (2 staples/yd^2). Moderate slopes, 1:2 (V:H) to 1:3 (V:H), require a minimum of 1½ staples/m^2 (1 ½ staples/yd^2), placing 1 staple/m (1 staple/yd) on centers. Gentle slopes require a minimum of 1 staple/m^2 (1 staple/yd^2).

Installation in Channels

Always consult the manufacturer's recommendations for installation. In general, these will be as follows:

- Dig initial anchor trench 300 mm (12 in) deep and 150 mm (6 in) wide across the channel at the lower end of the project area.
- Excavate intermittent check slots, 150 mm (6 in) deep and 150 mm (6 in) wide across the channel at 8 m to 10 m (25 ft to 30 ft) intervals along the channels.
- Cut longitudinal channel anchor slots 100 mm (4 in) deep and 100 mm (4 in) wide along each side of the installation to bury edges of matting, whenever possible extend matting 50 mm (2 in) to 75 mm (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 300 mm (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 75 mm (3 in).
- Secure these initial ends of mats with anchors at 300 mm (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 75 mm (3 in) overlap.
- Fold and secure all rolls of matting snugly into all transverse check slots. Lay mat in the bottom of the slot then fold back against itself. Anchor through both layers of mat at 300 mm (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 150 mm (6 in) centers at 8 m (25 ft) to 10 m (30 ft) intervals in lieu of excavated check slots.
- Shingle-lap spliced ends by a minimum of 300 mm (12 in) apart on 300 mm (12 in) intervals.
- Place edges of outside mats in previously excavated longitudinal slots, anchor using prescribed staple pattern, backfill and compact soil.
- Anchor, fill and compact upstream end of mat in a 300 mm (12 in) by 150 mm (6 in) terminal trench.
- Secure mat to ground surface using U-shaped wire staples, geotextile pins, or wooden stakes.
- Seed and fill turf reinforcement matting with soil, if specified.

Soil Filling (if specified for turf reinforcement)

- Always consult the manufacturer's recommendations for installation.
- Do not drive tracked or heavy equipment over mat.

- Avoid any traffic over matting if loose or wet soil conditions exist.
- Use shovels, rakes or brooms for fine grading and touch up.
- Smooth out soil filling; just exposing top netting of mat.

Temporary Soil Stabilization Removal

- When no longer required for the work, temporary soil stabilization shall become the property of the Contractor.

Maintenance and Inspection

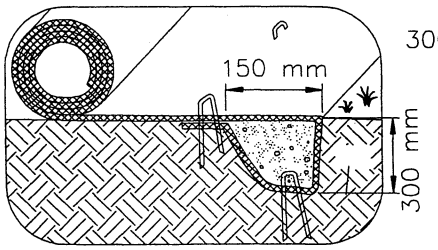
Areas treated with temporary soil stabilization shall be inspected as specified in the special provisions. Areas treated with temporary soil stabilization shall be maintained to provide adequate erosion control. Temporary soil stabilization shall be reapplied or replaced on exposed soils when greater than 10 percent of the previously treated area becomes exposed or exhibits visible erosion.

- All blankets and mats shall be inspected periodically after installation.
- Installation shall be inspected after significant rain storms 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.

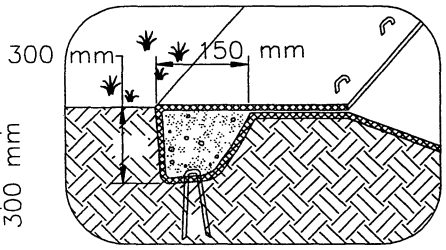
* Altered by D-MAX Engineering, Inc.

Geotextiles, Plastic Covers and Erosion Control Blankets/Mats

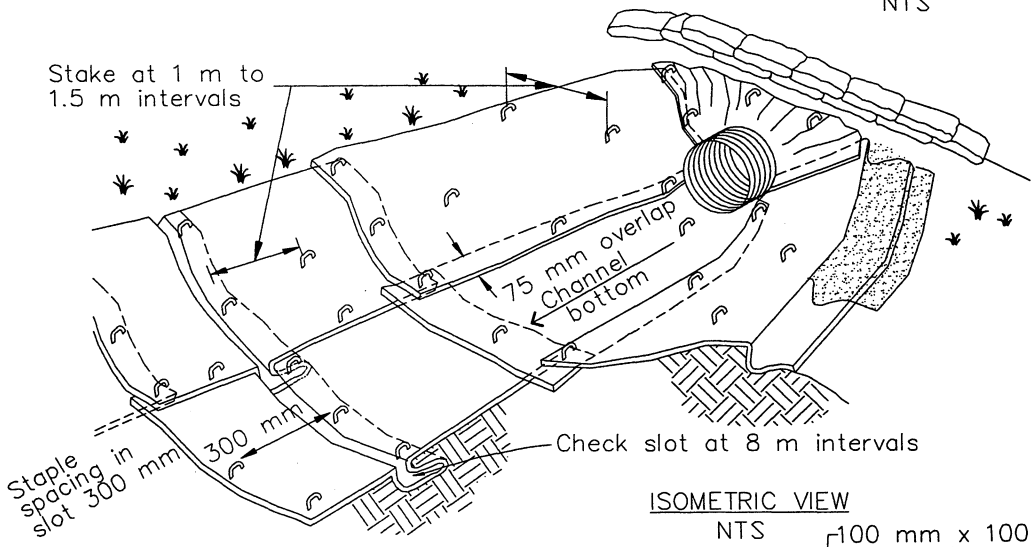
SS-7



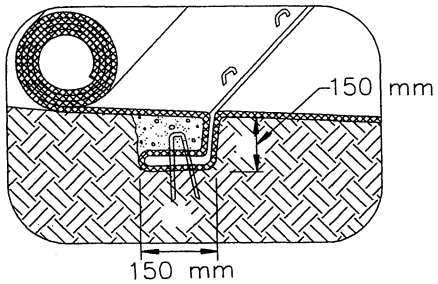
INITIAL CHANNEL ANCHOR TRENCH
NTS



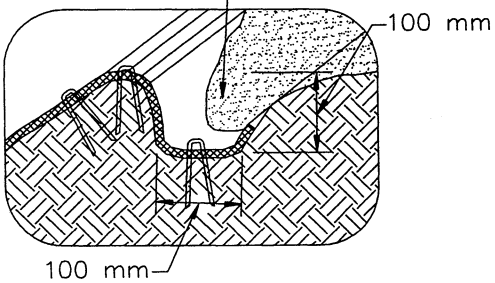
TERMINAL SLOPE AND CHANNEL ANCHOR TRENCH
NTS



ISOMETRIC VIEW
NTS



INTERMITTENT CHECK SLOT
NTS

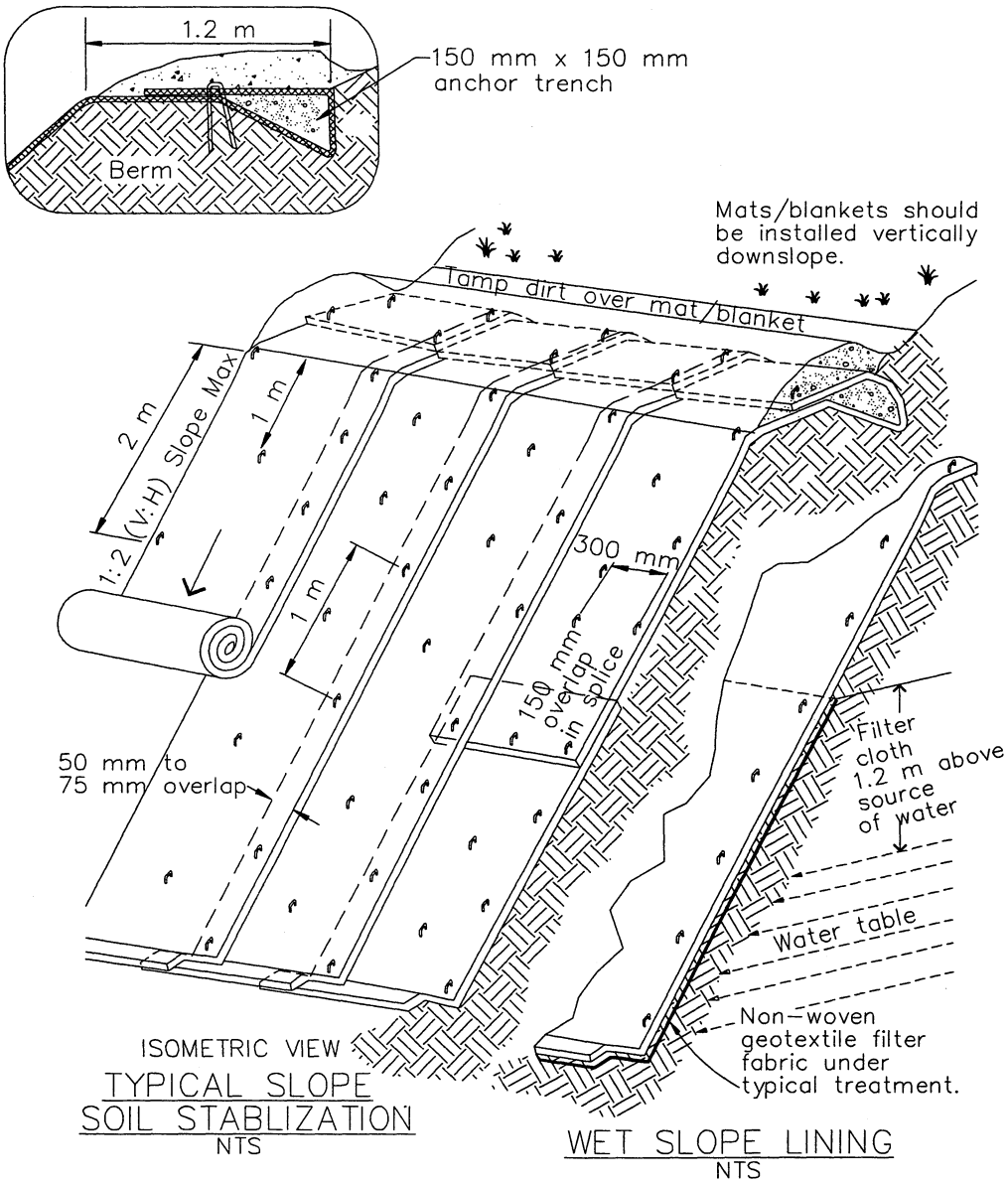


LONGITUDINAL ANCHOR TRENCH
NTS

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

Geotextiles, Plastic Covers and Erosion Control Blankets/Mats

SS-7

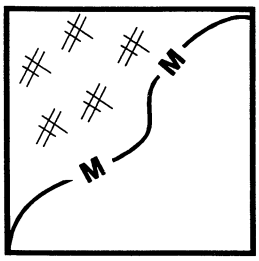


NOTES:

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

Wood Mulching

SS-8



BMP Objectives

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

Definition and Purpose

Wood mulching consist of applying a mixture of shredded wood mulch, 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.

Shredded Wood

Shredded wood does not withstand concentrated flows and is prone to sheet erosion.

Green Material/Compost

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.

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 District 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 City requirements.

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 grass, shredded shrubs and trees. Methods of application are generally by hand, although pneumatic methods are available. Mulch shall be composted to kill weed seeds.
  - 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 50 mm (2 in).
- Shredded Wood: Suitable for ground cover in ornamental or revegetated plantings.
  - Shredded wood/bark is conditionally suitable; see note under limitations.
  - Shall be distributed by hand (although pneumatic methods may be available).
  - The mulch shall be evenly distributed across the soil surface to a depth of 50 mm (2 in) to 75 mm (3 in).
- Avoid mulch placement onto the traveled way, sidewalks, lined drainage channels, sound walls, and existing vegetation.
- All material must be removed before re-starting work on the slopes.

* Altered by D-MAX Engineering, Inc.

Maintenance and Inspection

- 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 revegetation.

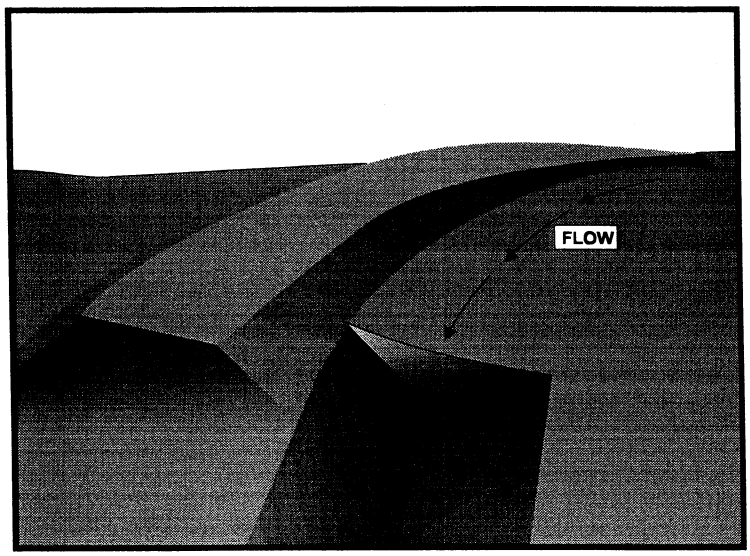
- Where vegetation is not the ultimate cover, such as ornamental and landscape applications of bark or wood chips, inspection and maintenance shall focus on longevity and integrity of the mulch.

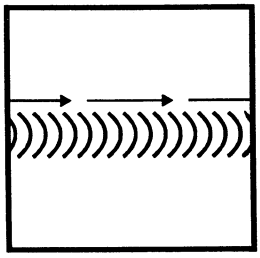
- Mulch applied to a slope of 2:1 or steeper must be tackified at 4,000 pounds per acre and approved by the Resident Engineer (RE) in advance of the work.

* Altered by D-MAX Engineering, Inc.

Earth Dikes/Drainage Swales and Lined Ditches

SS-9





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 steep grades 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 and feasible by the Resident Engineer (RE).

Earth Dikes/Drainage Swales and Lined Ditches

SS-9

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

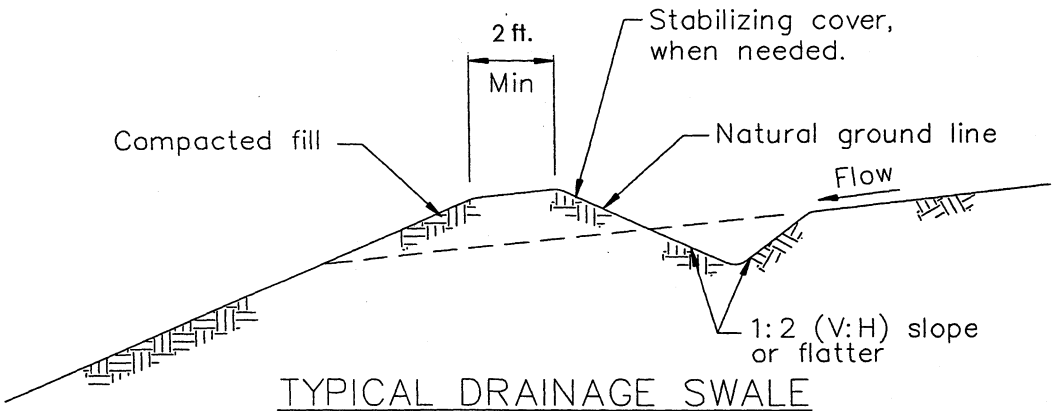
- Care must be applied to correctly size and locate earth dikes, drainage swales and lined ditches. Excessively steep, unlined dikes and swales are subject to erosion and gully formation.
- Conveyances shall be stabilized.
- Use a lined ditch for high flow velocities.
- Select flow velocity based on careful evaluation of the risks due to erosion of the measure, soil types, over topping, flow backups, washout, and drainage flow patterns for each project site.
- Compact any fills to prevent unequal settlement.
- Do not divert runoff from the Highway right-of-way onto other property.
- When possible, install and utilize permanent dikes, swales and ditches early in the construction process.
- 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.
- Inspect ditches and berms for washouts. Replace lost riprap, damaged linings or soil stabilizers as needed.
- Inspect channel linings, embankments, and beds of ditches and berms for erosion and accumulation of debris and sediment. Remove debris and sediment, and repair linings and embankments as needed or as directed by the Engineer.
- Temporary conveyances shall be completely removed as soon as the surrounding drainage area has been stabilized, or at the completion of construction.

Earth Dikes/Drainage Swales * and Lined Ditches

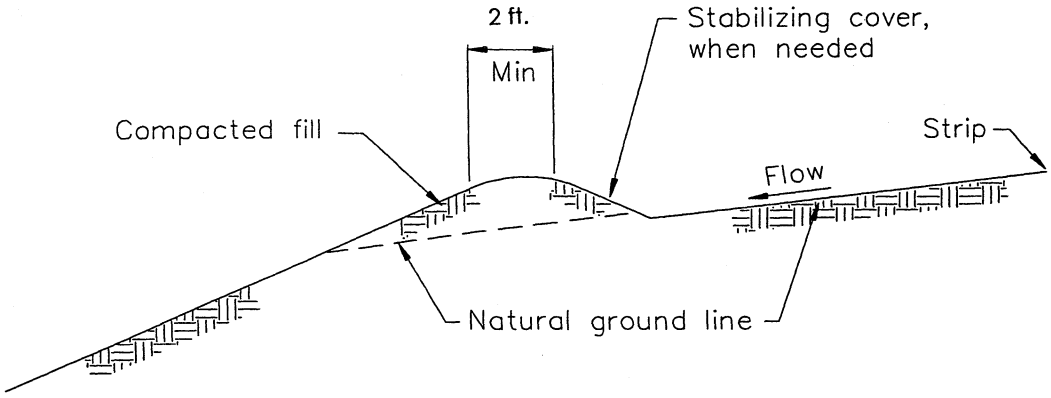
SS-9



TYPICAL DRAINAGE SWALE
NOT TO SCALE

NOTES:

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

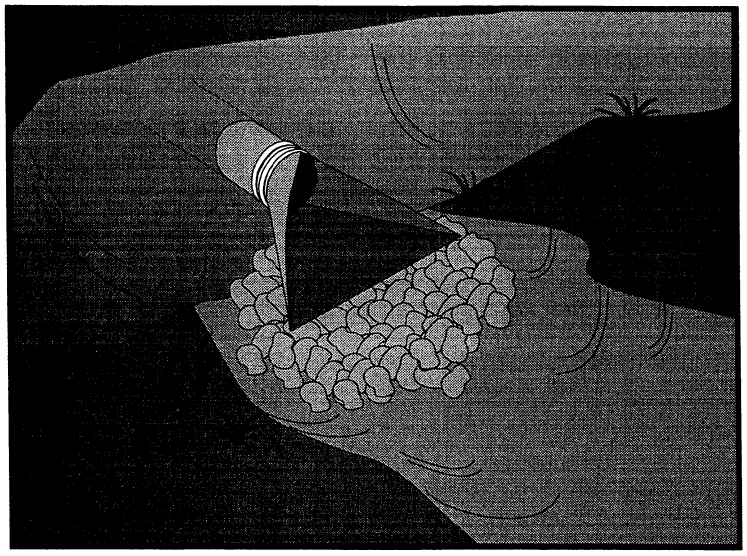


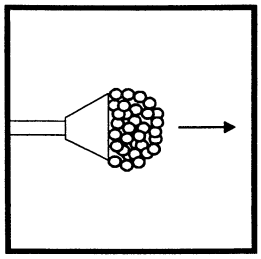
TYPICAL EARTH DIKE
NOT TO SCALE

* Altered by D-MAX Engineering, Inc.

Outlet Protection/Velocity Dissipation Devices

SS-10





BMP Objectives

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

Definition and Purpose

These devices are placed at pipe outlets to prevent scour and reduce the velocity and/or energy of exiting storm water flows.

Appropriate Applications

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

Limitations

- Loose rock may have stones washed away during high flows.
- Grouted riprap may break up in areas of freeze and thaw.
- If there is not adequate drainage, and water builds up behind grouted riprap, it may cause the grouted riprap to break up due to the resulting hydrostatic pressure.

Outlet Protection/Velocity * Dissipation Devices

SS-10

Standards and Specifications

- There are many types of energy dissipater's, with rock being the one that is represented in the attached figure. Please note that this is only one example and the Resident Engineer (RE) may approve any other type of device proposed by the contractor.
- Install riprap, grouted riprap, or concrete apron at selected outlet. Riprap aprons are best suited for temporary use during construction.
- Carefully place riprap to avoid damaging the filter fabric.
- For proper operation of apron:
  - Align temporary apron with receiving stream and keep straight throughout its length. If a curve is needed to fit site conditions, place it in the upper section of apron.
  - If size of apron riprap is large, protect underlying filter fabric with a gravel blanket
- Outlets on slopes steeper than 10 percent shall have additional protection.

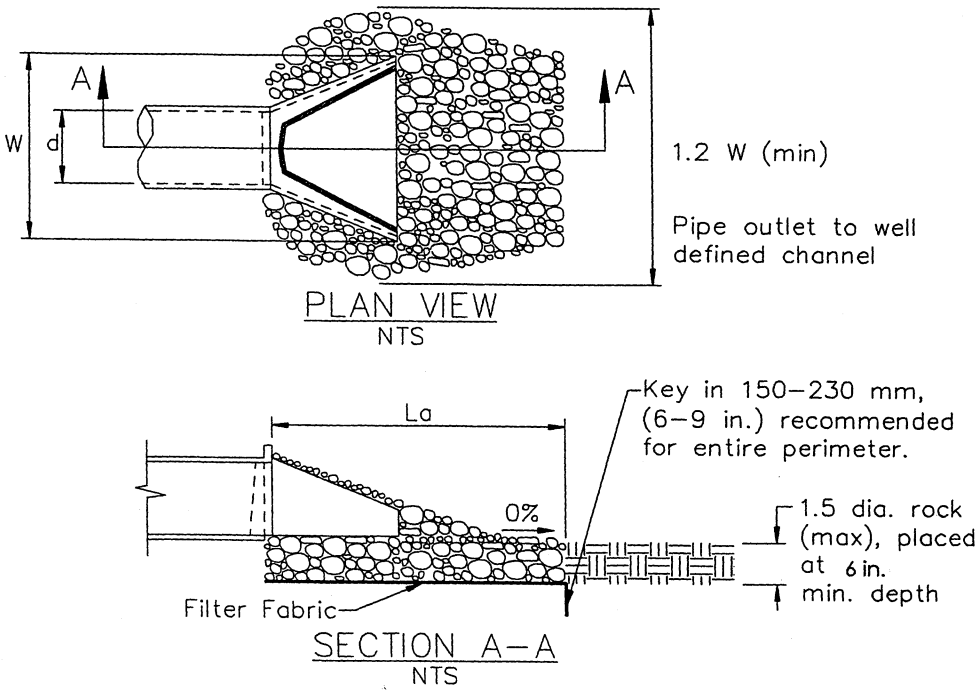
Maintenance and Inspection

- 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 which has washed away.
- Inspect for scour beneath the riprap and around the outlet. Repair damage to slopes or underlying filter fabric immediately.
- Temporary devices shall be completely removed as soon as the surrounding drainage area has been stabilized, or at the completion of construction.

* Altered by D-MAX Engineering, Inc.

Outlet Protection/Velocity* Dissipation Devices

SS-10



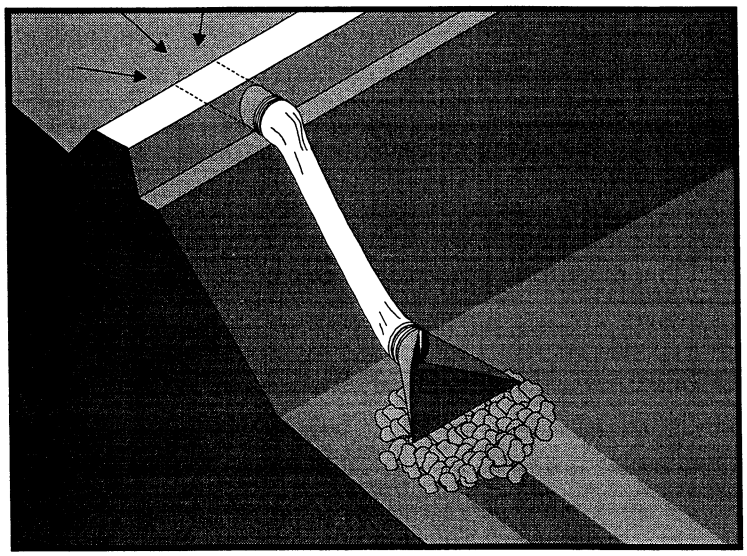
Pipe Diameter		Discharge		Apron Length, La		Rip Rap D_{50} Diameter Min	
mm	in.	m^3/s	ft^3/s	m	ft.	mm	in.
300	11.8	0.14	4.94	3	9.84	100	3.93
		0.28	9.89	4	13.12	150	5.9
450	17.7	0.28	9.89	2	6.56	150	5.9
		0.57	20.13	5	16.4	200	7.87
		0.85	30.02	7	22.97	300	11.8
		1.13	39.91	8	26.24	400	15.7
600	23.6	0.85	30.05	5	16.4	200	7.87
		1.13	39.91	8	26.24	200	7.87
		1.42	50.15	8	26.24	300	11.8
		1.70	60.03	9	29.57	400	15.7
For larger or higher flows, consult a Registered Civil Engineer							

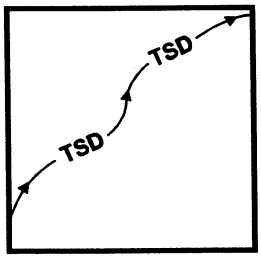
Source: USDA – SCS

* Altered by D-MAX Engineering, Inc.

Slope Drains

SS-11





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.

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 when determined necessary and feasible by the Resident Engineer (RE).

Limitations

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

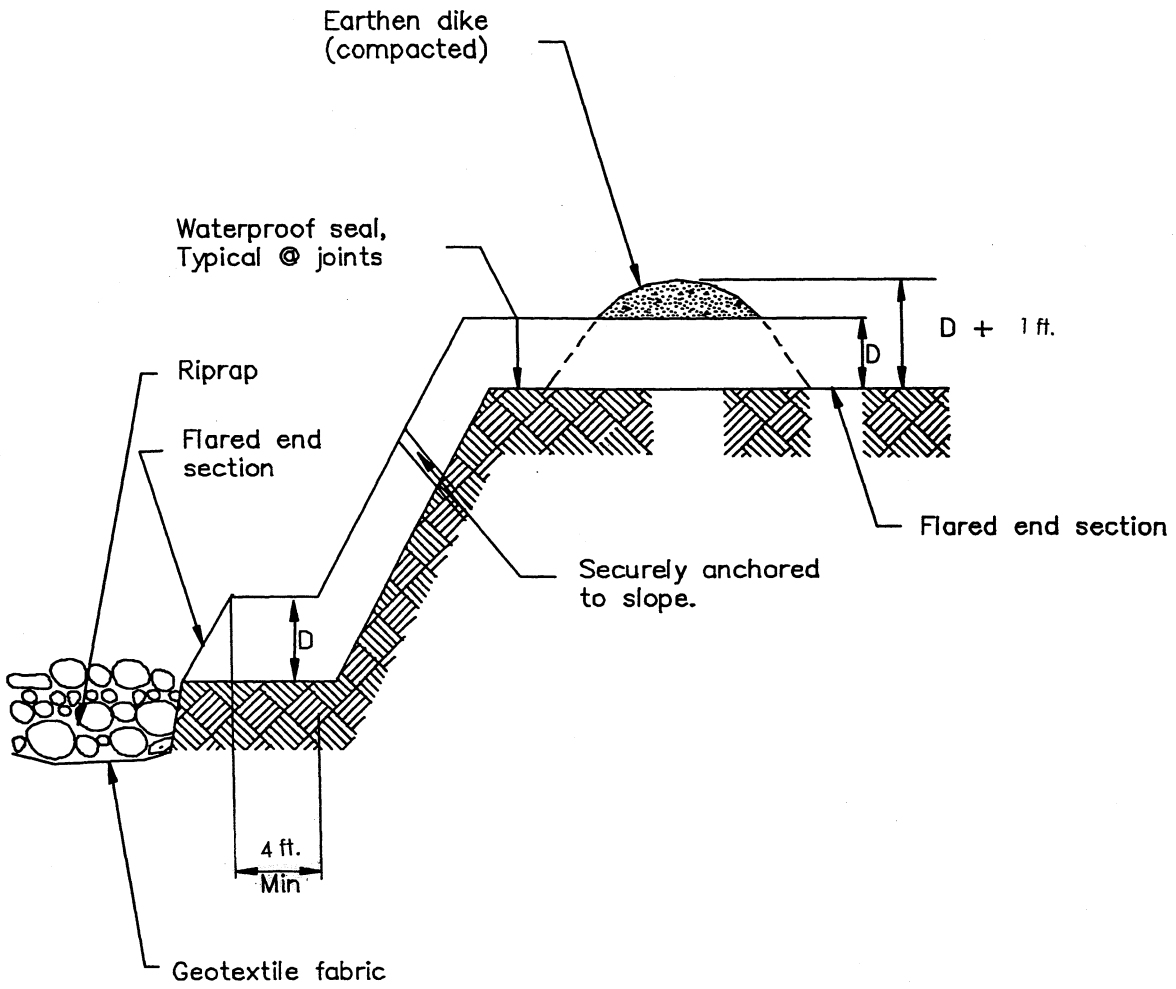
Standards and Specifications

- When using slope drains, limit drainage area to 4 ha (10 ac) per pipe. For larger areas, use a rock-lined channel or a series of pipes.
- Maximum slope generally limited to 1:2 (V:H), 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.
- Recommended materials are PVC, ABS, or comparable pipe.

- 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 water tight.
  - Protect area around inlet with filter cloth. Protect outlet with riprap or other energy dissipation device. For high energy discharges, reinforce riprap with concrete or use reinforced concrete device.
  - Protect inlet and outlet of slope drains: use standard flared end section at entrance for pipe slope drains 300 mm (12in) and larger.

Maintenance and Inspection

- Inspect before and after each rain storm, 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.).



TYPICAL SLOPE DRAIN
NOT TO SCALE

* Altered by D-MAX Engineering, Inc.