Benton County Erosion and Sediment Control

Manual

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Benton County Erosion and Sediment Control Manual Introduction

This packet of materials is a condensed guideline for erosion and sediment control (ESC) requirements set forth by Benton County in conjunction with our ESC permitting program. The recently adopted Benton County Erosion and Sediment Control Ordinance adopts the Oregon Department of Environmental Quality‟s Erosion and Sediment Control Manual (DEQ-ESCM). These guidelines are fundamentally based on the DEQ-ESCM with a few supplemental materials taken from the City of Corvallis Erosion Prevention and Sediment Control Manual, the Oregon Department of Transportation (ODOT) Hydraulics Manual Volume II (current edition) and the ODOT Standard Drawings (current edition). The purpose of these guidelines is to streamline the permit application process and provide the applicant with an overview of the components necessary for a successful and complete application. The applicant should bear in mind that this is a guideline and a complete understanding of the processes and function of erosion control systems as viewed by is governed by the DEQ-ESCM (available on line at http://www.deq.state.or.us/wq/stormwater/escmanual.htm).

Close examination of the DEQ-ESC will reveal that many of the Best Management Practices (BMP‟s) listed in the manual have been omitted from these guidelines. This should not be construed to mean that they may not be used or required. Given certain site conditions, weather events, unforeseen soil conditions or other extenuating circumstances staff may require use of BMP‟s from the DEQ-ESC not shown in this guideline packet either at the time of application or as a remedial action after permit issuance. However, the BMP‟s selected for this guideline were chosen because they represent a comprehensive cross section of the most widely accepted BMP‟s currently in practice.

Before the applicant submits an erosion control plan for review Benton County staff will review the applicant‟s preliminary plot plan and determine whether the site is classified low, medium or high erodability. There are BMP‟s associated with each of these classifications, the most basic applying to the “low” category and the most complicated to the “high” category. A suite of BMP‟s in the packet may be specified in the erosion control application depending on the erodability classification. A “medium” classification may select from all of those BMP‟s in the “low” and “medium” categories, a “high” classification may select from any of the BMP‟s in the packet.

The low, medium or high erodability classification will be arrived by an internal review of the preliminary site plan by comparison of the following criteria:

The applicant may ask for a consultation with County staff to clarify questions or concerns regarding the erodability determination.

The applicant is strongly encouraged to employ the services of a qualified professional to perform the tasks required by this ordinanc

Benton County Erosion and Sediment Control Permit Requirements for Building Activities

What's this all about?

Benton County is required under the Clean Water Act and a State Water Quality Management Plan to develop, implement, and enforce a local Erosion and Sediment Control program to improve and protect water quality.

Benton County Erosion and Sediment Control Permit:

A Benton County Erosion and Sediment Control (ESC) permit is required for all Benton County permitted building activities, that result in „ground disturbing" activities of 1-acre or more or part of a „common plan of development" that results in cumulative disturbance of 1-acre or more.

Definition of „ground disturbing activity":

Any activity associated with a Benton County Building Permit that includes grading, grubbing, clearing or other impacts to soil and/or aboveground features.

Requirements to obtain an erosion and sediment control permit:

1. Applicants submit a Benton County ESC application.
2. Applicants provide 2 copies of an ESC site plan meeting the requirements based on site location and susceptibility to erosion.

A Benton County ESC Sample Plan and Manual will be made available to the potential applicant. Resources are also available on the county stormwater website at: www.co.benton.or.us/cd/environment/stormwater

Are there special qualifications required to prepare this ESC Plan?

Yes applicants are to employ the services of a qualified professional or other person allowed by Benton Coutny to perform the tasks required.

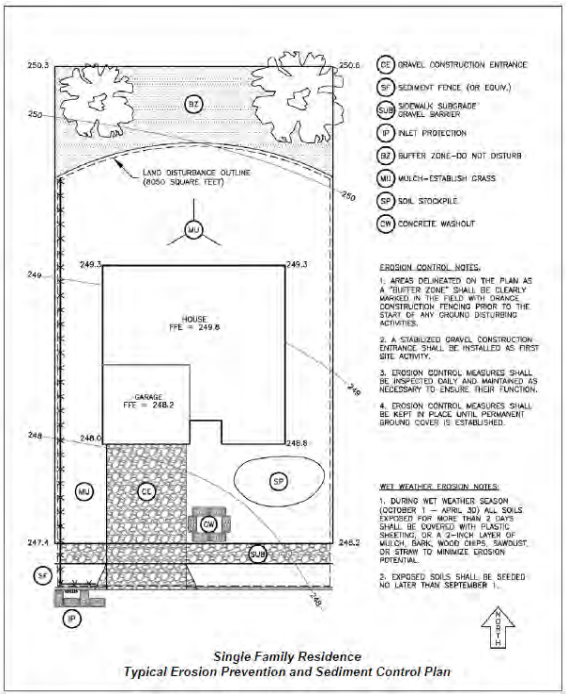
Benton County ESC Assistance:

Benton County is at your service. Building, planning and engineering staff will assist applicants with specific ESC application requirements.

Permit Fees:

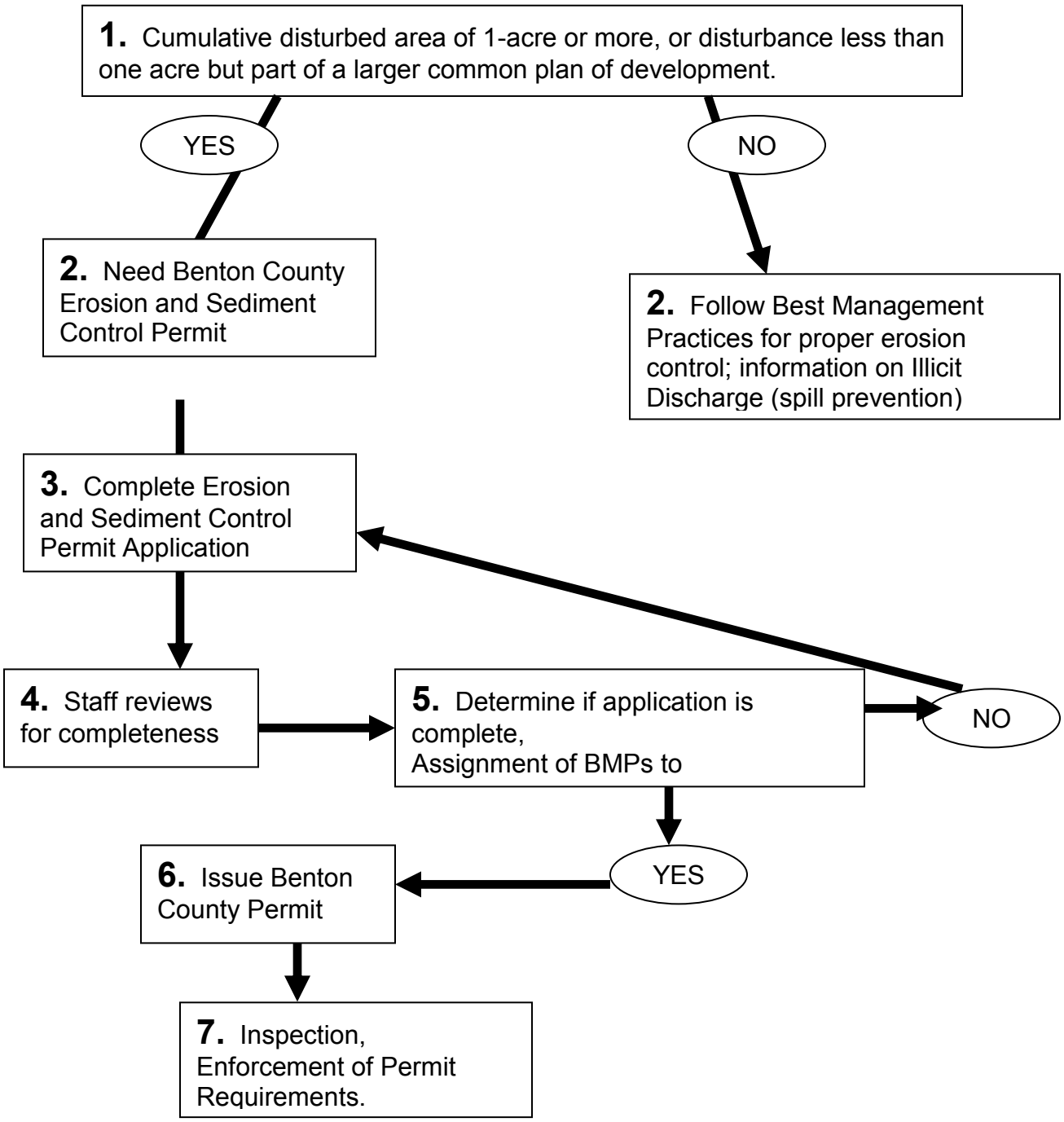
Fee amounts range depend on the location of the proposed ground disturbance. Sensitive, complex or other sites may require additional staff time.

*** Benton County ESC Permitting Process Flow Chart on other side**



Single Family Residence
Typical Erosion Prevention and Sediment Control Plan

Benton County Erosion and Sediment Control Permit Requirements Flow Chart:



Benton County Erosion Prevention and Sediment Control Plan Requirements

Summary
Follow this guide to prepare an Erosion Prevention and Sediment Control (EPSC) site plan showing how soil erosion will be minimized and sediment contained on-site during residential construction activities. **Please Note that Benton County encourages all applicants to utilize an Erosion Prevention and Sediment Control professional to expedite your permit process.**

What do I need to submit?
You must submit a completed Erosion Prevention and Sediment Control (EPSC) Permit Application along with 2 copies of an EPSC site plan. Follow the checklist below to create the EPSC site plan.

Erosion Prevention and Site Plan Checklist

If all requirements are not met Benton County will not accept the application.

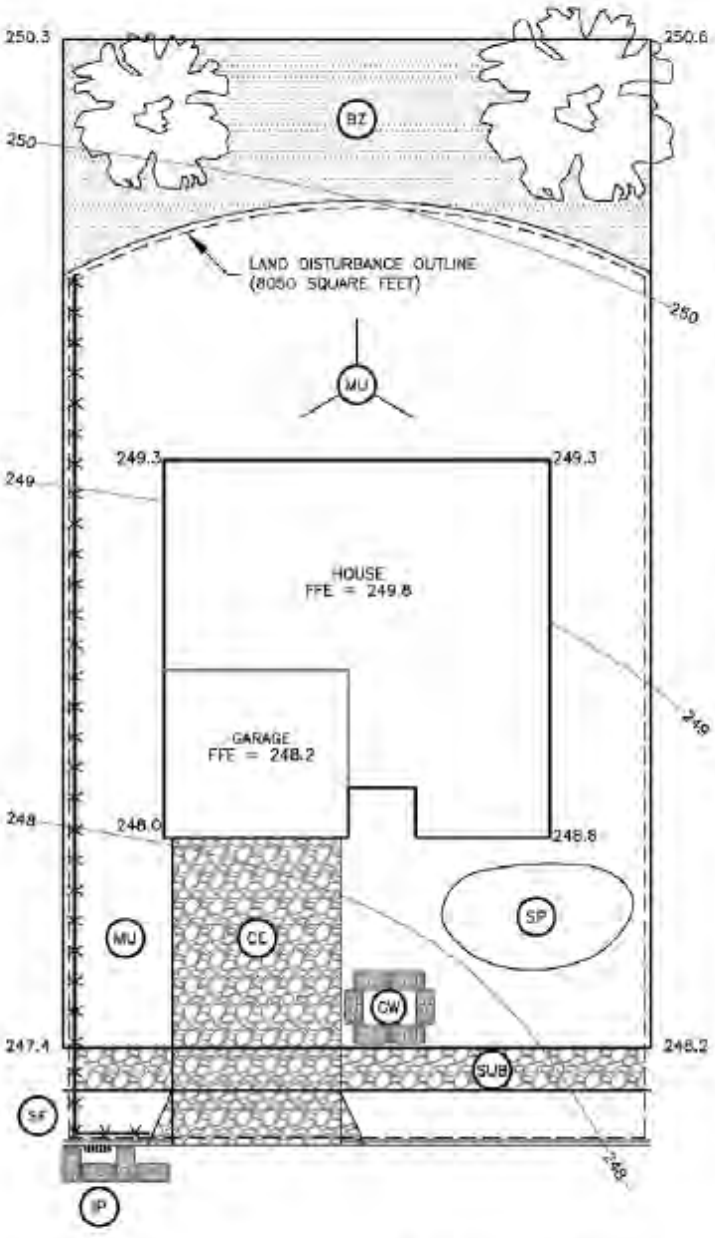
Prepare a site plan, showing the following. Be sure to work with Benton County Planning to complete application requirements:

- ☐ Minimum distance between work site and sensitive area(s) (**NOTE:** please check with Benton County Planning)
- ☐ Average site slope
- ☐ Property lines, easements, north arrow
- ☐ Footprint of all structures
- ☐ Location of driveways and sidewalks

In Addition be sure to include the following Erosion Prevention and Sediment Control Information:

Application Checklist required Best Management Practices (BMPs):

- ☐ Assigned **Runoff Control Best BMPs** to protect downhill resources (stormdrain inlets, drainages).
- ☐ Assigned **Erosion Prevention BMPs** such as buffers, sheeting, etc.
- ☐ Assigned **Sediment Control BMPs** downhill from all disturbed areas



CE GRAVEL CONSTRUCTION ENTRANCE

SF SEDIMENT FENCE (OR EQUIV.)

SUB SIDEWALK SUBGRADE GRAVEL BARRIER

IP INLET PROTECTION

BZ BUFFER ZONE-DO NOT DISTURB

MU MULCH-ESTABLISH GRASS

SP SOIL STOCKPILE

CW CONCRETE WASHOUT

EROSION CONTROL NOTES:

1. AREAS DELINEATED ON THE PLAN AS A "BUFFER ZONE" SHALL BE CLEARLY MARKED IN THE FIELD WITH ORANGE CONSTRUCTION FENCING PRIOR TO THE START OF ANY GROUND DISTURBING ACTIVITIES.

2. A STABILIZED GRAVEL CONSTRUCTION ENTRANCE SHALL BE INSTALLED AS FIRST SITE ACTIVITY.

3. EROSION CONTROL MEASURES SHALL BE INSPECTED DAILY AND MAINTAINED AS NECESSARY TO ENSURE THEIR FUNCTION.

4. EROSION CONTROL MEASURES SHALL BE KEPT IN PLACE UNTIL PERMANENT GROUND COVER IS ESTABLISHED.

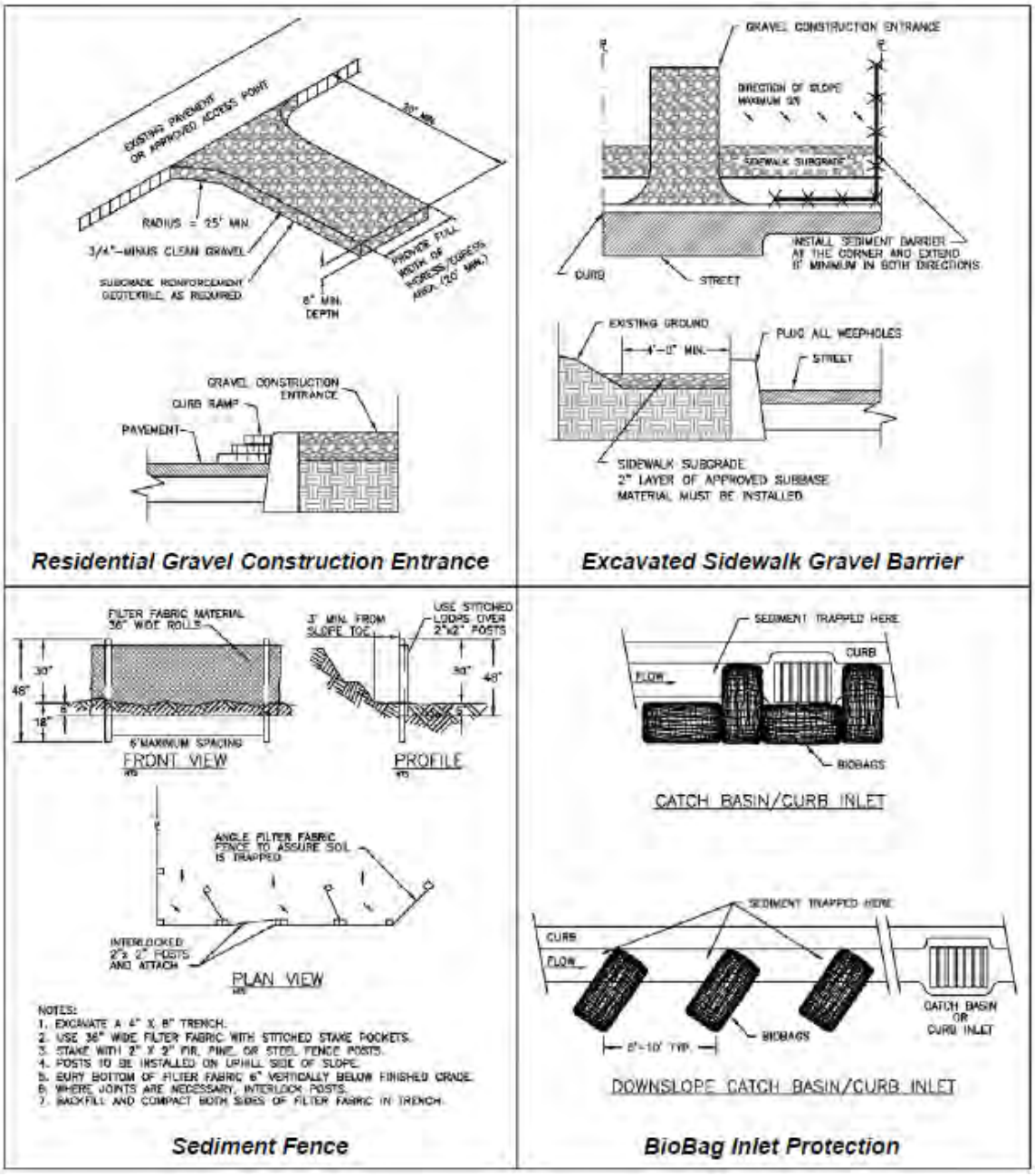
WET WEATHER EROSION NOTES:

1. DURING WET WEATHER SEASON (OCTOBER 1 – APRIL 30) ALL SOILS EXPOSED FOR MORE THAN 2 DAYS SHALL BE COVERED WITH PLASTIC SHEETING, OR A 2-INCH LAYER OF MULCH, BARK, WOOD CHIPS, SAWDUST, OR STRAW TO MINIMIZE EROSION POTENTIAL.

2. EXPOSED SOILS SHALL BE SEEDED NO LATER THAN SEPTEMBER 1.

NORTH

Single Family Residence
Typical Erosion Prevention and Sediment Control Plan



Refer to the *Benton County Erosion Prevention and Sediment Control Manual requirements* available on-line at www.co.benton.or.us/cd/environment/stormwater for additional information and erosion control measures.

Standard permit conditions

1. Prior to any ground disturbing activity on the site, an initial inspection by County staff is required. Erosion and Sediment Control (ESC) measures should be in place prior to the inspector arriving. Call *(541) 766-6819* to schedule your inspection.

2. ESC measures must be constructed in conjunction with, and prior to, all clearing and grading activities and in a manner as to ensure that sediment and sediment-laden water does not enter the drainage system, roadways, or violate applicable water quality standards.

3. ESC measures shown on the plans are minimum requirements for anticipated site conditions. During the construction period, the ESC measures shall be upgraded as needed for unexpected storm events and to ensure that sediment and sediment-laden water does not leave the site.

4. ESC measures shall be inspected daily by the permit holder, and maintained as necessary to ensure their function.

5. Stabilized gravel construction entrances shall be installed at the beginning of construction and maintained for the duration of the project. Additional measures may be required to ensure that all paved areas are kept clean for the duration of the project.

6. ESC measures shall be kept in place until permanent ground cover is established.

7. All exposed soil must be permanently stabilized against wind and water erosion before the ESC permit can be closed. Once the site is stabilized, schedule a final inspection by calling *(541) 766-6819*. Permanent soil stabilization includes landscaping, seeding, or covering exposed soil with bark or other suitable biodegradable cover.

Wet weather permit conditions

1. Wet weather erosion prevention measures will be in effect from October 1 through April 30.

2. Soil exposed for more than 2 days shall be seeded, or covered with plastic sheeting, matting, or a 2-inch layer of mulch, bark, wood chips, sawdust, or straw or other approved material to minimize erosion potential.

3. Exposed soils shall be seeded no later than September 1 to allow time for proper germination and growth before the wet weather season.

Where can I get assistance?

We are here to help you. Staff is typically available from 8:00 am to 4:00 pm weekdays to answer your questions by phone *(541) 766-6819* and at the Benton County Community Development Department, 360 SW Avery Ave., Corvallis, OR 97333. We encourage you to call and make arrangements for consultation.

For more information

Benton County Community Development—Building Division (541) 766-6819

Benton County Erosion Prevention and Sediment Control
Best Management Practices (BMP) Requirements

Required Level of Erosion Control

	Low	Medium	High
Runoff Control BMPs	RC-14: Outlet Protection RC-11: Check Dams	RC-2: Energy Dissipator RC-3: Diversion of Run-On RC-4: Temporary Diversion Dike RC-5: Grass-lined Channel	RC-1: Slope Drain RC-12: Bioengineering Stabilization RC-13: Structural Stabilization
Erosion Prevention BMPs	EP-1: Scheduling EP-2: Preservation of Existing Vegetation EP-2A: Preserve Ground Cover EP-2B: Buffer Zone EP-6: Permanent Seeding and Planting EP-8: Mulches EP-21: Sodding EP-22: Plastic Sheeting EP-23: Rip Rap	EP-5: Temporary Seeding and Planting EP-10: Erosion Control Blankets & Mats EP-13: Wind/Dust Erosion Control	EP-3: Surface Roughening EP-3A: Gradient Terraces EP6-A: Vegetative Stabilization EP-17: Brush Box
Sediment Control BMPs	SC-1: Sediment Fence SC-6: Compost Berms & Socks SC-7: Fiber Rolls or Wattles SC-8: Storm Drain Inlet Protection SC-11: Entrance/Exit Tracking Controls SC-13: Soil/Aggregate Stockpile	SC-2: Sand Bag Barrier SC-4: Straw Bale Dike SC-5: Rock or Brush Filters	SC-9: Temporary Sediment Basin SC-9AtoD: Temporary Sediment Trap SC-10: Entrance/Exit Tire Wash

* Oregon Department of Environmental Quality Erosion and Sediment Control Manual, Oregon Department of Transportation Erosion and Sediment Control Manual, and City of Corvallis Erosion Prevention and Sediment Control Manual will be referenced.

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- **Minimum Distance between Work Limits and Sensitive Areas**
  - Jurisdictional Wetlands
  - Fedral, State or Locally Mapped Wetlands
  - Hydric Soils
  - Endangered Species or ES Habitat
  - Riparian Buffers
  - Conservation Areas
  - Designated Slide Hazard Areas
  - Geologic Instability
- **Average Site Slopes**
- **Predominant Soil Types (K-factor)**
- **Cumulative Disturbed Area**
- **Proximity to Urban Growth Boundaries or City Limits**

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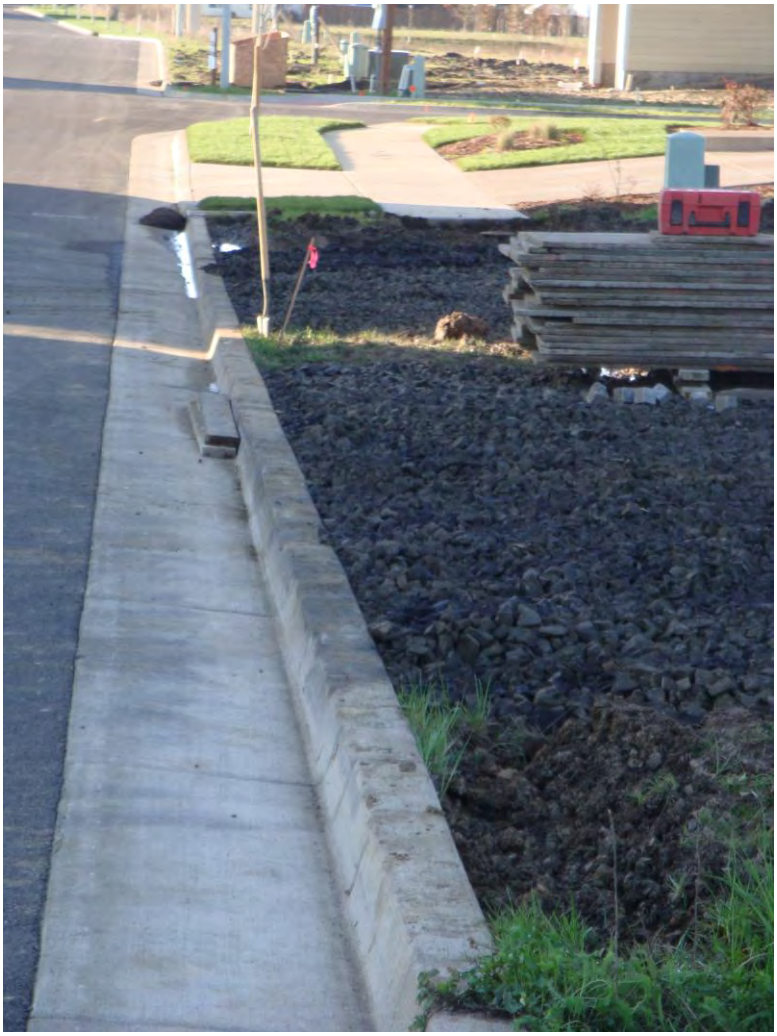


RUNOFF CONTROL BMPS

RC-1 (PSD) PIPE SLOPE DRAINS

RC-2 (EO) ENERGY DISSIPATOR (OUTLET PROTECTION)

RC-4 (IDS) INTERCEPTOR DIKE & SWALE

RC-5 (GLS) GRASS LINED SWALE

RC-11 (CD) CHECK DAMS

RC-12 (BSS) BIOENGINEERING METHODS OF STREAMBANK STABILIZATION

RC-13 (SSS) STRUCTURAL STREAMBANK STABILIZATION

EROSION PREVENTION BMPS

EP-2 (PV) PRESERVE VEGETATION

EP-2A (GC) GROUND COVER

EP-2B (BZ) BUFFER ZONES

EP-3 (SR) SURFACE ROUGHENING

EP-3 (GT) GRADIENT TERRACES

EP-5 (TS) TEMPORARY SEEDING

EROSION PREVENTION BMPS (CONT.)

EP-6 (PS) PERMANENT SEEDING & PLANTING

EP-6A (VSS) VEGETATIVE STREAMBANK STABILIZATION

EP-8 & EP-10 (MU) MULCHING & MATTING

EP-13 (DC) DUST CONTROL MEASURES

EP-17 (BB) BRUSH BOX/BARRIER

EP-21 (SO) SOD

EP-22 (PS) PLACTIC SHEETING

EP-23 (RR) RIP RAP

SEDIMENT CONTROL BMPS

SC-1 (SF) SEDIMENT FENCE

SC-2 (SBB) SAND BAG BARRIER

SC-4 (STB) STAKED STRAW BALE BIOFILTER

SC-6 (CB) COMPOST BERM

SC-7 (SW) STRAW WATTLES

SEDIMENT CONTROL BMPS (CONT.)

SC-8 (IP) INLET PROTECTION

SC-9 (ST) TEMPORARY SEDIMENT BASIN

SC-9A (SB) SEDIMENT POND OR BASIN

SC-10 (TW) TIRE WASHDOWN BASIN-CONCRETE OR ROCKLINED

SC-11 (CE) STABILIZED CONSTRUCTION ENTRANCE

SC-13 (SP) SOIL/AGGREGATE STOCKPILE

BARRIER SPACING

INSTALL PARALLEL ALONG CONTOURS AS FOLLOWS

% SLOPE	SLOPE (V:H)	MAX. SPACING ON SLOPE
<10%	<1:10	300 FT
10% > % ≥ 15	1:10 > X ≥ 1:7.5	150 FT
15 > % ≥ 20	1:7.5 > X ≥ 1:5	100 FT
20 > % ≥ 30	1:5 > X ≥ 1:3	50 FT
>30%	>1:3	25 FT

SLOPE DRAIN – RC-1

Construction Specifications:

A common failure of slope drains is caused by water saturating the soil and seeping along the pipe. Proper backfilling around and under the pipe haunches with stable soil material and hand compacting in 6 inch (0.2 m) lifts to achieve firm contact between the pipe and the soil at all points will reduce this type of failure.

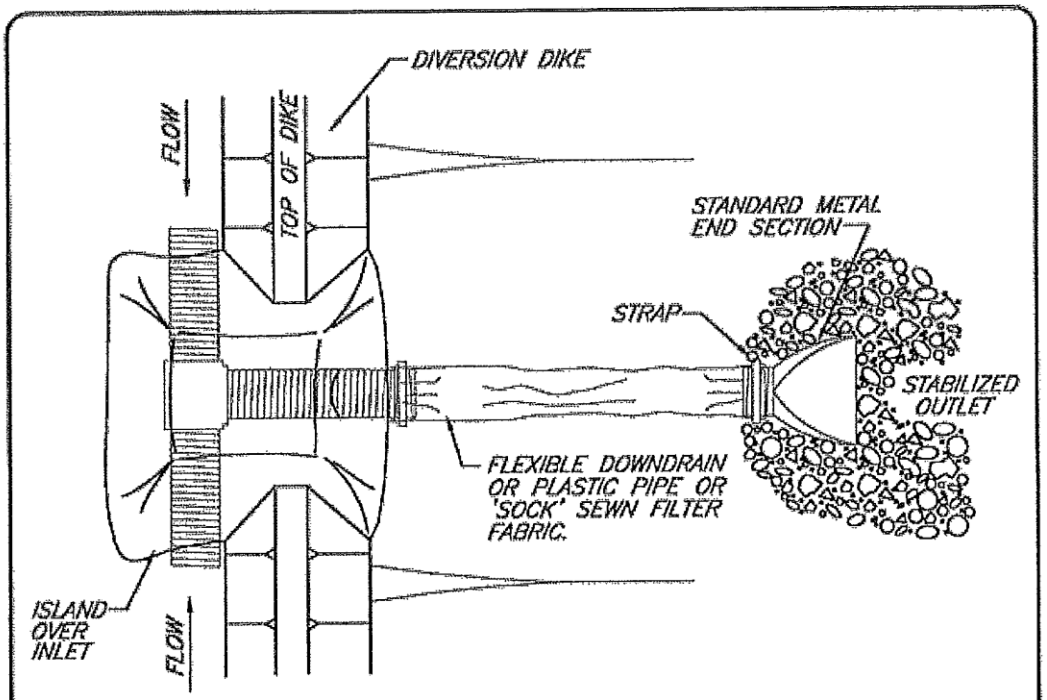
- Place slope drains on undisturbed soil or well-compacted fill at locations and elevations shown on the plans.
- Slightly slope the section of pipe under the dike toward its outlet.
- Compact the soil under and around the entrance section in lifts not to exceed 6 inches.
- Ensure that fill over the drain at the top of the slope has a minimum depth of 1.5 feet (0.5 m) and a minimum top width of 4 feet (1.2 m). The sides should have a 3:1 slope.
- Ensure that all slope drain connections are watertight.
- Ensure that all fill material is well-compacted. Securely fasten the exposed section of the drain with grommets or stakes spaced no more than 10 feet (3.1 m) apart. If the drain is longer than 10 feet (3.1 m), the drain must be anchored within each 10 foot (3.1 m) section and at the end section. Anchoring methods can vary depending on site conditions. At a minimum, the drain should be staked such that it is not able to move laterally or separate from the upstream diversion culvert.
- Extend the drain beyond the toe of the slope and adequately protect the outlet from erosion (see EC-10).
- Make the settled, compacted dike ridge no less than 1 foot (0.3 m) higher than the top of the pipe inlet.
- As an alternative to slope drains visqueen flume down drains may be used to convey runoff to a stabilized downstream conveyance. The visqueen shall be anchored at the top of a slope similar to erosion control blankets (EC-10). Use sandbags to stabilize the sides of the visqueen flume similar to sand bag barriers (SC-2). The visqueen (plastic sheet) shall meet the following specifications:
    - 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 (3 m) apart. Seams are typically taped or weighted down their entire length, and there shall be at least a 12 to 24 inches (300 mm to 600 mm) overlap of all seams. Edges shall be embedded a minimum of 6 inches (150 mm) 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 occurs, the material shall be re-installed after repairing the damage to the slope.
- Immediately after grading, stabilize all disturbed areas as appropriate (see Erosion Prevention BMPs).

Minimum BMP standards are provided on the following detail.

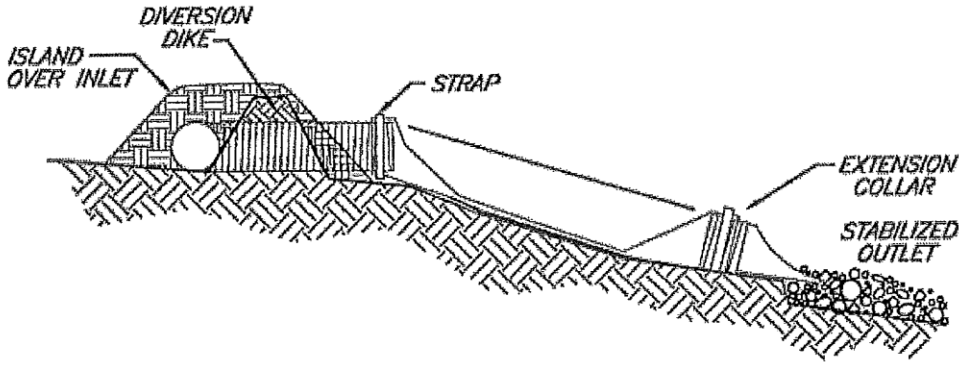
Inspection and Maintenance:

- Inspect the slope drain and supporting diversions before, during, and after every storm event and promptly make necessary repairs.
- When the protected area has been permanently stabilized, temporary measures may be removed, materials disposed of properly, and all disturbed areas stabilized appropriately.

SLOPE DRAIN – RC-1



PLAN VIEW



SECTION

Alternative to Flexible downdrain:
Visqueen flume anchored with closely placed sand bags

SLOPE DRAIN

FILE: SLOPEDRN

ENERGY DISSIPATOR – RC-2

This BMP provides specifications for riprap type energy dissipators. Alternative energy dissipation methods such as mats, plates, or other stabilization techniques may be used in the project ESCP as approved by DEQ or a local agency acting as DEQ's agent.

Construction Specifications:

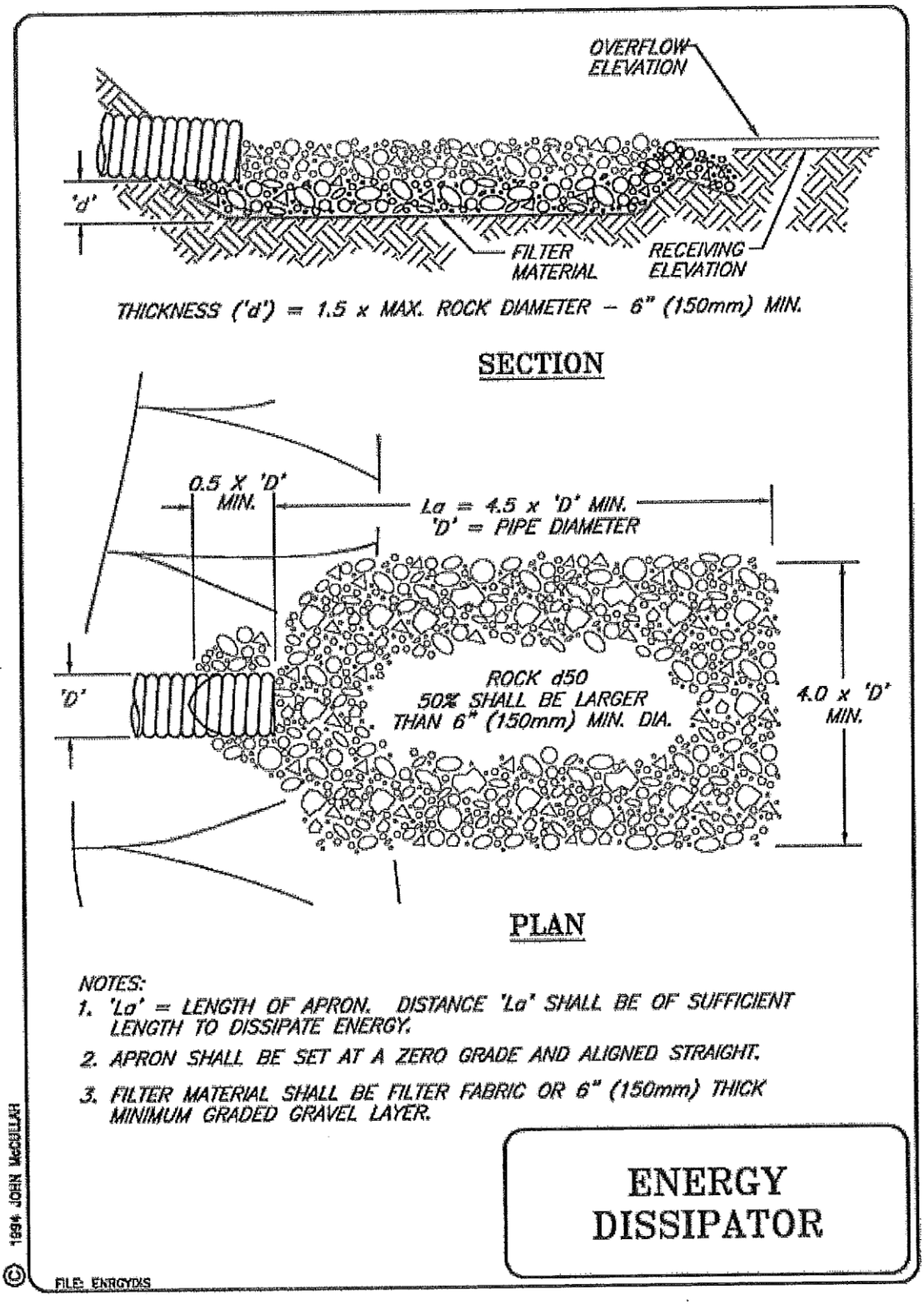
- Ensure that the subgrade for the filter and riprap follows the required lines and grades shown on the plans. Compact any fill required in the subgrade to the density of the surrounding undisturbed material. Low areas in the subgrade on undisturbed soil may also be filled by increasing the riprap thickness.
- The riprap and gravel filter must conform to the specified grading limits shown on the plans.
- Filter fabric, when used, must meet design requirements and be properly protected from punching or tearing during installation. Repair any damaged fabric by removing the riprap and placing another piece of filter fabric over the damaged area. All connecting joints should overlap a minimum of 1 foot (0.3 m). If the damage is extensive, replace the entire filter cloth.
- Riprap may be placed by equipment, but take care to avoid damaging the fabric.
- The minimum thickness of the riprap should be 1.5 times the maximum stone diameter.
- Riprap may be field stone or rough quarry stone. It shall be hard, angular, highly weather-resistant and well graded.
- Construct the apron on zero grade with no overflow at the end. Make the top of the riprap at the downstream end level with the receiving area or slightly below it.
- Ensure that the apron is properly aligned with the receiving stream and preferably straight throughout its length. If a curve is needed to fit site conditions, place it in the upper section of the apron.
- Immediately after construction, stabilize all disturbed areas with vegetation.
- Outlets of all water conveyances must be stabilized.

Minimum BMP standards are provided on the following detail.

Inspection and Maintenance:

- Inspect riprap outlet structures before, during, and after rains to see if any erosion around or below the riprap has taken place or if stones have been dislodged. Immediately make all needed repairs to prevent further damage.
- Clean out energy dissipation as necessary when approximately half of the void space is filled with sediment and debris.

ENERGY DISSIPATOR – RC-2

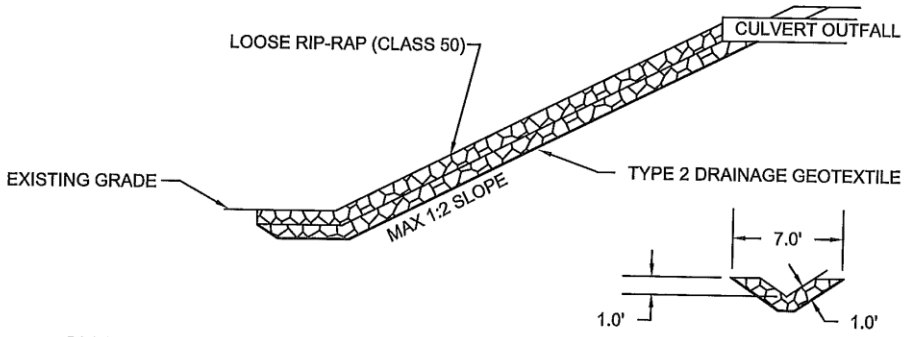


NOTES:

1. 'La' = LENGTH OF APRON. DISTANCE 'La' SHALL BE OF SUFFICIENT LENGTH TO DISSIPATE ENERGY.
2. APRON SHALL BE SET AT A ZERO GRADE AND ALIGNED STRAIGHT.
3. FILTER MATERIAL SHALL BE FILTER FABRIC OR 6" (150mm) THICK MINIMUM GRADED GRAVEL LAYER.

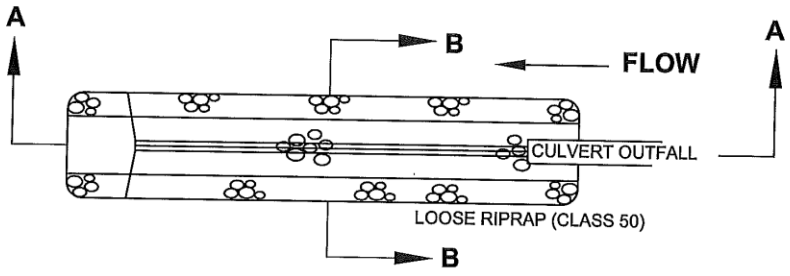
ENERGY DISSIPATOR

FILE: ENRGYDIS



SECTION A-A

SECTION B-B



PLAN

DRAWING RC-2
OUTLET PROTECTION
(N.T.S.)

TEMPORARY DIVERSION DIKE RC-4

Construction Specifications

A Diversion Dike is a low berm (or ditch and berm combination) that is constructed along the crest or top of a streambank. The purpose of a diversion is to intercept and divert runoff away from the face of a steep slope or streambank. Diverted runoff should outlet onto a stabilized area, a prepared level spreader, or into a slope protection structure, e.g., a slope drain. Diversion dikes are constructed from compacted earthen fill and should be used on drainage areas of 5 acres (2 ha) or less. In addition to protecting the face of a streambank from overbank runoff, diversions may also improve general slope stability by preventing runoff from infiltrating into and saturating the face of the bank.

Conditions Where Practice Applies

Diversion Dikes should be used only on drainage areas of 5 acres (2 ha) or less.

Design Guidelines / Typical Drawings

Diversion dikes are constructed from compacted earthen fill to a height of 18 in (45 cm) with side slopes 1V:2H or flatter. Height is measured from the upslope toe to the top of the dike (see Figure 1).

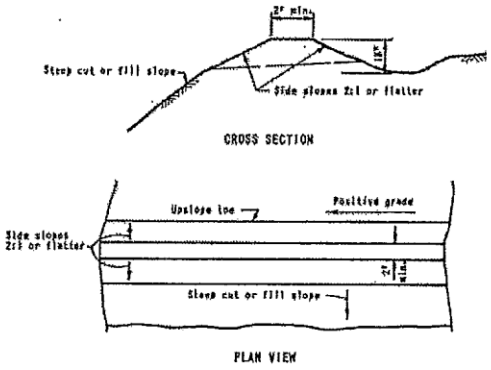


Figure 1. Cross section and plan views of diversion dike

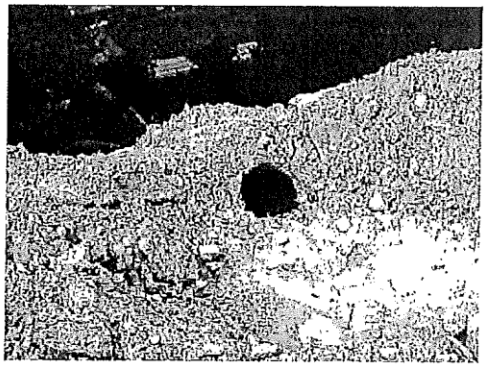


Figure 2. Diversion dike used in combination with a flexible slope drain

The dike should have a minimum top width of 2 ft (60 cm). A conceptual design for a diversion dike, either a berm only or a berm and ditch combination is shown in Figure 1. A shallow trench or swale to contain the diverted runoff is normally incorporated into the design. Soil from the ditch can be used to construct the berm, provided it has sufficient fines to hold a 1V:2H side slope and be relatively impermeable when compacted. The swale or drainage ditch must have positive drainage to an outlet. Vegetative or mechanical stabilization may be required where grades are excessive.

Materials and Equipment

Construction of a low dike requires soil with sufficient fines to hold a 1V:2H side slope and to be relatively impermeable when compacted. The dike can be constructed by hand or with the aid of a backhoe or front-end loader.

Construction / Installation

- If overbank runoff is a problem, construction of a diversion dike or interceptor should precede other bank stabilization treatments.
- The height of the dike should be kept under 18 in (45 cm) so as not to interfere with bank access.
- Use of a ditch and bank combination allows more efficient capture and diversion of runoff.

- In addition, the soil excavated from the ditch can be used to construct the dike. Down drains or slope drains should be inserted through the dike periodically to convey the collected runoff to the stream below.
- Alternatively, the ditch should be constructed with sufficient positive grade to some other type of outlet.

Inspection and Maintenance

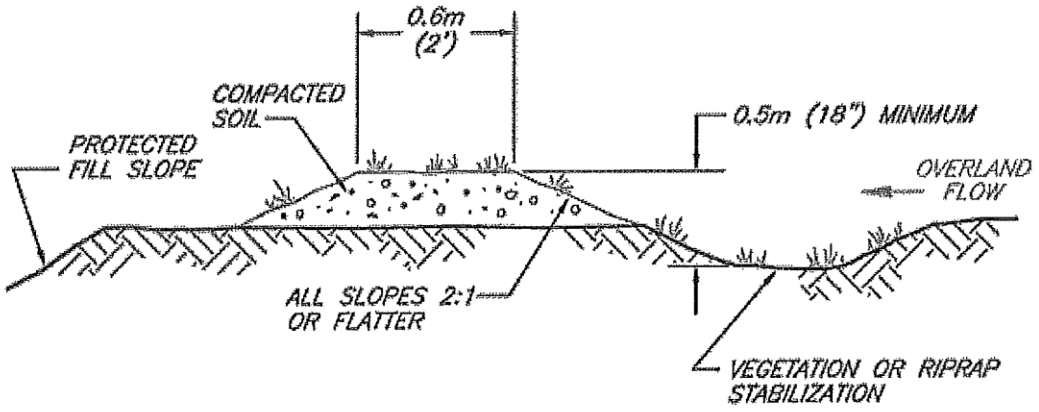
The dike or berm should be inspected to check that it has not been breached. Repair as needed. The ditch or swale behind the dike should also be checked for accumulation of sediment and debris. Excessive sediment accumulations should be removed.

Common Reasons / Circumstances for Failure

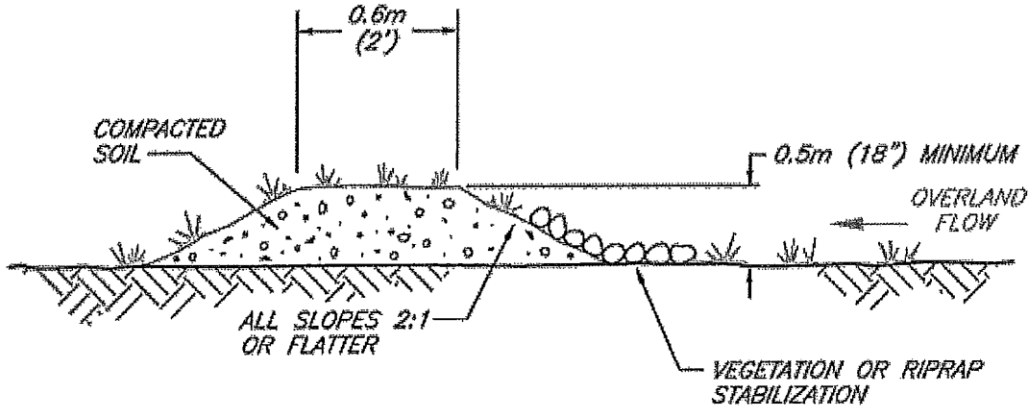
The most common reasons for failure are:

1. Overtopping and/or breaching of the dike or berm,
2. Excessive sediment accumulation in the ditch or swale behind the berm, and
3. Inadequate or insufficient outlet capacity of any appurtenant drop inlet and/or slope drains.

TEMPORARY DIVERSION DIKE RC-4



TYPICAL FILL DIVERSION



TYPICAL TEMPORARY DIVERSION DIKE

NOTES:
1. THE CHANNEL BEHIND THE DIKE SHOULD HAVE POSITIVE GRADE TO A STABILIZED OUTLET.
2. THE DIKE SHALL BE ADEQUATELY COMPACTED TO PREVENT FAILURE.
3. THE DIKE SHOULD BE STABILIZED WITH TEMPORARY OR PERMANENT SEEDING OR RIPRAP.

DIVERSION DIKE

FILE: DIVDK

GRASS-LINED CHANNEL (TURF REINFORCEMENT MATS) RC-5

Construction Specifications

Turf Reinforcement Mats (TRMs) are similar to Erosion Control Blankets, but they usually are intended for lining channels. They are composed of ultraviolet (UV) stabilized polymeric fibers, filaments, nettings and/or wire mesh, integrating together to form a three-dimensional matrix ¼ to ¾ in (5 to 20 mm) thick. The types of polymer include polypropylene, polyethylene, polyamides, and polyvinyl chloride. Often TRMs are combined with organic material such as coir to aide vegetation establishment and provide the initial temporary erosion control necessary to resist the forces of running water until the vegetation can become established. Typical vegetation includes grasses that can withstand inundation.

Conditions Where Practice Applies

TRMs are designed to provide protection to resist channel and streambank erosion, and are useful when underlying soil boundaries may subside or shift slightly after installation.

Design Specifications / Typical Drawings

There are three types of TRMs, and their application depends on the site condition, as shown in Table 1.

TRMs can be installed after applying seed to the prepared soil surface or deployed first, and then seeded following infilling with soil. The former method allows the roots and shoots to grow through and interlock with the geosynthetic matrix, as shown in the second figure above. The channel or bank surface requires careful preparation, must be uniform and relatively free of rocks, stumps, clods etc, to ensure that there is complete contact between the TRM and the soil surface.

The number of anchoring stakes or staples per ft (or per m) is site and product specific, and should be determined according to the manufacturer's specifications. See Table 2 for stake sizing recommendations. Live willow stakes may be substituted for metal or wooden anchoring stakes, although it should be noted that willows could shade out turf grass. Willow wattles or fascines may be used to anchor the mats into the slots.

GRASS-LINED CHANNEL (TURF REINFORCEMENT MATS) RC-5

Table 1. Recommendations for TRM applications (ECTC, 2001)

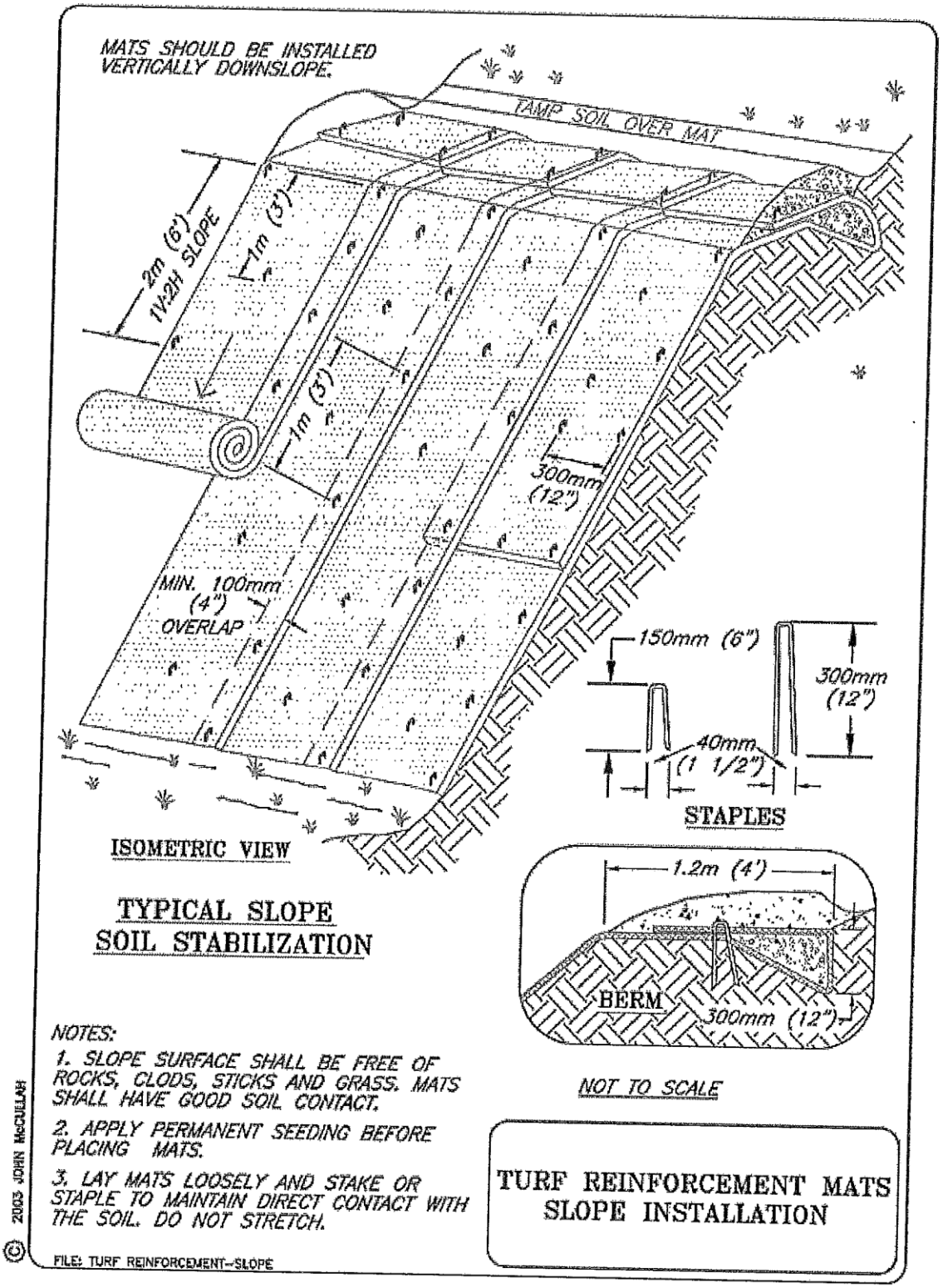
Type	UV Stability Minimum tensile strength retained after 1000 hr. (ASTM D 4355) (%)	Tensile Strength[1,2] (ECTC[4] mod. ASTM D5035) lb/ft (kN/m)	Application	
			Slope V:H	Channel max. shear stress[3] (ASTM D6460 or other ECTC approved tests) lb/ft^2 (Pa)
A	80	125 (1.82)	1:1	6 (288)
B	80	150 (2.19)	1:0.5	8 (384)
C	80	175 (2.55)	1:0.5	10 (480)

[1]Minimum average roll values, machine direction.
[2]Field conditions with high loading and/or high survivability requirement may warrant the use of TRMs with tensile strength of 3000 lb/ft (44 kN/m) or greater
[3]Max. shear stress TRM (fully vegetated) can sustain without physical damage or excess erosion during a 30-minute flow event. (Note: fully vegetated shear stress properties for TRMs containing degradable components must be obtained on the nondegradable portion of the matting alone.)
[4]Erosion Control Technology Council – Technical Guidance Manual for Testing Rolled Erosion Control Products.

Table 2. Recommendations for TRM stake selection

Stake Length	**Soil Conditions**
6 inches	Typical soil conditions. Six-inch staples used in all but loose soil types.
8 inches	Loam, relatively loose sandy loam to sandy soils. Eight-inch staples are typically used in high velocity channel applications.
> 12 inches	Excessively loose soils, slopes containing fine silt, sand, or soft mud. Deep and soft fills, loose sands, silts, loams or "quick" conditions. Staples 12 inches and longer are used in shoreline applications in which wave action is a factor or in instances where soils remain saturated for long periods of time.

GRASS-LINED CHANNEL (TURF REINFORCEMENT MATS) RC-5



GRASS-LINED CHANNEL (TURF REINFORCEMENT MATS) RC-5

Materials and Equipment

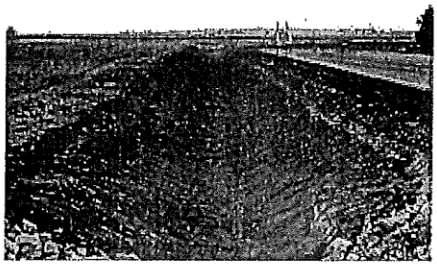
TRMs may be installed either with hand labor or equipment; the main tools or equipment required consist of hammers, stapling devices, and shovels or equipment for trenching.

Construction / Installation

TRMs (in channels) typically require very special installation and construction techniques.

Site Preparation

The site should be fine graded to a smooth profile and relatively free from all weeds, clods, stones, roots, sticks, rills, gullies, crusting and caking.



Fill any voids and make sure that the channel is compacted properly.

Seeding

Seed the area to be vegetated with a seed mix adapted to the local geographical area and soil conditions.

Choosing the appropriate seed mix will ensure optimum germination, root system development, vegetation density, and long term functionality. The types of seeds planted above the anticipated water line may differ from those below the anticipated water line.

If the prepared seed bed becomes crusted or eroded, or if ruts or depressions exist for any reason, prior to RECP installation the contractor should rework the soil until it is smooth and re-seed reworked areas.

TRM Installation in Channel Bottom

TRMs should always be unrolled in the direction of water flow.

First, install the TRM in the channel bottom. Try to minimize the number of seams that are placed on the bottom of the channel, as these are sites of weakness. Do not put seams in the center of the channel bottom or in areas of concentrated water flow. When installing two TRMs side by side in a waterway, the center of the TRM should be centered in the area of concentrated water flow. Install adjoining TRMs away from the center of the channel bottom. Follow the manufacturer's recommendations for overlapping the TRM; generally the overlap will be 50 to 100 mm (2 to 4 in).

Secure the TRM at the beginning of the channel with a 150 mm x 150 mm (6" x 6") check slot dug perpendicular to the direction of water flow across the entire width of the channel.

Lay the TRM in the check slot with 750 mm (30 in) extending upstream of the check slot. Stake or staple the TRM in the check slot on 300 mm (12 in) centers.

Backfill the anchor trench and compact the soil. Place seed over the compacted soil if necessary.

Cover the compacted soil with the remaining 300 mm (12 in) of the terminal end of the TRM. Staple or stake the terminal end of the TRM down slope of the anchor trench on 300 mm (12 in) centers.

Check Slots

"Check slots" (cutoff trenches) must be provided every 7.5 to 15 m (25-50 ft) to ensure water moving under the TRM is forced back to the surface. Longitudinal check slots are required to ensure off site "side flows" do not get under the TRM. Similarly, beginning and terminal check slots are critical.

Check slots can be installed in one of two ways, depending upon the Engineers discretion and/or the manufacturer's recommendations.

One type of check slot is constructed by installing a double row of staples or stakes staggered and spaced 100 mm (4 in) apart.

The second option is to install a check slot 150 mm (6 in) wide by 150 mm (6 in) deep, and secure the TRM in the upstream side of the check slot with staples or stakes on 300 mm (12 in) centers.

Flip the TRM roll on the upstream edge. Back fill the check slot and compact the soil. Continue rolling the TRM downstream over the completed check slot.

Installation on Side Slopes

As the TRM is installed from the channel bottom up the slope, a shingle-type installation is recommended with the up-slope TRM overlapping the lower TRM approximately 50 to 100 mm (2 to 4 in).

Anchor the TRMs with a minimum of one staple every 60 mm (24 in) across the width and one staple every 90 mm (36 in) down the length.

If the TRM needs to be spliced, "shingle" it as discussed above, with a 100 mm (4 in) overlap. Use a staple check slot to secure the overlap.

Anchor the RECP placed at the top of the channel slope in the same manner as described in the slope section.

Terminal End

Secure the TRM at the terminal end of the channel with a check slot similar to the one made at the beginning of the channel.

Alternative Channel Installation Method

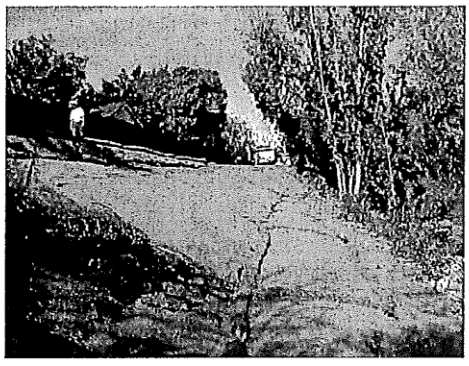
Another installation method for TRMs is to install them vertically and approximately 1 m (3 ft) onto the flat of the channel bottom. Construct a check slot in areas of concentrated water flow. Use a 50 to 100 mm (2 to 4 in) shingle-type overlap upstream to downstream.

Inspection and Maintenance

Basic monitoring consists of visual inspections to determine mat integrity and attachment performance. Rill development beneath the mat or edge lifting are evidence of inadequate attachment. Additional staking and trenching can be employed to correct defects. Recently placed mats may be replaced, but once vegetation becomes established, replacement is not a reasonable option.

Common Reasons / Circumstances for Failure

Critical points in conveyance system applications where mats can lose support include points of overlap between mats, projected water surface boundaries and channel bottoms.

	
Coir TRM channel installation, Guadalupe River, San Jose CA., October 2003	Same site during first large winter storms, winter 2004

CHECK DAMS –RC-11

Construction Specifications:

- Check dams shall be placed at a distance and height to allow small pools to form behind them. The maximum spacing between the dams shall be such that the toe of the upstream dam is at the same elevation as the top of the downstream 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.
- Construct rock dams such that structures are not damaged by vehicles and do not impede travel ways.
- Rock dams shall be constructed of 2 to 15-inch rock.
- Keep the center rock (spillway) section at least 6 inches lower than the outer edges.
- Extend the abutments 18" into the channel bank.
- Only gravel bags may be used as check dams with the following specifications:

  Materials

  - Bag Material: Bags shall be either polypropylene, polyethylene or polyamide woven fabric, minimum unit weight four ounces per square yard (135 g/m^2), mullen burst strength exceeding 300 psi (2,070 kPa) in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70% in conformance with the requirements in ASTM designation D4355.
  - Bag Size: Each gravel-filled bag shall have a length of 18 in (450 mm), width of 12 in (300 mm), thickness of 3 in (75 mm), and mass of approximately 33 lb (15 kg). Bag dimensions are nominal, and may vary based on locally available materials. Alternative bag sizes shall be submitted to the engineer for approval prior to deployment.
  - Fill Material: Fill material shall be between 10 mm and 20 mm (0.4 and 0.8 inch) in diameter, and shall be clean and free from clay balls, organic matter, and other deleterious materials. The opening of gravel-filled bags shall be secured such that gravel does not escape. Gravel-filled bags shall be between 28 and 48 lb (13 kg and 22 kg) in mass. Fill material is subject to approval by the engineer.

  Installation

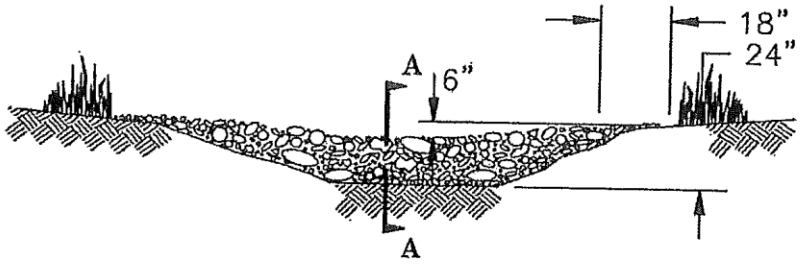
  - Install along a level contour.
  - Tightly abut bags and stack gravel bags using a pyramid approach. Gravel bags shall not be stacked any higher than 3.2 ft (1 meter).
  - Upper rows of gravel bags shall overlap joints in lower rows.
  - Local and state requirements shall be met concerning fencing and signs warning the public of hazards of soft sediment and floodwater.

Minimum BMP standards are provided on the following illustrations.

Inspection and Maintenance:

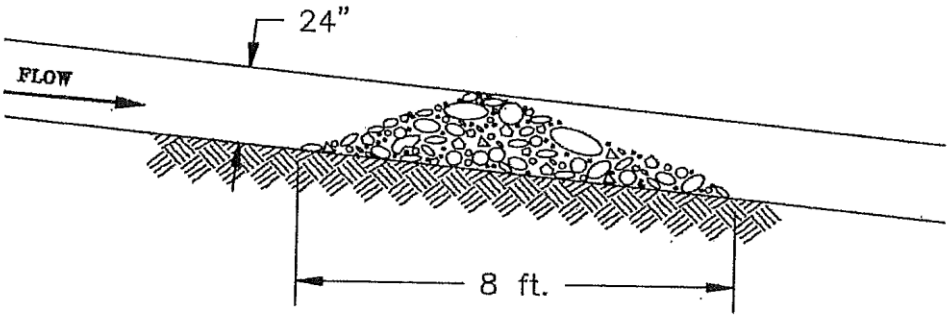
- Inspect check dams before, during, and after each rainfall event. Repair damage as needed.
- Remove sediment when depth reaches one-third of the check dam height.
- Remove accumulated sediment prior to permanent seeding or soil stabilization.
- Remove check dam and accumulated sediment when check dams are no longer needed.
- Removed sediment shall be incorporated in the project or disposed of properly.

CHECK DAMS –RC-11

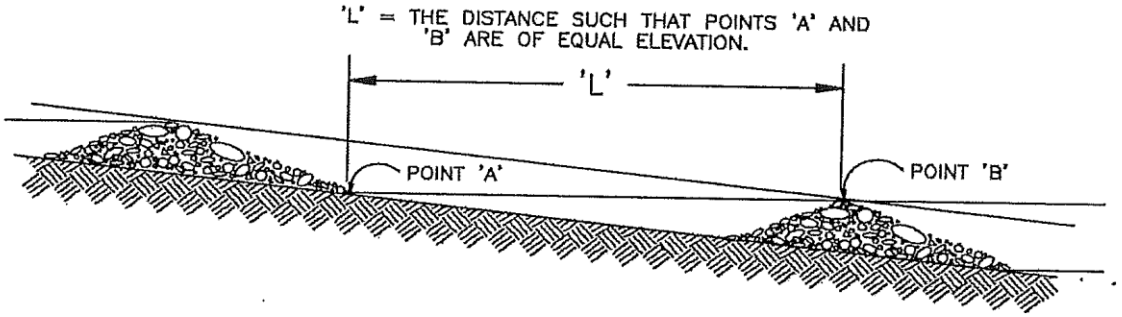


VIEW LOOKING UPSTREAM

NOTE:
KEY STONE INTO THE CHANNEL BANKS AND EXTEND CHECK DAM A MINIMUM OF 18" TO PREVENT FLOW AROUND DAM.

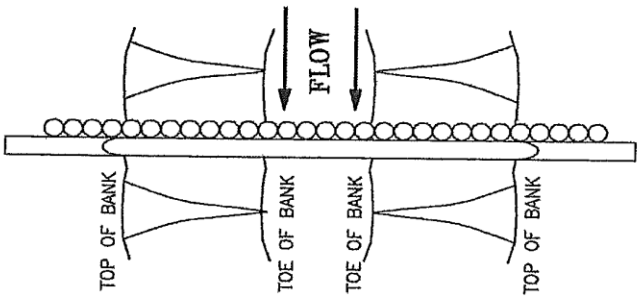


SECTION A – A

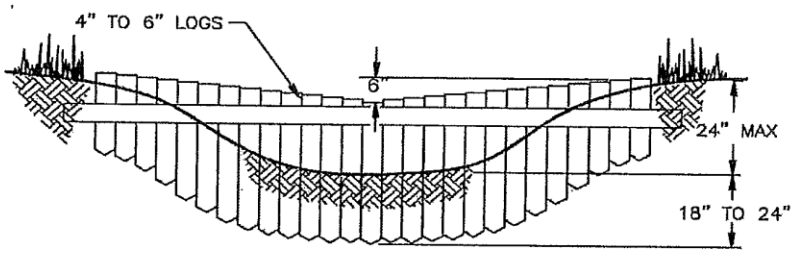


SPACING BETWEEN CHECK DAMS

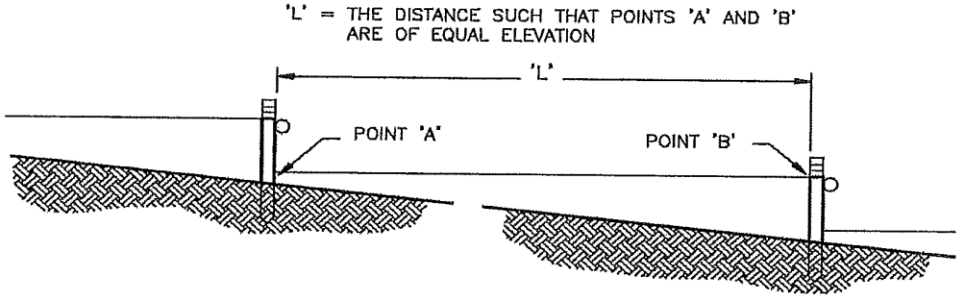
CHECK DAMS –RC-11



PLAN VIEW



VIEW LOOKING UPSTREAM



SPACING BETWEEN CHECK DAMS

NOTE:
KEY THE ENDS OF THE CHECK DAM INTO THE CHANNEL BANK. LOGS SHALL BE PRESSURE TREATED IF GRADE STABILIZATION STRUCTURE IS INTENDED TO BE PERMANENT.

BIOENGINEERING STREAM BANK STABILZATION RC-12

This BMP should be considered for implementation along banks in creeks, streams and rivers subject to erosion from excess runoff. This practice is generally applicable where bankfull flow velocity does not exceed 1.5 meters per second (5 ft. /sec) and soils are erosion resistant. Above 1.5 meters per second, structural measures are generally required.

Bioengineering uses live plant materials to provide erosion control, slope and stream bank stabilization, landscape restoration, and wildlife habitat. These techniques are used alone or in conjunction with conventional engineering techniques. Soil bioengineering refers to the use of amendments such as compost, mycorrhizae fungi, bacteria inoculations and other soil treatments that promote living soil and functional soil ecology.

There are many types of bioengineering methods of varying levels of complexity. Resources are widely available. Some are proprietary and some are generally accepted practices. Should the applicant chose to use this method of stream bank stabilization a bioengineering plan and methodology must be prepared by a qualified professional for review.

A good reference for general bioengineering methodology, applications and supporting science is the United States Department of Agriculture, Natural Resource Protection Service Field Engineering Handbook, Chapter 18, Soil Bioengineering for Upland Slope Protection and Erosion Reduction. Available on-line at:
ftp://ftp-nhq.sc.egov.usda.gov/NHQ/pub/outgoing/jbernard/CED-Directives/efh/EFH-Ch18.pdf

STRUCTURAL STREAM BANK STABILZATION RC-13

This BMP should be considered for implementation along banks in creeks, streams and rivers subject to erosion from excess runoff. This practice is generally applicable where bankfull flow velocity exceeds 1.5 meters per second (5 ft. /sec), soils are not erosion resistant and bioengineering methodologies are likely to fail.

The most common structural stabilization methods are, rip-rap, gabions, cast in place reinforced concrete deflectors, metal sheet piles, log cribbing, interlocking retaining walls and grid pavers. These techniques are used alone or in conjunction with conventional engineering techniques. This is only a partial list of available techniques and materials.

There are many types of structural stabilization systems of varying levels of complexity. Resources are widely available. Some are proprietary and some are generally accepted practices. Should the applicant chose to use this method of stream bank stabilization a structural stabilization plan and methodology must be prepared by a qualified professional for review.

SCHEDULING – EP-1

Scheduling involves sequencing construction activities and the installation of erosion and sediment control measures to reduce the amount and duration of soil exposed to erosion by wind, rain, runoff and vehicle tracking. The timing of soil-disturbing activities and the timing of implementation of BMPs are both critical to the prevention of accelerated erosion and transport of sediment off-site. The scheduling of grading should take into account the rainy season and should minimize the length of the time that soils are left exposed, and reduce the total area of exposed soil during the rainy season. Consideration should be given to phasing the grading and construction so that critical areas (such as highly erodible soils, areas adjacent to receiving waters, etc.) are not disturbed until the non-rainy season, and so the entire area that is disturbed at any one time is kept to a size that can be controlled effectively.

Construction Specifications:

- The optimum grading period is when the chance for precipitation is minimized (e.g., the non-rainy season), particularly for the critical areas. If precipitation is likely during grading, minimize the length of time that soils are exposed, and the total area of exposure.
- Materials used for erosion and sediment control shall be on site at all times.
- Take the following measures when precipitation is forecast:
  - Minimize the length of time that the soils are left exposed.
  - Reduce the total area of exposed soil.
  - Protect critical areas such as drainage channels, streams, and natural water courses.
  - Stabilize exposed areas quickly.
- The schedule shall clearly show how regional precipitation trends relate to soil-disturbing and re-stabilization activities. The construction schedule shall be incorporated into the Erosion and Sediment Control Plan.
- The schedule shall include detail on the implementation and deployment of temporary soil stabilization measures, temporary sediment controls, tracking controls, wind erosion controls, non-storm water pollution controls (including waste management and materials pollution controls).
- The schedule shall also include dates for significant long-term operations or activities that may have planned non-storm water discharges such as dewatering, saw cutting, grinding, drilling, boring, crushing, blasting, painting, hydro-demolition, mortar mixing, bridge cleaning, etc.
- Develop 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 when the chances of precipitation are minimized when practical.
- Schedule the installation, removal, or modification of run-on controls and flow conveyance structures for the non-rainy season or when there is a low probability of precipitation to reduce the likelihood of uncontrolled flow across and from the site.
- Stabilize non-active areas after the cessation of soil-disturbing activities or prior to the onset of precipitation in accordance with local requirements.
- 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 practices. Erosion may be caused during dry seasons by unseasonable rainfall, wind, and vehicle tracking. Keep the site stabilized year-round, and retain and maintain 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 as work progresses.
- Consider scheduling when establishing permanent vegetation (appropriate planting time for specified vegetation).

Inspection and Maintenance:

SCHEDULING – EP-1

- Verify that work is progressing in accordance with the schedule. If progress deviates, take corrective actions.
- Amend the schedule when changes are warranted.
- Amend the schedule to show updated information on the deployment and implementation of construction site BMPs.

PRESERVATION OF EXISTING VEGETATION / BUFFER STRIPS – EP-2

Maintaining existing vegetation or placing vegetative buffer strips can have numerous benefits for stormwater quality, erosion and sediment control, as well as landscape beautification, dust control, noise reduction, shade and watershed protection.

Construction Specifications:

Preservation of Existing Vegetation:

Timing

- Preservation of existing vegetation shall be provided prior to the commencement of clearing and grubbing operations or other soil-disturbing activities in areas identified on the plans to be preserved, especially on areas designated as Environmentally Sensitive Areas (ESAs) or where no construction activity is planned or will occur at a later date.
- Limits of clearing and grubbing should be clearly marked prior to any grading or clearing activities.
- Preservation of existing vegetation shall conform to scheduling requirements and local permitting agency requirements.

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 3.2. ft (1 meter) tall and shall have openings not larger than 2 in by 2 in (50 mm by 50 mm).
- Fence posts shall be either wood or metal 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.
- 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 at least to drip line.
- 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 100 ft (30 m) of the drip line of any retained trees. No toxic or construction materials (including paint, acid, nails, gypsum board, chemicals, fuels, and lubricants) shall be stored within 50 ft (15 m) 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 18 in (450 mm) 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.

PRESERVATION OF EXISTING VEGETATION / BUFFER STRIPS – EP-2

- The ends of damaged or cut roots shall be cut off smoothly.
- Trenches and tunnels shall be filled as soon as possible or in accordance with local requirements. 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.
- 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.

Vegetative Buffer Strips:

- Vegetated buffer strips (vegetated filter strips, filter strips, and grassed filters) are vegetated surfaces that are designed to treat sheet flow from adjacent surfaces. Filter strips function by slowing runoff velocities and allowing sediment and other pollutants (e.g., total and dissolved metals) to settle and partially infiltrate into underlying soils. With proper design and maintenance, filter strips can provide relatively high pollutant removal.
- Designate watercourse buffer-filter strips on the site design plan.
- The width of a buffer strip (i.e., flow path length) shall be maximized to the extent feasible with a 15 foot suggested minimum width. Buffer strips shall be sized in accordance with site conditions and local requirements.

SURFACE ROUGHENING – EP-3

Surface roughening involves roughening surface soils by mechanical methods including sheepsfoot rolling, track walking, scarifying, stair stepping, and imprinting. All slopes prepared by surface roughening must meet engineering compaction requirements required by the project design and local grading requirements. This BMP is intended to only affect surface soils and is not intended to compromise slope stability or overall compaction.

Construction Specifications:

Cut Slope Roughening:

- Stair-step grade or groove the cut slopes that are steeper than 3:1.
- Use stair-step grading on any erodible material soft enough to be ripped with a bulldozer. Slopes consisting of soft rock with some subsoil are particularly suited to stair-step grading.
- Make the vertical cut distance less than the horizontal distance, and slightly slope the horizontal position of the "step" in toward the vertical wall.
- Do not make individual vertical cuts more than 2 feet (0.6 m) high in soft materials or more than 3 feet (0.9 m) high in rocky materials.
- Groove the slope using machinery to create a series of ridges and depressions that run across the slope, on the contour.

Fill Slope Roughening:

- Place on fill slopes with a gradient steeper than 3:1 in lifts not to exceed 8 inches (0.2 m), and make sure each lift is properly compacted.
- Ensure that the face of the slope consists of loose, uncompacted fill 4-6 inches (0.1-0.2 m) deep.
- Use grooving or tracking to roughen the face of the slopes, if necessary.
- Do not blade or scrape the final slope face.

Roughening for Slopes to be Mowed:

- Slopes which require mowing activities shall not be steeper than 3:1.
- Roughen these areas to shallow grooves by track walking, scarifying, sheepsfoot rolling, or imprinting.
- Make grooves close together (less than 10 inches (0.3 m)), and not less than 1 inch (25.4 mm) deep, and perpendicular to the direction of runoff (i.e., parallel to the slope contours).
- Excessive roughness is undesirable where mowing is planned.

Roughening With Tracked Machinery:

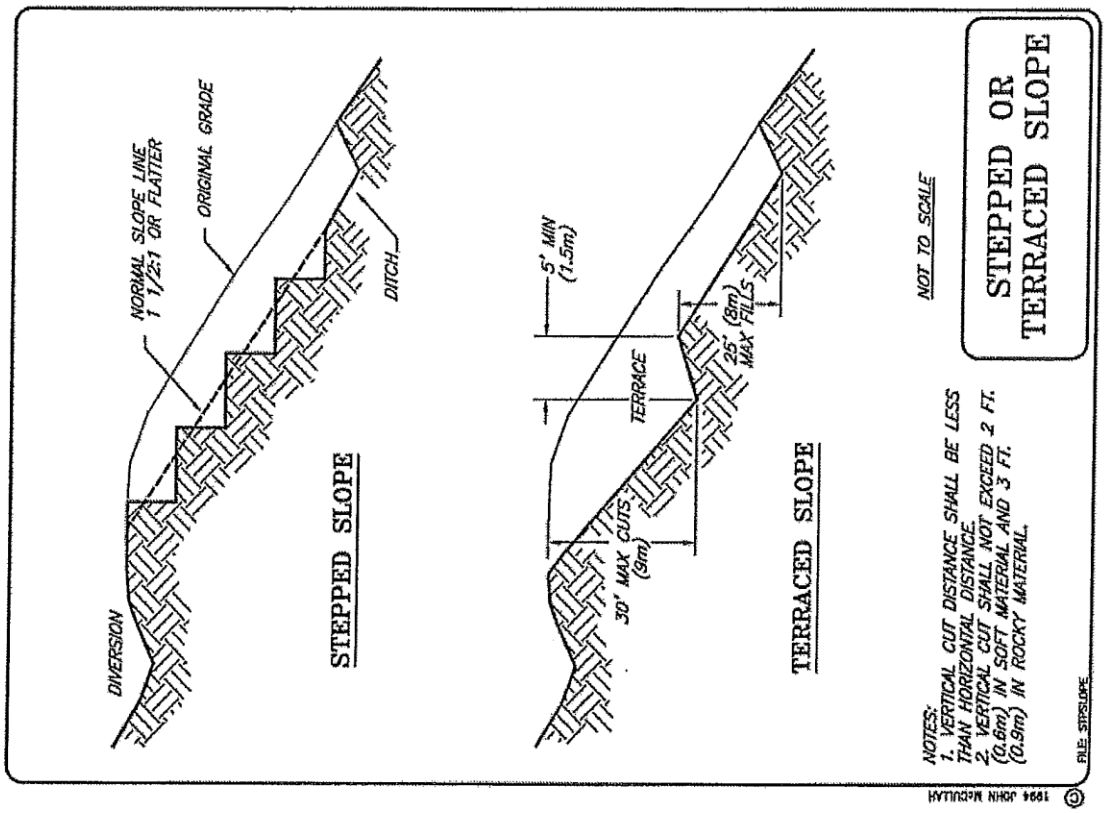
- Limit roughening with tracked machinery to soils with a sandy textural component to avoid undue compaction of the soil surface.
- Operate tracked machinery up and down the slope to leave horizontal depressions in the soil. Do not back-blade during the final grading operation.
- Seed and mulch roughened areas as soon as possible to obtain optimum seed germination and growth.

Minimum BMP standards are presented in the attached detail.

Inspection and Maintenance:

Check the seeded slopes for signs of erosion such as rills and gullies. Fill these areas slightly above the original grade, then reseed and mulch as soon as possible.

SURFACE ROUGHENING – EP-3



TEMPORARY SEEDING AND PLANTING EP-5

Temporary seeding and planting consists of the establishment of temporary vegetative cover on disturbed areas to reduce erosion by seeding with appropriate and rapidly growing annual grasses and forbs.

Construction Specifications

Conditions Where Practice Applies

- Cleared or graded areas that are exposed and subject to erosion for extended periods (e.g., 14 to 30 days depending on local requirements).
- Cleared or graded areas exposed to seasonal rains.
- Areas that will not be subjected to heavy wear by construction equipment.
- Temporary seeding is encouraged whenever possible to aid in reducing erosion on construction sites. Temporary seeding is an important component of "phased" construction activities. Permanent seeding shall be applied to areas intended to be left dormant for a year or more.

The following chart shows recorded shear stress and velocities withstood by grass mixtures and applications.

Bank Material/Protection	Shear		Velocity			Reference
	lb/ft^2	N/m^2	ft/s	m/s		
Sandy Loam	0.0167		1.75	0.53	Design	Temple, 1980
Silt Loam	0.0218		2	0.61	Design	Temple, 1980
Alluvial silts	0.0218		2	0.61	Design	Temple, 1980
Ordinary firm loam	0.0341		2.5	0.76	Design	Temple, 1980
Very light loose sand, no vegetation or protection			1-1.5	.3-.46	Limit	Fortier & Scobey, 1926
Average sandy soil			2-2.5	.61-.76	Limit	Fortier & Scobey, 1926
Stiff clay, ordinary gravel soil			4-5	1.2-1.5	Limit	Fortier & Scobey, 1926
Bermuda grass, erosion resistant soils, 0-5% slope			8	2.4	Design	USDA, 1947
Bermuda grass, erosion resistant soils, 5-19% slope			7	2.1	Design	USDA, 1947
Bermuda grass, erosion resistant soils, over 10% slope			6	1.8	Design	USDA, 1947
Bermuda grass, easily eroded soils, 0-5% slope			6	1.8	Design	USDA, 1947
Bermuda grass, easily eroded soils, 5-10% slope			5	1.5	Design	USDA, 1947
Bermuda grass, easily eroded soils, over 10% slope			4	1.2	Design	USDA, 1947
Grass mixture, erosion resistant soils, 0-5% slope			5	1.5	Design	USDA, 1947
Grass mixture, erosion resistant soils, 5-10% slope			4	1.2	Design	USDA, 1947
Grass mixture, easily eroded soils, 0-5% slope			4	1.2	Design	USDA, 1947
Grass mixture, easily eroded soils, 5-10% slope			3	0.91	Design	USDA, 1947

1" riprap	0.33	16			Limit	Chen & Cotton, 1988
2" riprap	0.67	33			Limit	Chen & Cotton, 1988
6" riprap	2	98			Limit	Chen & Cotton, 1988
12" riprap	4	196			Limit	Chen & Cotton, 1988
Dense sod, fair condition (class D/E), moderately cohesive soil	0.35	17			Limit	Austin & Theisen, 1994
Bermuda grass, fair stand <12 cm tall, dormant	0.9	44			Limit	Parsons, 1963
Bermuda grass, good stand <12 cm tall, dormant	1.1	54			Limit	Parsons, 1963
Bermuda grass, excellent stand 20 cm tall, dormant	2.7	132			Limit	Parsons, 1963
Bermuda grass, excellent stand 20 cm tall, green	2.8	137			Limit	Parsons, 1963
Bermuda grass, excellent stand >20 cm tall, green	3.2	156			Limit	Parsons, 1963
12.5 cm of excellent growth of grass/woody veg on outside bend	1	49			Limit	Parsons, 1963
Flume trials, fabric reinforced vegetation – failed after 50 hours	5	244			Limit	Theisen, 1992
Flume trials, fabric reinforced vegetation – failed after 8 hours	8	391			Limit	Theisen, 1992
Sod revetment, short period of attack	0.41	20.09			Design	Schoklitsch, 1937
Wattle (coarse sand between)	0.2	9.8			Design	Schoklitsch, 1937
Wattles (gravel between)	0.31	15.19			Design	Schoklitsch, 1937
Wattles (parallel or oblique to current)	1	49			Design	Schoklitsch, 1937
Fascine revetment	1.4	68.6			Design	Schoklitsch, 1937
Cribs with stone	30	1470			Design	Schoklitsch, 1937
Turf (immediately after construction)	0.2	10			Limit	Schiechtl & Stern, 1994
Turf (after 3-4 seasons)	2.04	100			Limit	Schiechtl & Stern, 1994

Site Considerations

- Prior to seeding, install necessary erosion control practices such as temporary continuous berms, diversion dikes, channels, and sediment basins.
- Proper seedbed preparation and the use of quality seed are important in this practice just as in permanent seeding. Failure to carefully follow sound agronomic recommendations will often result in an inadequate stand of vegetation that provides little or no erosion control.
- Annual plants which sprout rapidly and survive for only one growing season are suitable for establishing temporary vegetative cover. Consider mixes because they are more adaptable than single species.
- Check with local municipalities for local specifications and requirements prior to seeding and planting.

- Mulching is commonly used with seeding practices for temporary cover and to aid in the establishment of vegetation.
- Temporary seeding also prevents costly maintenance operations on other erosion control systems. For example, sediment basin maintenance (clean-out) will be reduced if the drainage area has temporary vegetative cover when grading and construction are not taking place. (Temporary seeding is essential to preserve the integrity of earthen structures used to control sediment, such as diversion dikes, and sediment basins)
- To reduce the amount of fertilizer, pesticides and other inputs needed, choose adapted varieties based on environmental conditions, management level desired, and the intended use. Check with local municipalities prior to use of fertilizer or pesticides.

Timing

The proper time to seed is dependent upon the climate of the area and the species of seed selected. To determine seeding dates for temporary cover, consult the seed supplier.

Seed Mixes

- All seed should be selected in accordance with local municipality requirements.
- Select plants appropriate to the season and site conditions.
- The seeding rates are based on a minimum acceptable pure live seed (PLS) of 80%. When PLS is below 80% adjust rates accordingly.
- Legumes should be inoculated with the proper rhizobium bacteria before planting. Pellet inoculated seed can be purchased or inoculation can be done in the field. Use only fresh, age dated inoculate specifically labeled for use with the legume you are using.

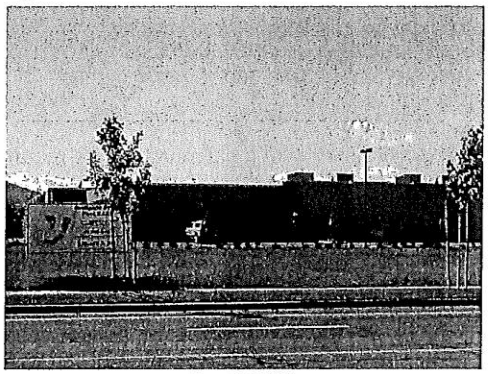
Site Preparation

- Grade as needed and feasible to permit the use of equipment for seedbed preparation.
- Install needed erosion control practices, such as sediment basins, diversion dikes and channels, prior to seeding. Divert concentrated flows away from seeded areas.
- Soil tests should be done to determine the nutrient and pH content of soil. Depending on the results of soil tests, soil management may be necessary to adjust the pH to between 6.5 and 7.0 (for most conditions). All lime, fertilizer and other soil amendments should be added following sound soil management practices.
- Surface roughening: If the area has been recently loosened or disturbed, no further roughening is required. When the area is compacted, crusted or hardened the soil should be loosened with discing, raking or harrowing. Tracking with bulldozer cleats is very effective on sandy soils.
- Hydroseeding and hydraulic planting generally require less seedbed preparation.
- Generally, slopes steeper than 2:1 that cannot have good seedbed preparations with equipment will require hydraulic planting techniques.
- Seed to soil contact is the key to good germination. Prepare a 3-5 inch (76-127 mm) deep seedbed, with the top 3-4 inches (76-102 mm) consisting of topsoil. Note that the earth bed upon which the topsoil is to be placed should be at the required grade.
- The seedbed should be firm but not compact. The top 3 inches (76 mm) of soil should be loose, moist and free of large clods and stones. For most applications, all stones larger than 2 inches (51 mm) in diameter, roots, litter and any foreign matter should be raked and removed. The topsoil surface should be in reasonably close conformity to the lines, grades and cross sections shown on the grading plans.

TEMPORARY SEEDING AND PLANTING EP-5

Hydroseeding site in September 2003

December 2003



April 2004

Planting:

- Seed should be applied as soon after seedbed preparation as possible, when the soil is loose and moist.
- Always apply seed before mulch, unless seed is applied with a hydraulic matrix or bonded fiber matrix (See BMP EP-8, Mulches).
- Apply seed at the rates specified using calibrated spreaders, cyclone seeders, mechanical drills, or hydroseeders so the seed is applied uniformly on the site.
- If seed is applied with a bonded fiber matrix, apply BFM from multiple directions to adequately cover the soil. Application from a single direction can result in shadowing, uneven coverage, and failure of the BFM.
- Apply fertilizer if required. Seed and fertilizer should be incorporated into the soil by raking or chain dragging, or otherwise floated, then lightly compacted to provide good seed-soil contact.
- Straw mulch, erosion control blankets or mulch and tackifiers/soil binders should be applied over the seeded areas.

Inspection and Maintenance:

- Newly seeded areas need to be inspected frequently to ensure the grass is growing. Areas that fail to establish cover adequate to prevent sheet and rill erosion will be reseeded as soon as such areas are identified. Spot seeding can be done on small areas to fill in bare spots where grass did not grow properly.
- If the seeded area is damaged due to concentrated runoff, additional practices may be needed.
- Temporary vegetated areas will be maintained until permanent vegetation or other erosion control practices can be established.

PERMANENT SEEDING AND PLANTING EP-6

Permanent seeding involves the establishment of a permanent, perennial vegetative cover on disturbed areas from seed. Refer to BMP EP-21 for installation of sod. Planting of shrubs, trees, and container plants should be conducted in accordance with project landscaping specifications and local requirements.

The use of native, indigenous, or naturally-occurring grasses is recommended for biotechnical works. These "native" grasses have evolved in a manner that will not compete with or preclude the establishment, or natural recruitment, of naturally-occurring woody vegetation. Establishment of permanent vegetation provides natural erosion and sediment control by trapping particulates, slowing runoff velocities and enhancing infiltration. Permanent vegetation also is beneficial for long-term aesthetics and wildlife habitat.

Construction Specifications

Conditions Where Practice Applies

- Graded, final-graded or cleared areas where permanent vegetative cover is needed to stabilize the soil. Permanent seeding with perennial grasses is recommended when fibrous and deeply rooted are needed to provide slope and soil reinforcement.
- Slopes designated to be treated with erosion control blankets should be seeded first.
- Grass-lined channels or waterways designed to be treated with turf reinforcement mats, fiber roving systems, or other channel liners will require special grass blends.

Materials

Proper seed selection is very important. Choose climatically adapted perennial species that are long-lived, hearty and require low inputs of fertilizer, irrigation and mowing. You may consider a locally occurring species for native grass establishment. Consider seed blends because they are more adaptable.

Use seeds appropriate to the season and site conditions. Use a seed blend, which include annuals, perennials and legumes. Legumes should be inoculated with the proper rhizobium bacteria before planting. Pellet inoculated seed can be purchased or inoculation can be done in the field. Unless otherwise specified by local requirements, use seed rates based on minimum pure live seed (PLS) of 80%. When PLS is below 80% adjust rates accordingly. Consult a local seed supplier, landscape architect, or erosion control specialist for appropriate seed blends. Seed should be selected in accordance with local regulations.

Installation

The probability of successful plant establishment can be maximized through good planning, knowledge of soil characteristics, selection of appropriate seed blends for the site, good seedbed preparation, and timely planting. Prior to seeding, install necessary erosion control practices such as diversion dikes, channels, and sediment basins. Site area should be at final grade and not be disturbed by future construction activities.

Timing

- Apply permanent seeding on areas left dormant for 1 year or more.
- Apply permanent seeding when no further disturbances are planned.
- To determine optimum seeding schedule, consult a local agronomist or erosion control specialist.
- Apply permanent seeding before seasonal rains or freezing weather is anticipated.
- Use dormant seeding for late fall or winter seeding schedules.

Seed Mixes

- Use seeds appropriate to the season and site conditions.
- Consult local agronomist or erosion control specialists for seed mix.
- Use a seed blend to include annuals, perennials and legumes.

- Use seed rates based on pure live seed (PLS) of 80%. When PLS is below 80% adjust rates accordingly.

Site Preparation

- Bring the planting area to final grade and install the necessary erosion control BMPs (i.e., sediment basins and temporary diversion dikes).
- Divert concentrated flows away from the seeded area.
- Conduct soil test to determine pH and nutrient content. Roughen the soil by harrowing, tracking, grooving or furrowing.
- Apply amendments as needed and permitted by local municipalities to adjust pH to 6.0-7.5. Incorporate these amendments into the soil. Prepare a 3-5 in (76-127 mm) deep seedbed, with the top 3-4 in (76-102 mm) consisting of topsoil. The seedbed should be firm but not compact. The top three inches of soil should be loose, moist and free of large clods and stones. The topsoil surface should be in reasonably close conformity to the lines, grades and cross sections shown on the grading plans.

Planting:

- Seed to soil contact is the key to good germination.
- Seed should be applied immediately after seedbed preparation while the soil is loose and moist. If the seedbed has been idle long enough for the soil to become compact, the topsoil should be harrowed with a disk, spring tooth drag, spike tooth drag, or other equipment designed to conditions the soil for seeding.
- Harrowing, tracking or furrowing should be done horizontally across the face of the slope.
- Always apply seed before applying mulch, unless using a hydraulic matrix or bonded fiber matrix where seed is mixed with mulch prior before application.
- Apply seed at the rates specified using calibrated seed spreaders, cyclone seeders, mechanical drills, or a hydroseeder so the seed is applied uniformly on the site.
- Broadcast seed should be incorporated into the soil by raking or chain dragging, and then lightly compacted to provide good seed-soil contact.
- Apply fertilizer as specified and allowed by local municipalities.
- Apply mulch or erosion control blanket, as specified, over the seeded areas.

Inspection and Maintenance

- Newly seeded areas need to be inspected frequently to ensure the grass is growing.
- If the seeded area is damaged due to runoff, additional stormwater measures may be needed.
- Spot seeding can be done on small areas to fill in bare spots where grass did not grow properly.
- Irrigation/watering should be used as necessary and recommended to establish vegetation in accordance with local regulations.

VEGETATIVE STREAM BANK STABILZATION EP-6A

This BMP should be considered for implementation along banks in creeks, streams and rivers subject to erosion from excess runoff. This practice is generally applicable where bankfull flow velocity does not exceed 1.5 meters per second (5 ft. /sec) and soils are erosion resistant. Above 1.5 meters per second, structural measures are generally required.

Most natural stream channels are formed with a bankfull capacity to pass the runoff from a storm with a 1-1/2 to 2 year recurrence interval. The protection provided by natural vegetation is more reliable and effective where the cover consists of natural plant communities which are native to the site. Vegetation also provides habitat for fish and wildlife and is aesthetically pleasing. Plants provide erosion protection to streambanks by reducing stream velocity, binding soil in place with a root mat and covering the soil surface when high flows tend to flatten vegetation against the banks. For these reasons, vegetation should always be considered first. The erosion potential for the stream needs to be evaluated to determine the best solutions.

The following items should be considered in the evaluation:

- The frequency of bankfull flow based on anticipated watershed development.
- The channel slope and flow velocity, by design reaches.
- The antecedent soil conditions.
- Present and anticipated channel roughness ("n") values.
- The location of channel bends along with bank conditions.
- The location of unstable areas and trouble spots. Steep channel reaches, high erosive banks and sharp bends may require structural stabilization measures such as riprap, while the remainder of the streambank may require only vegetation.

Vegetation Zones Along Watercourses

Aquatic Plant Zone

This zone is normally permanently submerged. In the Pacific Northwest, this zone is inhabited by plants such as pondweeds, cattail, wapato and water lilies, which reduce the water's flow rate by friction. The roots of these plants help to bind the soil, and they further protect the channel from erosion because the water flow tends to flatten them against the banks and bed of the stream.

Emergent Zone 1 (1' below – 1" above design water level)

The lower part of this zone is normally submerged for only about half the year. In Mid-Atlantic states, this zone is inhabited by rushes, burreeds, cattails, speedwell and other plants which bind the soil with their roods, rhizomes and shoots and slow the water's flow rate by friction.

Emergent Zone 2 (design water level to 2' above)

This zone is flooded only during periods of average high water. The northwest, the shrub zone is inhabited by trees and shrubs—such as willow, managrass, parsnip, tufted hairgrass and dogwood—with a high regenerative capacity. These plants hold the soil with their root systems and slow water speed by friction. They also protect tree trunks from damage caused by breaking ice and help to prevent the formation of strong eddies around large trees during flood flows. Shrub zone vegetation is particularly beneficial along the impact bank of a stream meander,

where maximum scouring tends to occur. Infringement of shrub vegetation into the channel tends to reduce the channel width, increasing probability of floods. However, brief flooding of riverside woods and undeveloped bottomlands does no significant damage, and the silt deposits in these wooded areas are less of a problem than failed banks.

Riparian Zone (1' – 3' above design water level)

This zone is flooded only during periods of very high water (i.e., the 2 year bankfull flow or greater flows). Typical northwest riparian trees are alder, ash, cottonwood, willow, cedar, white oak, hemlock and maple. These trees hold soil in place with their root systems.

Design Criteria

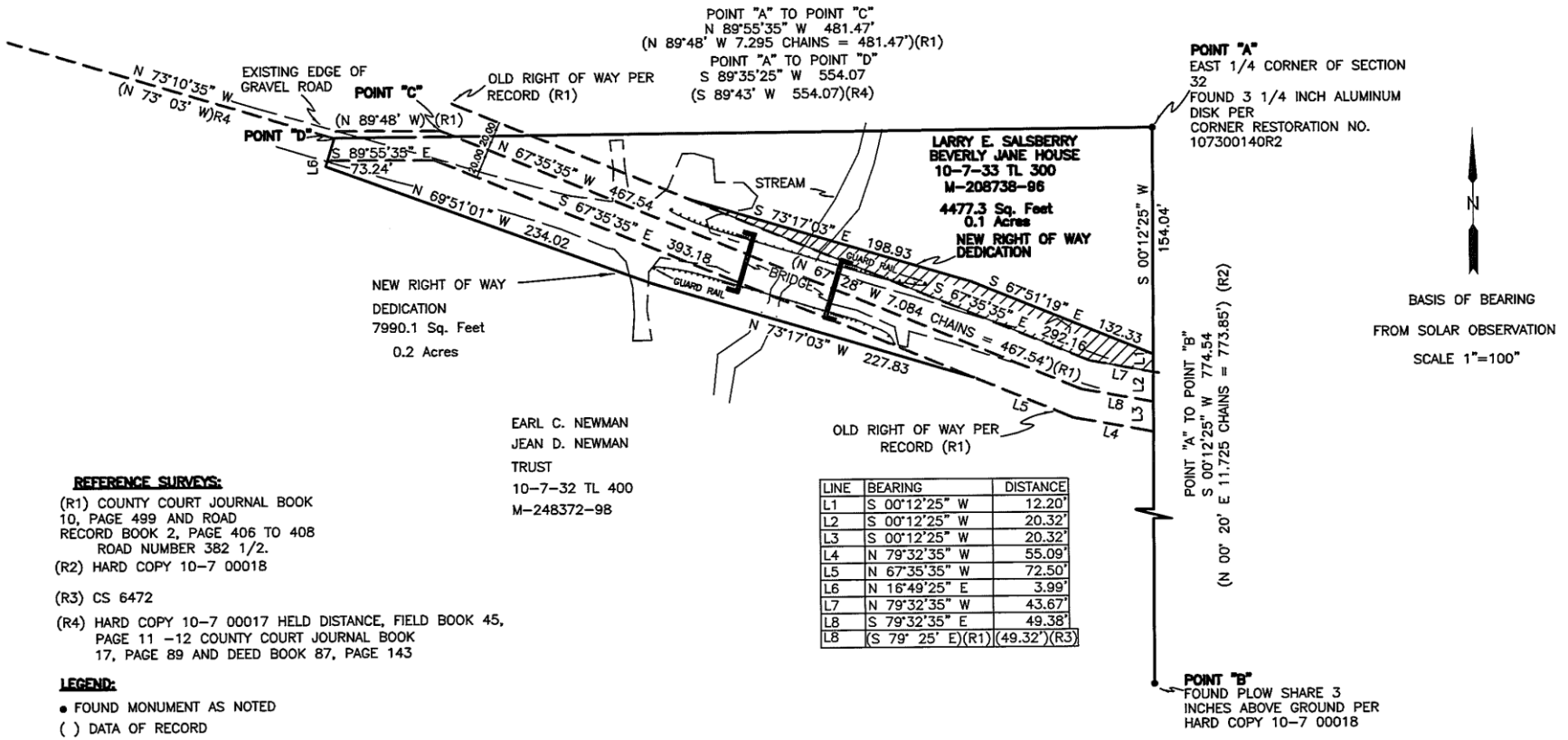
Table 6-A-1 provides general guidelines for maximum allowable velocities in streams to be protected by vegetation.

- Ensure that channel bottoms are stable before stabilizing channel banks.
- Keep velocities at bankfull flow non-erosive for the site conditions.
- Provide mechanical protection such as riprap on the outside of the channel bends if bankfull stream velocities approach the maximum allowable for the site conditions.
- Be sure that requirements of other state or federal agencies are met in the design in the case that other approvals or permits are necessary.

TABLE 6-1-A
CONDITIONS WHERE VEGETATIVE
STREAMBANK STABILIZATION IS ACCEPTABLE

Frequency of Bankfull Flow	Max. Allowable Velocity in meters per second (m/sec) for Highly Erodible Soil	Max. Allowable Velocity in meters per second (m/sec) for Erosion Resistant Soil
> 4 times/yr.	1.2 m/sec (4 ft/sec)	1.5 m/sec (5 ft/sec)
1 to 4 times/yr.	1.5 m/sec (5 ft/sec)	1.8 m/sec (6 ft/sec)
< 1 time/yr.	1.8 m/sec (6 ft/sec)	1.8 m/sec (6 ft/sec)

RIGHT OF WAY DEDICATION
FOR
HOSKINS ROAD COUNTY ROAD NO. 06540
LOCATED IN THE NORTHEAST QUARTER AND THE SOUTHEAST QUARTER OF SECTION 32
TOWNSHIP 10 SOUTH, RANGE 7 WEST,
WILLAMETTE MERIDIAN
BENTON COUNTY, OREGON
FOR BENTON COUNTY PUBLIC WORKS



LINE	BEARING	DISTANCE
L1	S 00°12'25" W	12.20'
L2	S 00°12'25" W	20.32'
L3	S 00°12'25" W	20.32'
L4	N 79°32'35" W	55.09'
L5	N 67°35'35" W	72.50'
L6	N 16°49'25" E	3.99'
L7	N 79°32'35" W	43.67'
L8	S 79°32'35" E	49.38'
L8	(S 79° 25' E)(R1)	(49.32')(R3)

REFERENCE SURVEYS:

(R1) COUNTY COURT JOURNAL BOOK 10, PAGE 499 AND ROAD RECORD BOOK 2, PAGE 406 TO 408 ROAD NUMBER 382 1/2.

(R2) HARD COPY 10-7 00018

(R3) CS 6472

(R4) HARD COPY 10-7 00017 HELD DISTANCE, FIELD BOOK 45, PAGE 11 -12 COUNTY COURT JOURNAL BOOK 17, PAGE 89 AND DEED BOOK 87, PAGE 143

LEGEND:

• FOUND MONUMENT AS NOTED

( ) DATA OF RECORD

MULCHES – EP-8

Mulching is the process of applying bulk materials to the soil surface to reduce rainfall impact, increase infiltration and in some cases, aid in revegetation. Common types of mulch include vegetable fibers, green material, hydraulic mulches from recycled paper or wood fibers, hydraulic matrices, and straw mulch. Mulches may include a tackifier to increase the longevity of the application.

Construction Specifications:

- Mulch should be used for temporary applications only; permanent erosion control measures should also be applied.
- 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.

Wood Fiber Mulch – Materials and Application Procedures

- Wood fiber mulch is a component of hydraulic applications. It is usually used in combination with seed and fertilizer. It is typically applied at the rate of 2,000 to 4,000 lb/ac (2,250 to 4,500 kg/ha) with 0-5% by weight of a stabilizing emulsion or tackifier (e.g., guar, psyllium, acrylic copolymer) and applied as a slurry. This type of mulch is manufactured from wood or wood waste from lumber mills or from urban sources.
- Wood fiber mulch can be specified with or without a tackifier; previous work has shown that wood fiber mulches with tackifiers have better erosion control performances.
- Materials for wood fiber based hydraulic mulches and hydraulic matrices shall conform to Oregon DOT Standard Specifications Sections 01030.15 and 01030.16 and local municipality requirements and specifications.

Recycled Paper Mulch – Materials and Application Procedures

- Recycled paper mulch contains fibers of shorter length than wood fiber mulches and is typically made from recycled newsprint, magazine, or other waste paper sources. It is a component of hydraulic applications and is usually used in combination with seed and fertilizer. It is typically applied at the rate of 1 to 2 tons/ac (2,250 to 4,500 kg/Ha). It can be specified with or without a tackifier.

Green Material – Materials and Application Procedures

- This type of mulch is produced by recycling 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 may 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 (50 mm).

Hydraulic Matrix – Materials and Application Procedures

- Hydraulic matrix is a combination of wood fiber mulch and a tackifier applied as a slurry. It is typically applied at the rate of 2,000 to 4,000 lb/ac (2,250 to 4,500 kg/ha) with 5-10% by weight of a stabilizing emulsion or tackifier (e.g., guar, psyllium, acrylic copolymer).
- Materials for wood fiber based hydraulic mulches and hydraulic matrices shall conform to Oregon DOT Standard Specifications Sections 01030.15 and 01030.16 and local municipality requirements and specifications.
- Hydraulic matrices require 24 hours to dry before rainfall occurs to be effective unless approved by Oregon DEQ.

Bonded Fiber Matrix – Materials and Application Procedures

- 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/ac (3,400 to 4,500 kg/ha) based on the manufacturer's recommendation. The biodegradable BFM is composed of materials that are 100% biodegradable. The binder in the BFM shall also be biodegradable and shall 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 require 12 to 24 hours to dry to become effective.
- BFM should be selected and used in accordance with local municipality requirements and specifications.
- Apply bonded fiber matrices from multiple directions to adequately cover the soil. Application from a single direction can result in shadowing, uneven coverage, and failure of the BFM.

Straw Mulch - Materials

- All materials shall conform to Oregon DOT Standard Specifications Sections 01030.15(b) and any local municipality requirements.
- Straw shall be derived from wheat, rice, or barley. The straw mulch contractor shall furnish evidence that clearance has been obtained from the County Agricultural Commissioner, as required by law, before straw obtained from outside the county in which it is to be used is delivered to the site of the work. Straw that has been used for stable bedding shall not be used.

Straw Mulch – Application Procedures

- Apply loose straw at a minimum rate of 4,000 lb/ac (3,570 kg/ha), or as indicated in the project's Erosion and Sediment Control Plan, either by machine or by hand distribution.
- The straw mulch must be evenly distributed on the soil surface.
- Avoid placing straw onto the traveled way, sidewalks, lined drainage channels, walls, and existing vegetation.
- Anchor the mulch in place by using a tackifier (preferred) or by "punching" it into the soil mechanically (incorporating).
- If using a tackifier 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.
- 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 (see Oregon DOT Standard Specifications Section 01030.16).
- A tackifier is typically applied at a rate of 125 lb/ac (140 kg/ha). In windy conditions, the rate is typically 178 lb/ac (200 kg/ha).
- Straw mulch with tackifier shall not be applied during or immediately before rainfall.
- 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 Oregon DOT Standard Specifications Section 01030.48(b) and any local municipality's specifications and requirements.
  - On small areas, a spade or shovel can be used.
  - 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 may be "punched" into the ground using a knife-blade roller or a straight bladed coulter, known commercially as a "crimper."
  - On small areas and/or steep slopes, straw may 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. Refer to EP-10, "Erosion Control Blankets and Mats."

MULCHES – EP-8

Inspection and Maintenance:

- Maintain an unbroken, temporary mulched ground cover throughout the period of construction when the soils are not being reworked. Inspect before expected rain events and repair any damaged ground cover and re-mulch exposed areas of bare soil.
- The key consideration in maintenance and inspection is that the mulch needs to last long enough to achieve erosion control objectives. Mulch is a temporary ground cover and not suitable for long-term erosion control.
- 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 mulch and tackifier may be required by Oregon DEQ and local municipalities to maintain effective soil stabilization over disturbed areas and slopes.
- After any rainfall event, maintain all slopes to reduce or prevent erosion.

EROSION CONTROL BLANKETS AND MATS – EP-10

Erosion control blankets and mats (a.k.a., rolled erosion control products - RECPs) provide erosion control by protecting the bare soil from rainfall impact, increasing infiltration and promoting vegetation by protecting seeds from predators and moderating soil temperature. Erosion control blankets and mats can be biodegradable or synthetic and can be temporary or permanent erosion control applications.

Construction Specifications:

Site Preparation:

- Proper site preparation is essential to ensure complete contact of the protection matting with the soil.
- Site preparation should be performed in accordance with any local municipality requirements and specifications.
- Grade and shape area of installation.
- Remove all rocks, clods, vegetative or other obstructions so that the installed blankets, or mats will have direct contact with the soil.
- Prepare seedbed by loosening 2-3 inches (50.8-76.2 mm) of topsoil above final grade.
- Incorporate amendments, such as lime and fertilizer, into soil according to soil test and the seeding plan.

Materials:

Erosion control blankets are grouped into three types: biodegradable, non-biodegradable, and a combination of synthetic and biodegradable.

BiodegradableRECPs

Biodegradable RECPs are typically composed of jute fibers, curled wood fibers, straw, coconut fiber, or a combination of these materials.

- Jute Mesh: Jute is a natural fiber that is made into a yarn which 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 should be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.
- Curled Wood Fiber: Excelsior (curled wood fiber) blanket material should consist of machine produced mats of curled wood excelsior with 80 percent of the fiber 6 inches (15 cm) or longer. The excelsior blanket should be of consistent thickness. The wood fiber should be evenly distributed over the entire area of the blanket. The top surface of the blanket should be covered with a photodegradable extruded plastic mesh. The blanket should be smolder resistant without the use of chemical additives and shall be non-toxic and non-injurious to plant and animal life. Excelsior blanket should be furnished in rolled strips, a minimum of 4 feet (122 cm) wide, and should have an average weight of 0.1 lb/ft^2 (0.5 kg/m^2), ±10 percent, at the time of manufacture. Excelsior blankets should be secured in place with wire staples. Staples should be made of 0.12 inches (3.05-mm) steel wire and should be U-shaped with 8 inches (20 cm) legs and 2 inches (5 cm) crown. Always follow the manufacturer's recommendation on staple types, patterns and the number to use per square yard or meter.
- Straw: Straw blanket should be machine-produced mats of straw with a lightweight biodegradable netting top layer. The straw should be attached to the netting with biodegradable thread or glue strips. The straw blanket should be of consistent thickness. The straw should be evenly distributed over the entire area of the blanket. Straw blanket should be furnished in rolled strips a minimum of 6.5 feet (2 meters) wide, a minimum of 80 feet (25 meters) long and a minimum of 0.05 lbs/ft^2 (0.27 kg/m^2). Straw blankets should be secured in place with wire staples. Staples should be made of

0.12 inches (3.05-mm) steel wire and should be U-shaped with 8 inches (20 cm) legs and 2 inches (5 cm) crown.

- Wood Fiber: Wood fiber blanket is comprised of biodegradable fiber mulch with extruded plastic netting held together with adhesives. The material is designed to enhance revegetation. The material is furnished in rolled strips, which should be secured to the ground with U-shaped staples or stakes in accordance with manufacturers' recommendations.
- Coconut Fiber: Coconut fiber blanket should be machine-produced mats of 100 percent coconut fiber with biodegradable netting on the top and bottom. The coconut fiber should be attached to the netting with biodegradable thread or glue strips. The coconut fiber blanket should be of consistent thickness. The coconut fiber should be evenly distributed over the entire area of the blanket. Coconut fiber blanket should be furnished in rolled strips with a minimum of 6.5 feet (2 meters) wide, a minimum of 80 feet (25 meters) long and a minimum of 0.05 lbs/ft^2 (0.27 kg/m^2). Coconut fiber blankets should be secured in place with wire staples. Staples should be made of 0.12 inches (3.05-mm) steel wire and should be U-shaped with 8 inches (20 cm) legs and 2 inches (5 cm) crown.
- Coconut Fiber Mesh: 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 should be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.
- Straw Coconut Fiber: Straw coconut fiber blanket should be machine-produced mats of 70 percent straw and 30 percent coconut fiber with a biodegradable netting top layer and a biodegradable bottom net. The straw and coconut fiber should be attached to the netting with biodegradable thread or glue strips. The straw coconut fiber blanket should be of consistent thickness. The straw and coconut fiber should be evenly distributed over the entire area of the blanket. Straw coconut fiber blanket should be furnished in rolled strips a minimum of 6.5 feet (2 meters) wide, a minimum of 80 feet (25 meters) long and a minimum of 0.05 lbs/ft^2 (0.27 kg/m^2). Straw coconut fiber blankets should be secured in place with wire staples. Staples should be made of 0.12 inches (3.05-mm) steel wire and should be U-shaped with 8 inches (20 cm) legs and 2 inches (5 cm) crown.

Non-Biodegradable RECPs

Non-biodegradable RECPs are typically composed of polypropylene, polyethylene, nylon or other synthetic fibers. In some cases, a combination of biodegradable and synthetic fibers is used to construct the RECP. Netting used to hold these fibers together is typically non-biodegradable as well.

- Plastic Netting: 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 should be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.
- Plastic Mesh: Plastic mesh is an open-weave geotextile that is comprised of an extruded synthetic fiber woven into a mesh with an opening size of less than 0.2 inches (0.5 cm). It is used with revegetation or may be used to secure loose fiber such as straw to the ground. The material is supplied in rolled strips, which should be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.
- Synthetic Fiber with Netting: Synthetic fiber with netting is a mat that is comprised 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 revegetated and provide a permanent composite system of soil, roots, and geomatrix. The material is furnished in rolled strips, which should be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.
- Bonded Synthetic Fiber: This type of product consists of 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 should be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

Combination Synthetic and Biodegradable RECPs

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 revegetation. The material is furnished in rolled strips, which should be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

Seeding:

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

Anchoring:

- Anchoring of RECPs is the most critical element of installation. Anchoring devices must be selected to be compatible with site soil conditions.
- Where soil conditions are suitable (i.e., topsoil without substantial rocks or cobbles), biodegradable stakes, staples, or pins are preferred. Although biodegradable anchoring devices are preferred they must be compatible with soil conditions to ensure proper blanket installation.
- U-shaped wire staples, metal geotextile stake pins, or triangular wooden stakes can be used to anchor mats to the ground surface. Wire staples shall be a minimum of 11 gauge. Metal stake pins shall be 3/16 inch (4.8 mm) diameter steel with a 1-1/2 inch (38.1 mm) steel washer at the head of the pin. Wire staples and metal stakes shall be driven flush to the soil surface. Two inches of wood staking shall remain above the soil surface. All anchors shall be 6-18 inches (0.2-0.5 m) long and have sufficient ground penetration to resist pullout. Longer anchors may be required for loose soils.

Installation on Slopes:

- Dig initial anchor trench 12 inches (0.3 m) deep and 6 inches (0.2 m) wide across the channel at the lower end of the project area.
- Begin at the top of the slope and anchor its blanket in a 6 inch (0.2 m) deep x 6 inch (0.2 m) wide trench. Backfill trench and tamp earth firmly.
- Unroll blanket down slope in the direction of the water flow.
- The edges of adjacent parallel rolls must be overlapped 2-3 inches (51-76 mm) and be stapled every 3 feet (0.9 m).
- When blankets must be spliced, place blankets end over end (shingle style) with 6 inch (0.2 m) overlap. Staple through overlapped area, approximately 12 inches (0.3 m) apart.
- Lay blankets loosely and maintain direct contact with the soil - do not stretch.
- Blankets shall be stapled sufficiently to anchor blanket and maintain contact with the soil in accordance with manufacturer's and local requirements. Guidelines for installation are as follows: Staples shall be placed down the center and staggered with the staples placed along the edges. Steep

slopes, 1:1 to 2:1, require 2 staples per square yard. Moderate slopes, 2:1 to 3:1, require 1-2 staples per square yard (1 staple, 3 feet on center). Gentle slopes require 1 staple per square yard.

Installation in Channels:

- Dig initial anchor trench 12 inches (0.3 m) deep and 6 inches (0.2 m) wide across the channel at the lower end of the project area.
- Excavate intermittent check slots, 6 inches (0.2 m) deep and 6 inches (0.2 m) wide across the channel at 25-30 foot (7.6-9.1 m) intervals along the channel.
- Cut longitudinal channel anchor slots 4 inches (101 mm) deep and 4 inches (101 mm) wide along each side of the installation to bury edges of matting. Whenever possible extend matting 2-3 inches (51-76 mm) above the crest of 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 1 foot (0.3 m) intervals. Note: matting will initially be upside down in anchor trench.
- In the same manner, position adjacent rolls in anchor trench, overlapping the preceding roll a minimum of 3 inches (7.6 cm).
- Secure these initial ends of mats with anchors at 1 foot (0.3 m) intervals, backfill and compact soil.
- Unroll center strip of matting upstream. Stop at next check slot or terminal anchor trench.
- Unroll adjacent mats upstream in similar fashion, maintaining a 3 inch (76 mm) 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 1 inch (25.4 mm) intervals, then backfill and compact soil. Continue rolling all mat widths upstream to the next check slot or terminal anchor trench.

Alternate Installation Method for Slopes <4:1:

- Place two rows of anchors on 6 inch (0.2 m) centers at 25-30 feet (7.6-9.1 m) intervals in lieu of excavated check slots.
- Shingle-lap spliced ends by a minimum of 1 foot (0.3 m) with upstream mat on top to prevent uplifting by water or begin new rolls in a check slot. Anchor overlapped area by placing two rows of anchors, 1 foot (0.3 m) apart on 1 foot (0.3 m) intervals.
- Place edges of outside mats in previously excavated longitudinal slots, anchor using prescribed staple pattern, backfill and compact soil.
- Anchor, fill and compact upstream end of mat in a 12 inch (0.3 m) x 6 inch (0.2 m) 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):

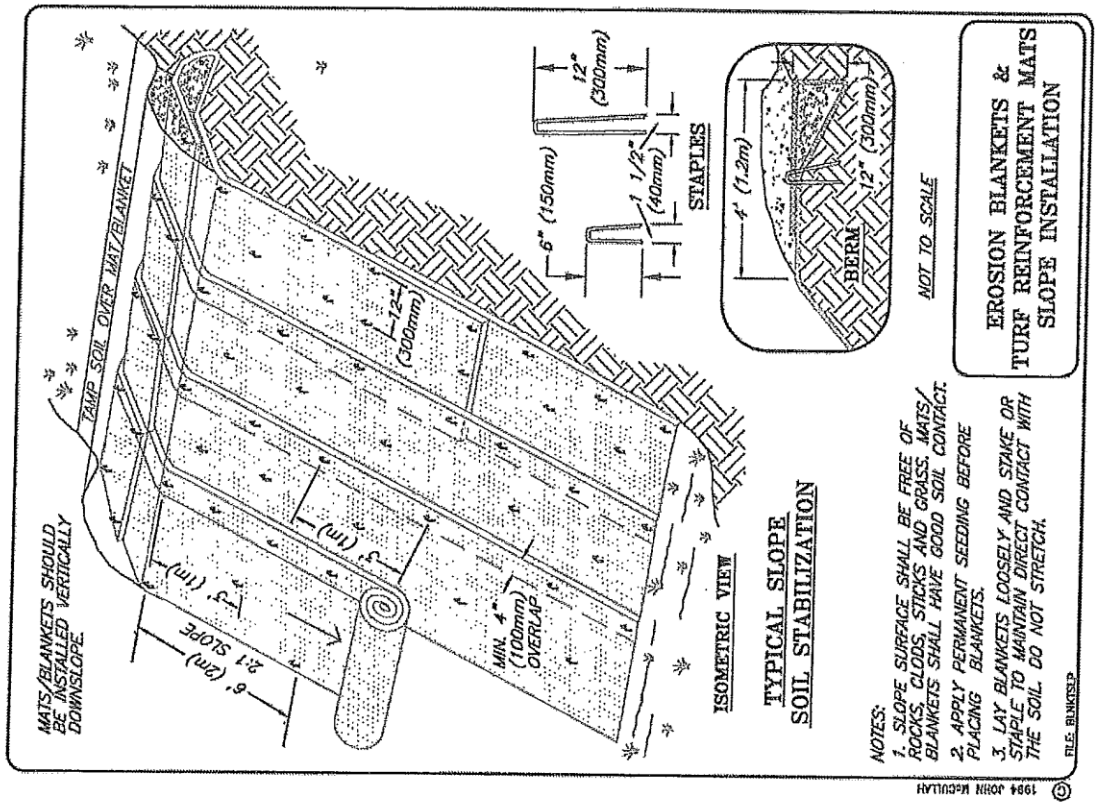
- After seeding, spread and lightly rake 1/2-3/4 inches (12.7-19.1 mm) of fine topsoil into the mat apertures to completely fill mat thickness. Use backside of rake or other flat implement.
- Spread topsoil using lightweight loader, backhoe, or other power equipment. Avoid sharp turns with equipment.

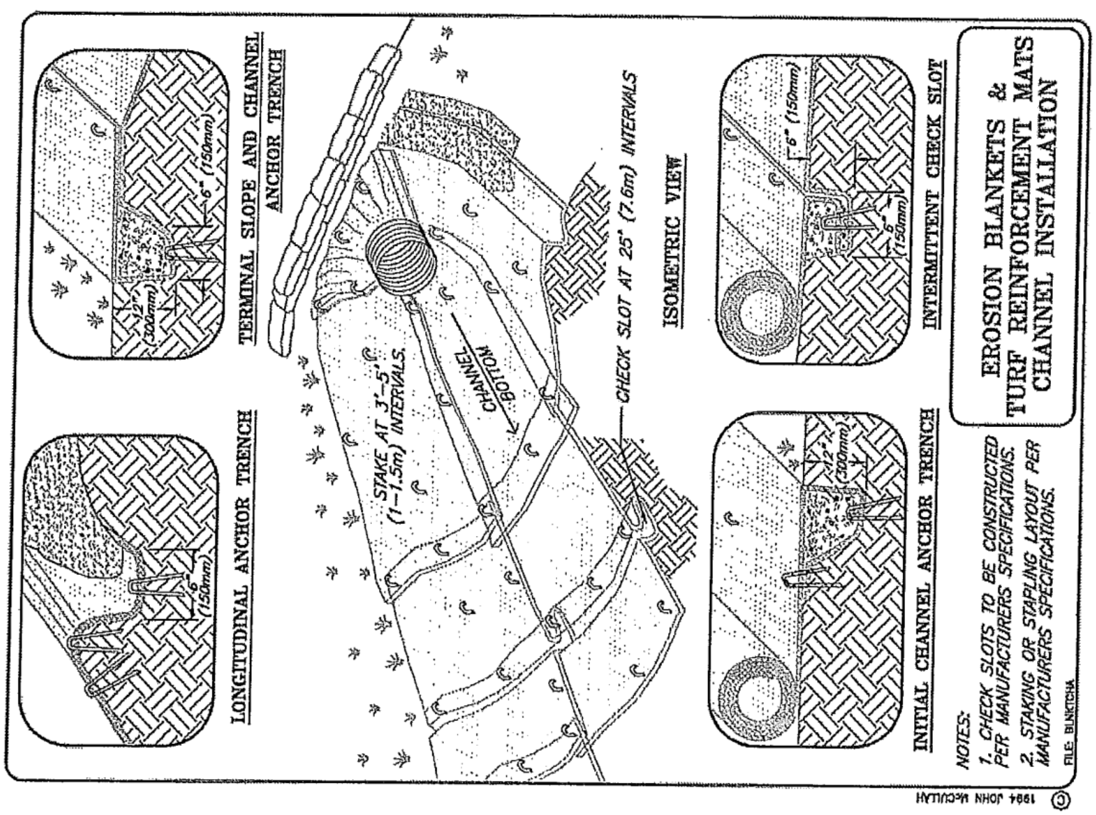
- Do not drive tracked or heavy equipment over mat. Avoid any traffic over matting if loose or wet soil conditions exist.
- Use shovels, rakes or brooms for fine grading and touch up.
- Smooth out soil filling, just exposing top netting of matrix.

Minimum BMP standards are provided on the following detail.

Inspection and Maintenance:

- All blanket and mats shall be inspected following installation and in accordance with permit requirements.
- Inspect installation before, during, and after storm events to check for erosion and undermining. Any failure shall be repaired immediately.
- If washout or breakage occurs, re-install the material after repairing the damage to the slope or drainage way.


MATS/BLANKETS SHOULD BE INSTALLED VERTICALLY DOWNSLOPE.
TAMP SOIL OVER MAT/BLANKET
6' (2m)
2:1 SLOPE
3' (1m)
3' (1m)
MIN. 4" (100mm) OVERLAP
12" (300mm)
6" (150mm)
1 1/2" (40mm)
12" (300mm)
STAPLES
4' (1.2m)
BERM
12" (300mm)
NOT TO SCALE
ISOMETRIC VIEW
TYPICAL SLOPE SOIL STABILIZATION
NOTES:
1. SLOPE SURFACE SHALL BE FREE OF ROCKS, CLODS, STICKS AND GRASS. MATS/BLANKETS SHALL HAVE GOOD SOIL CONTACT.
2. APPLY PERMANENT SEEDING BEFORE PLACING BLANKETS.
3. LAY BLANKETS LOOSELY AND STAKE OR STAPLE TO MAINTAIN DIRECT CONTACT WITH THE SOIL. DO NOT STRETCH.
EROSION BLANKETS & TURF REINFORCEMENT MATS SLOPE INSTALLATION
FILE: BLNKTSLP
© 1994 JOHN McCULLAH


LONGITUDINAL ANCHOR TRENCH
6" (150mm)
TERMINAL SLOPE AND CHANNEL ANCHOR TRENCH
12" (300mm)
6" (150mm)
STAKE AT 3'–5' (1–1.5m) INTERVALS.
CHANNEL BOTTOM
CHECK SLOT AT 25' (7.6m) INTERVALS
ISOMETRIC VIEW
INITIAL CHANNEL ANCHOR TRENCH
12" (300mm)
INTERMITTENT CHECK SLOT
6" (150mm)
6" (150mm)
NOTES:
1. CHECK SLOTS TO BE CONSTRUCTED PER MANUFACTURERS SPECIFICATIONS.
2. STAKING OR STAPLING LAYOUT PER MANUFACTURERS SPECIFICATIONS.
EROSION BLANKETS & TURF REINFORCEMENT MATS CHANNEL INSTALLATION
FILE: BLNKTCHA
© 1994 JOHN McCULLAH

WIND EROSION / DUST CONTROL – EP-13

Daily dust control shall be provided as needed to stabilize soil from wind erosion and to reduce dust generated by construction activities. Special attention shall be paid to stockpiled materials. Covering of small stockpiles or areas is an alternative to applying water or other dust palliatives.

Construction Specifications:

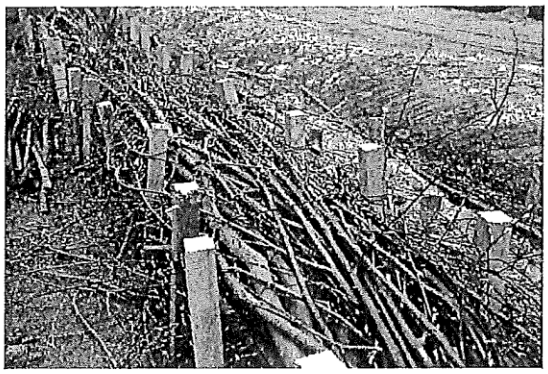
- Dust control shall be provided daily or more often (as deemed necessary based on wind conditions, time of year, and physical conditions of the site) by application of water alone or with addition of magnesium chloride or calcium chloride in accordance with manufacturer's specifications.
- Acrylic co-polymers or other biodegradable products (soil stabilizers/tackifiers) may be used for daily dust control if approved by the project engineer and local regulators.
- Water applied for dust control should be applied evenly and without over-watering which generates runoff and may result in erosion.
- Oil or other petroleum-based products shall not be used for dust control because the oil may migrate into drainage ways or seep into the soil.
- Dust control must be implemented in accordance with local air quality requirements.
- Non-potable water should not be conveyed in tanks or drainpipes that will be used to convey potable water and there should be no connection between potable and non-potable supplies. Non-potable tanks, pipes and other conveyances should be marked "NON-POTABLE WATER – DO NOT DRINK."

Inspection and Maintenance

- Check areas protected to ensure appropriate coverage.
- Reapply water or maintain covers, as necessary to maintain their effectiveness.

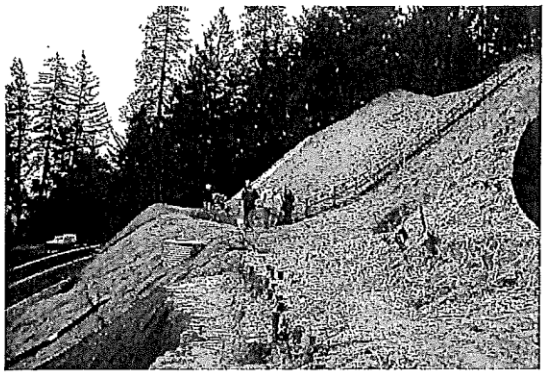
BRUSH BOX EP-17

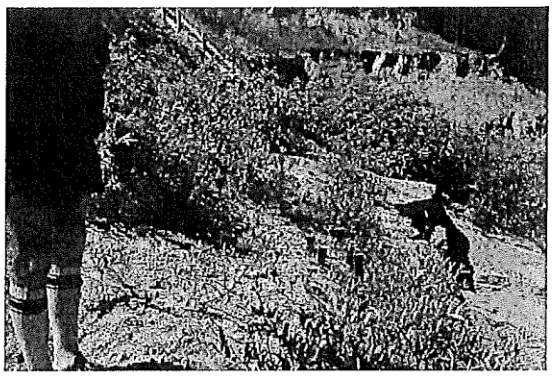
Brush boxes are toe wall or breast wall type retaining structures constructed with branch cuttings, wooden construction stakes, and wire.



Condition Where Practice Applies

Brush boxes are best if constructed on firm ground at the toe of a small slump or along the toe of an oversteepened stream bank. Brush boxes require minimal excavation and require fill behind them. Brush boxes are larger and stronger than wattles and are therefore more suitable for buttressing the base of a slope.





This brush box stabilized the toe of this slide even before the willow became established, and then vegetated the slide.

Materials

The ideal plant materials for brush boxes are those that:

1. Root easily.
2. Are long, straight and flexible.
3. Adapted to the site conditions.
4. Are in plentiful supply near the job site.

Willow (*Salix* spp) makes ideal cutting material. Some species of Coyotebrush (*Baccharis* spp), Dogwood (*Cornus* spp), and Cottonwood (*Populus* spp) also have very good rooting ability.

BRUSH BOX EP-17

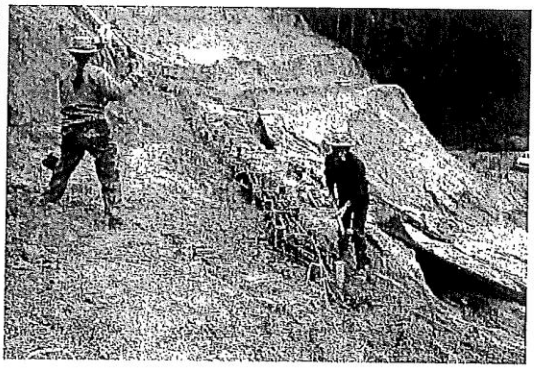
This brush box was made using mostly dead plant materials, and was intended to protect this eroding streambank and encourage siltation.

The cuttings should be very long, 6-12 ft (2-4 m) minimum, with straight branches up to 1 ½ inches (40 mm) in diameter. Trimmings of young suckers and some leafy branches may be included in the bundles to aid filtration. The number of stems varies with the size and kind of plant material. If willow or other rootable species are in short supply, non-rooting woody material may be used to partially fill the box (up to 50%).

Brush boxes require sturdy construction stakes, cut on a diagonal from vertical grained wood capable of being driven into the ground. Cut stakes at least 3 ft (1 m) long. Wire, usually 9 ga or heavier, is required to bind the tops of the stakes together.

Implementation

- Work shall start at the bottom of the slope. Perform any slope repairs, such as runoff diversions, prior to brush box installation.
- Dig a trench 12-18 inches (0.3-0.5 m) wide and approximately 12 inches (0.3 m) deep along the toe of the slump or stream bank.
- Drive construction stakes, 36-48 inches (0.9-1.2 m) long, into the soil adjacent to the trench wall across from each other, one on the downhill side of the trench and one on the uphill side of the trench. Repeat the procedure by driving pairs of stakes every 2 feet (0.6 m) along the length of the trench. Cut small notches into the stakes, approximately 3 inches (75 mm) from the top.



BRUSH BOX EP-17

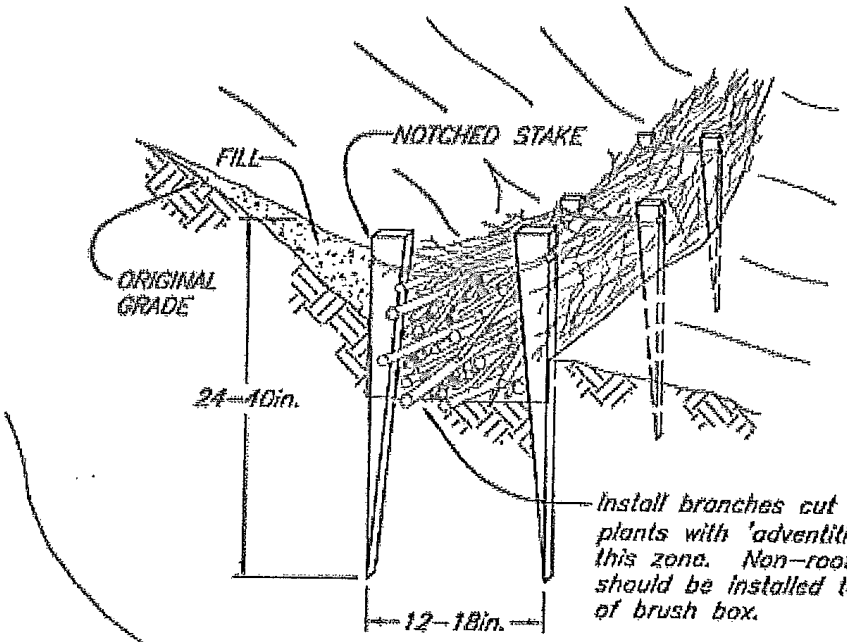
These brush boxes were installed for landslide repair.
("Old Faithful" cut slope project, Hwy 299W, CA, 1992)

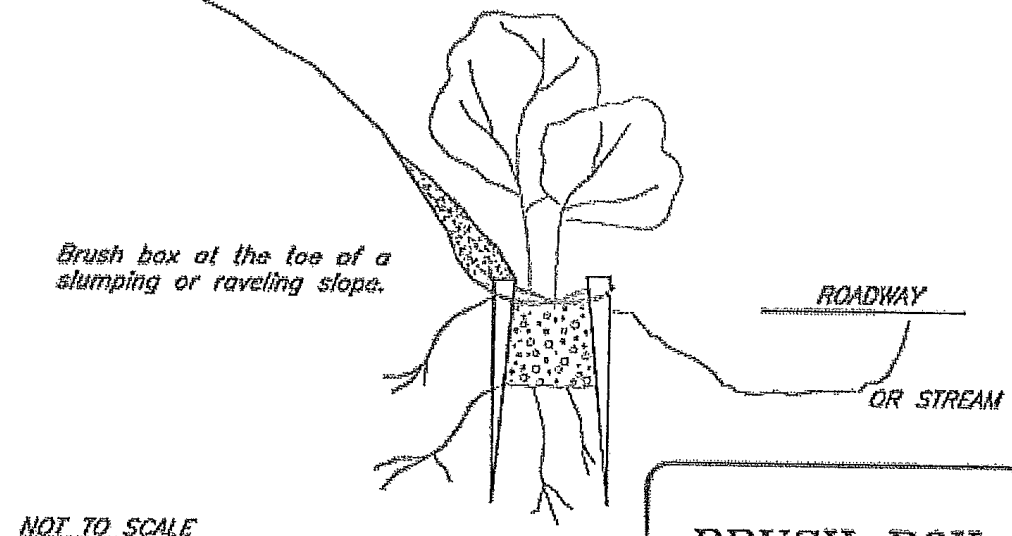
The same brush boxes in September of 2003

- Place the cuttings immediately after trenching to reduce desiccation of the soil. Cuttings shall be placed together between the stakes with the growing tips and butt ends oriented in alternating directions. Stagger the cuttings in the box so that the tips are evenly distributed throughout the length of the brush box.
- Compress the cuttings tightly between the stakes and tie the pair of stakes and cuttings together with a strong galvanized wire. Wrap the wire tightly around the stakes at the notches and twist the wire between the stakes to "cinch" the cuttings down. Drive the stakes further into the soil. This procedure will tighten the wires and compress the cuttings into the trench.
- Proper backfilling is essential to the successful rooting of the brush box. Backfill with soil graded from the slope above. Place moist soil along the sides of the live box. The backfill shall be worked into the cutting interstices during construction and compacted behind and below the bundle by walking on and working from brush box terrace.
- Repeat the proceeding steps to the top of the slope. The top of the brush box should be slightly visible when the installation is completed.

BRUSH BOX EP-17

NOTES:
1. Branches from non-rooting species may be combined when woody plants capable of vegetative propagation (Salix sp., Populus sp., Cornus sp.) are in short supply.
2. Proper backfilling is essential to the successful rooting of the brush box. Backfill with soil from slope above. The backfill must be 'worked' into the branches interstices during construction.





NOT TO SCALE

CROSS SECTION

BRUSH BOX

FILE: BRUSHBOX

SODDING – EP-21

Sodding is the placement of permanent grass cover that has been was grown elsewhere and brought to the site. Sodding involves the placement of "sheets" of pre-established grass. Sodding provides immediate stabilization to an area by covering the soil surface with pre-established sheets of grass, thereby protecting the soil from erosion, enhancing infiltration, filtering sediment and other pollutants, and slowing runoff velocities.

Sodding is appropriate for areas that contained turf or grasses before construction; any graded or cleared area that might erode; and areas where a permanent, long lived plant cover is needed immediately. Sodding may be used in vegetative buffer zones, stream banks, grassed dikes, swales, slopes, outlets, level spreaders, and filter strips and is particularly effective on flood plains, areas adjacent to wetlands or other sensitive water bodies, and on steep, unstable slopes. Natural revegetation may be more appropriate for areas not prone to erosion that have an available seed source.

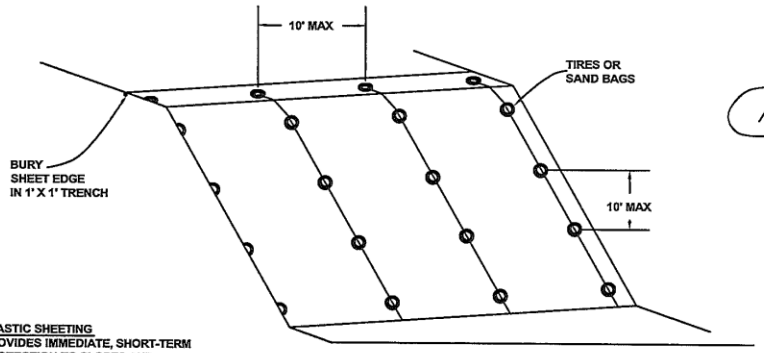
Construction Specifications:

- Sod should be protected with tarps or other protective covers during delivery and should not be allowed to dry out between harvesting and placement.
- All weeds and debris should be removed before cultivation of the area to be planted and properly disposed.
- After cultivation, installation of irrigation systems, and rough grading are completed, areas to be planted with sod should be fine graded and rolled. Topsoil may be needed in areas where the soil textures are inadequate. Areas to be planted with sod should be smooth and uniform before placing sod. Areas to be planted with sod adjacent to sidewalks, concrete headers, header boards, and other paved border and surface areas should be 1.5 in ± 0.25 in (38 mm ± 6 mm) below the top grade of such facilities after fine grading, rolling, and settlement of the soil. Sod should be placed so that ends of adjacent strips of sod are staggered at least 24 in (600 mm). All edges and ends of sod should be placed firmly against adjacent sod and against sidewalks, concrete headers, header boards, and other paved borders and surfaced areas.
- After placement of the sod, the entire sodded area should be lightly rolled to eliminate air pockets and ensure close contact with the soil. After rolling, the sodded areas should be watered so the soil is moistened to a minimum depth of 4 in (100 mm). Sod should not be allowed to dry out, planted during very hot or wet weather, or placed on slopes that are greater than 3:1:3 (H:V:H) if they are to be mowed.
- If irregular or uneven areas appear before or during the plant establishment period, such areas should be restored to a smooth and even appearance.
- The turf (sod) should be allowed to grow to 3 in (75 mm) high. When the turf reaches this height, it should be mowed to a height of 1 in (25 mm) or as recommended by the grower of the sod. All turf edges—including edges adjacent to sidewalks, concrete headers, header boards, and other paved borders and surfaced areas—should be trimmed to uniform edge not extending beyond the edge of turf or such facilities.
- Mowed and trimmed growth should be removed and disposed of outside the project. Trimming should be repeated whenever the height of the turf exceeds 1 in (25 mm).
- Sod should be healthy and, field grown, containing thatch not more than 0.5 in (13 mm) thick. The age of the sod should be between 8 and 16 months old. The sod should be free from disease, weeds, insects, and undesirable types of grasses and clovers and grown in accordance with any applicable agricultural requirements. Soil upon which the sod has been was grown should contain less than 50 percent silt and clay. Sod should be machine cut at a uniform soil thickness of 0.625 in ±0.25 in (16 mm ± 6 mm), excluding top growth and thatch.
- A certificate of compliance for the sod should be furnished to the contractor.

Inspection and Maintenance

- Inspect sod installations weekly and after significant storm events, until the turf is established.
- Maintenance should consist of mowing, weeding, and ensuring that the irrigation system is operating properly and as designed to sustain growth.

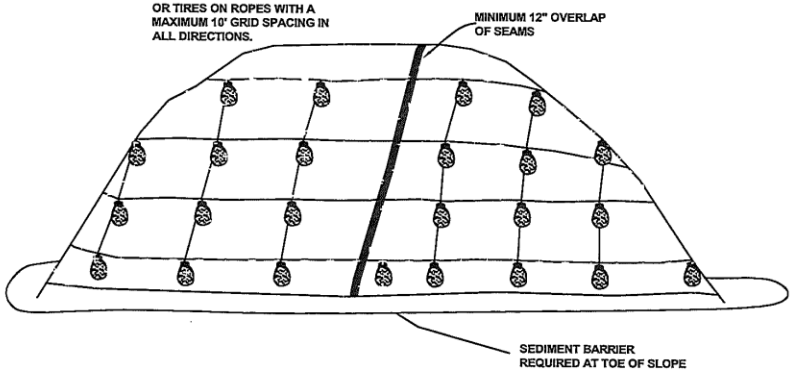
PLASTIC SHEETING



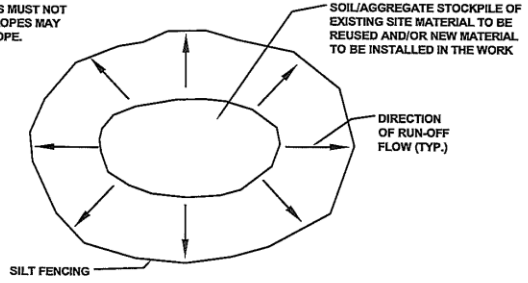
PLASTIC SHEETING
PROVIDES IMMEDIATE, SHORT-TERM PROTECTION TO SLOPES AND DISTURBED AREAS WHERE MULCH IS NOT PRACTICABLE. POOR APPLICATION, INSTALLATION, AND MAINTENANCE CAN CAUSE PROBLEMS, SO USE ALTERNATIVES TO PLASTIC SHEETING WHENEVER POSSIBLE.

- USE ON DISTURBED AREAS THAT REQUIRE COVER FOR LESS THAN 30 DAYS.
- ON CUT AND FILL SLOPES AND STOCKPILES.
- USE ONLY ON SMALL AREAS WHEN VEGETATION CANNOT BE ESTABLISHED TO PROTECT SOIL DURING RAINY SEASON; FOR LARGER AREAS CONSIDER MULCHING OR MATTING (EP-8 AND EP-10).
- CAN BE USED ALONE OR IN CONJUNCTION WITH SEDIMENT FENCES, DIVERSION DIKES, OR SOIL STOCKPILES.
- REPLACE TORN SHEETS AND REPAIR OPEN SEAMS.
- COMPLETELY REMOVE AND REPLACE PLASTIC WHEN IT BEGINS TO DETERIORATE.
- COMPLETELY REMOVE ALL PLASTIC ONCE IT IS NO LONGER NEEDED.
- CHECK ANCHORING SYSTEM AND REPAIR OR ADD ANCHORS AS NEEDED.

NOTES:
1. MINIMUM 12" OVERLAP OF ALL SEAMS REQUIRED.
2. BARRIER REQUIRED AT TOE OF STOCKPILE.
3. COVERING MAINTAINED TIGHTLY IN PLACE BY USING SANDBAGS OR TIRES ON ROPES WITH A MAXIMUM 10' GRID SPACING IN ALL DIRECTIONS.

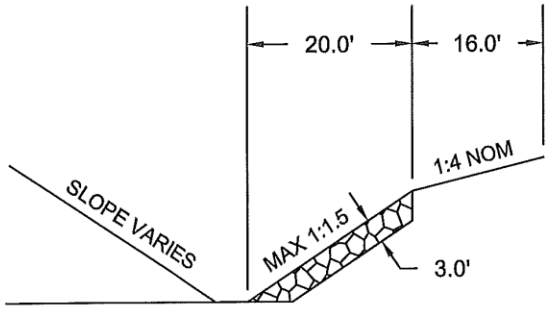


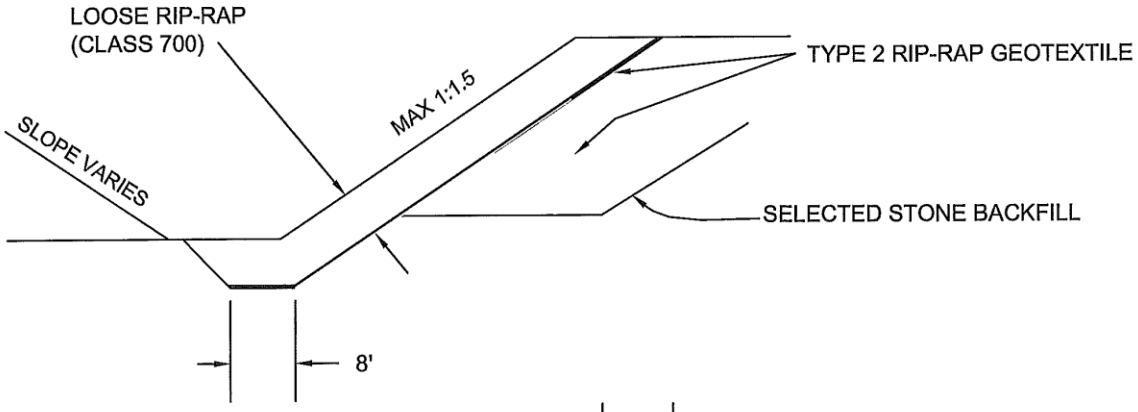
NOTES:
1. ALL EXISTING EXCAVATED MATERIAL THAT IS NOT TO BE REUSED IN THE WORK IS TO BE IMMEDIATELY REMOVED FROM THE SITE AND PROPERLY DISPOSED OF.
2. SOIL/AGGREGATE STOCKPILE SITES TO BE LOCATED WHERE SHOWN ON THE DRAWINGS.
3. RESTORE STOCKPILE SITES TO PRE-EXISTING PROJECT CONDITION AND RESEED AS REQUIRED.
4. STOCKPILE HEIGHTS MUST NOT EXCEED 35'. SIDE SLOPES MAY NOT EXCEED 2:1 SLOPE.

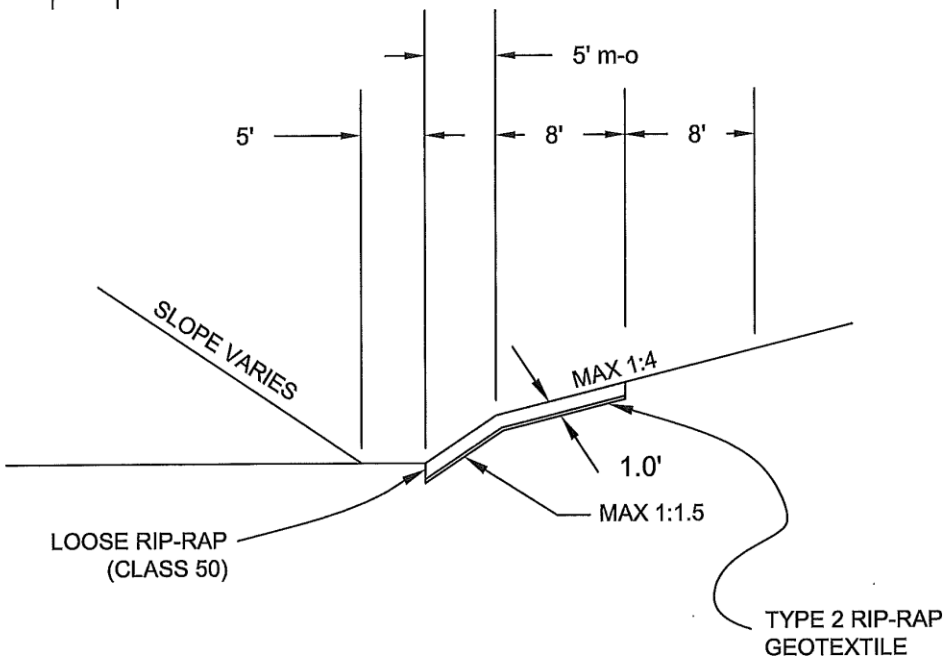


DRAWING EP-22
PLASTIC SHEETING & MATERIAL STOCKPILE DETAIL (N.T.S.)

DRAWING EP-23
RIP-RAP EMBANKMENT SLOPE PROTECTION (N.T.S.)







SEDIMENT FENCE – SC-1

Construction Specifications:

Local municipality requirements should be checked to determine if local requirements differ from this BMP with respect to specific types of sediment fence allowed and methods of installation.

Prefabricated Sediment Fence

Prefabricated fence fabric shall consist of material approved by its manufacturer for use in sediment fence applications and shall include pre-fabricated pockets for stake installation. Select standard duty or heavy duty prefabricated sediment fence based on criteria shown below:

Standard Duty Sediment Fence

- Slope of area draining to fence is 4H:1V or less - Use is generally limited to less than five months
- Area draining to fence produces moderate sediment loads
- Use prefabricated standard duty sediment fence.
- Layout in accordance with typical layout - Install in accordance with attached detail.

Heavy Duty Sediment Fence

- Slope of area draining to fence is 1H:1V or less
- Use generally limited to eight months. Longer periods may require fabric replacement
- Area draining to fence produces moderate sediment loads
- Use prefabricated heavy duty sediment fence. Heavy duty sediment fences typically have the following physical characteristics:
  - Fence fabric has greater tensile strength than other fabric types available from manufacturer
  - Fence fabric has a greater permittivity than other fabric types available from manufacturer
  - Fence fabric may be reinforced with a backing or additional support to increase fabric strength
  - Posts may be spaced closer together than other pre- manufactured sediment fence types available from manufacturer.
- Layout in accordance with attached typical layout.
- Install in accordance with attached standard details.

Installation

- Install sediment fence along a level contour, with the last 6 ft of fence turned up slope. Except for the ends, the difference in elevation between the highest and lowest point along the top of the sediment fence shall not exceed one-third the fence height.
- Generally, should be used in conjunction with erosion source controls up slope to provide effective control.

Minimum BMP standards that apply to Prefabricated Sediment Fence are provided on the attached details.

Common Reasons/Circumstances for Failure

- The most common reasons for sediment fence failure are due to improper installation and poor maintenance. In particular, the toe must be securely trenched into the slope and accumulated sediment should be removed when accumulation reaches 1/3 of the fence height.

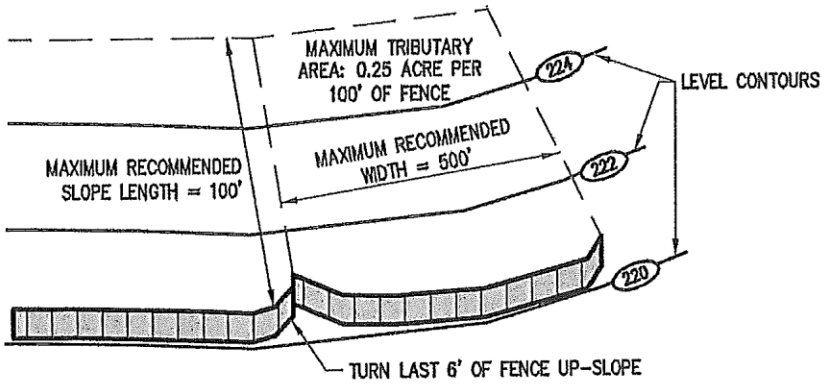
Inspection and Maintenance:

- Repair undercut sediment fences.

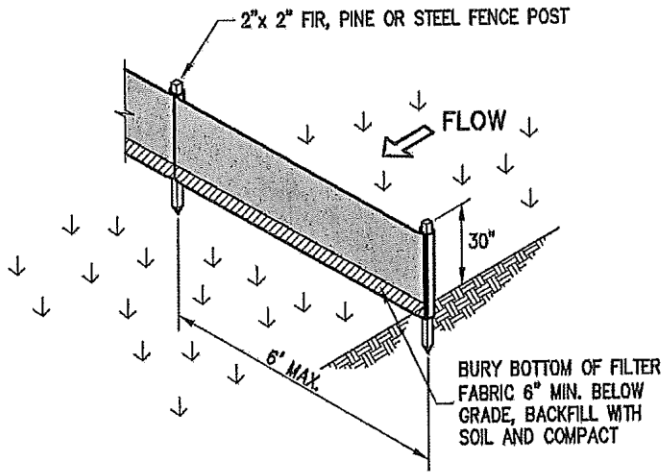
SEDIMENT FENCE – SC-1

- Repair or replace split, torn, slumping, or weathered fabric.
- Inspect sediment fence before, during, and after storm events.
- Any required repairs shall be performed as soon as possible.
- Remove sediment when accumulation reaches 1/3rd the fence height.
- The removed sediment shall be incorporated in the project, disposed of properly, or appropriately stabilized with vegetation.
- Remove sediment fence when no longer needed and upslope area has been stabilized. Fill and compact post holes and anchorage trench, remove sediment accumulation, and grade fence alignment to blend with adjacent ground.

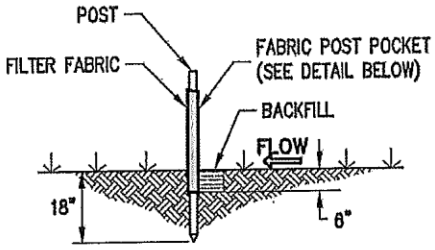
SEDIMENT FENCE – SC-1



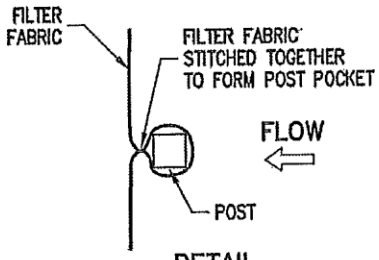
TYPICAL PREFABRICATED SEDIMENT FENCE LAYOUT



TYPICAL PREFABRICATED SEDIMENT FENCE LAYOUT



SECTION
MINIMUM INSTALLATION



DETAIL
FABRIC POST POCKET

NOTES:

1.) INSPECT AND REPAIR FENCE AFTER EACH STORM EVENT AND REMOVE SEDIMENT WHEN NECESSARY.

2.) REMOVED SEDIMENT SHALL BE DEPOSITED TO AN AREA THAT WILL NOT CONTRIBUTE SEDIMENT OFF-SITE AND CAN BE PERMANENTLY STABILIZED.

3.) SEDIMENT FENCE SHALL BE PLACED ON SLOPE CONTOURS TO MAXIMIZE PONDING EFFICIENCY.

4.) STITCHED POCKETS TO BE INSTALLED ON UPHILL SIDE OF SLOPE.

SAND BAG BARRIER – SC-2

Construction Specifications:

Sand bag barriers are intended to block and divert flow. They are not intended to be used as filtration devices.

Materials

- Sand bag Material: Sand bag shall be polypropylene, polyethylene or polyamide woven fabric, minimum unit weight four ounces per square yard (135 g/m^2), mullen burst strength exceeding 300 psi (2,070 kPa) in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70% in conformance with the requirements in ASTM designation D4355. Use of burlap is not acceptable since it rots and deteriorates easily.
- Sand bag Size: Each sand-filled bag shall have a length of 18 in (450 mm), width of 12 in (300 mm), thickness of 3 in (75 mm), and mass of approximately 33 lb. (15 kg). Bag dimensions are nominal, and may vary based on locally available materials. Alternative bag sizes shall be submitted to the engineer for approval prior to deployment.
- Fill Material: All sand bag fill material shall be non-cohesive, Class 1 or Class 2 permeable material free from clay and deleterious material, conforming to the provisions in Caltrans Standard Specifications Section 68-1.025 "Permeable Material". The requirements for the Durability Index and Sand Equivalent do not apply. Fill material is subject to approval by the engineer.
- Only use sandbag barriers when diverting runoff or run-on.

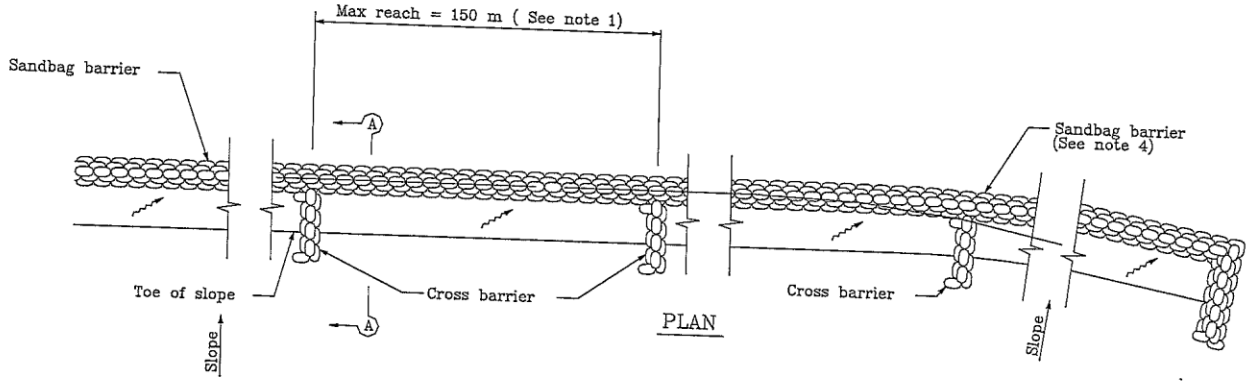
Installation

- Install along a level contour.
- Turn ends of sand bag row up slope to prevent flow around the ends.
- Generally, sand bag barriers shall be used in conjunction with temporary soil stabilization controls up slope to provide effective erosion and sediment control.
- Construct sand bag barriers with a set-back of at least 3 ft (1m) from the toe of a slope. Where it is determined to be not practical due to specific site conditions, the sand bag barrier may be constructed at the toe of the slope, but shall be constructed as far from the toe of the slope as practicable.

Minimum BMP standards are provided on the following details.

Inspection and Maintenance:

- Inspect sand bag barriers before, during, and after each rainfall event, and weekly throughout the rainy season.
- Reshape or replace sand bags as needed.
- Repair washouts or other damages as needed.
- Inspect sand bag barriers for sediment accumulations and remove sediment when accumulation reaches 1/3rd the barrier height. Removed sediment shall be incorporated in the project at locations designated by the engineer or shall be disposed of properly.
- Remove sand bags when no longer needed. Remove sediment accumulation, and clean, re-grade, and stabilized the area.



TEMPORARY LINEAR SEDIMENT BARRIER (TYPE SANDBAG)

TEMPORARY LINEAR SEDIMENT BARRIER
(TYPE SANDBAG)

NO SCALE

ALL DIMENSIONS ARE IN
MILLIMETERS UNLESS OTHERWISE SHOWN

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 150 m.
2. Place sandbags tightly.
3. Dimension may vary to fit field condition.
4. Sandbag barrier shall be a minimum of 3 bags high.
5. The end of the barrier shall be turned up slope.
6. Cross barriers shall be a min of 1/2 and a max of 2/3 the height of the linear barrier.
7. Sandbag rows and layers shall be staggered to eliminate gaps.

STRAW BALE DIKE – SC-4

Construction Specifications:

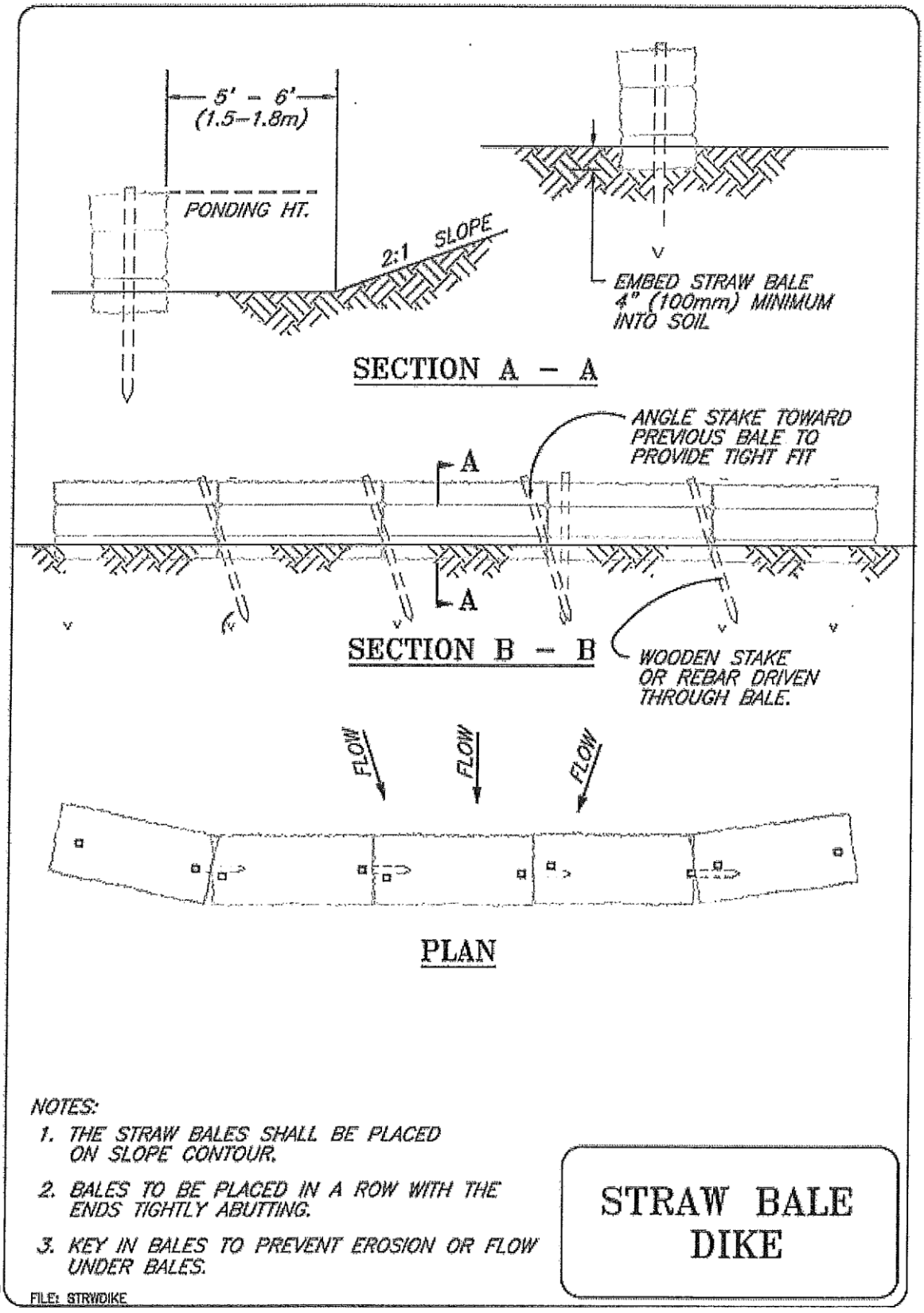
- Some local municipalities may only allow the use of straw bale dikes on an emergency basis; local requirements should be reviewed and followed.
- The bales shall be placed on the slope contour at the base of the slope or around the perimeter of the construction site.. If the dike is constructed at the toe of a slope, place it 5-6 feet (1.5-1.8 m) away from the slope if possible.
- Do not construct the dike more than one bale high.
- Bales shall be placed in a row with the ends tightly abutting.
- Each bale shall be embedded in the soil a minimum of 4 inches (101 mm). Use straw, rocks, or filter fabric to fill any gaps between the bales and tamp the backfill material to prevent erosion under or around the bales.
- If the bales are wire bound, they should be oriented so the bindings are around the sides rather than along the top and bottom. Wire bindings that are placed in contact with the soil soon disintegrate and may allow the bale to fall apart.
- The bales shall be securely anchored in place by two wooden stakes or rebar driven through the bales. The first stake in each bale shall be driven toward the previously laid bale to force the bales tightly together. Drive the stakes at least 18 inches (0.5 m) into the ground.
- The straw bales do not need to be anchored if the bales are used on a relatively flat construction area with slope lengths less than 100 feet and the straw bale dike is inspected regularly. The trapped sediment should be removed when required, and repairs made promptly. The bales also do not need to be anchored if they are to be removed and replaced daily to facilitate construction.

Minimum BMP standards are provided on the following detail.

Inspection and Maintenance:

- The straw bale dikes shall be inspected before, during, and after each rain event.
- Straw bales should be replaced if they have decomposed.
- In wet areas, bales may require replacement every 6 to 9 weeks during the rainy season.
- Repairs and/or replacement shall be made promptly. Replacement bales shall be in good condition, not previously exposed to weather.
- Remove sediment behind the barrier when it reaches a depth of 6 inches (0.2 m).
- Remove the straw bales when the upslope areas have been permanently stabilized.
- Sediment shall be removed and deposited in an area that will not contribute sediment offsite.

STRAW BALE DIKE – SC-4



ROCK OR BRUSH FILTER – SC-5

Rock or brush filters are temporary barriers composed of brush, wrapped in filter cloth and secured in place, or rock anchored in place. They are intended to intercept and filter sediment-laden storm water runoff from disturbed area, retaining the sediment and releasing water as sheet flow, at a reduced velocity. Note: filters require sufficient space for ponded water; are not effective for diverting runoff since filters allow to slowly seep through; and rock filter berms may difficult to remove when construction is complete.

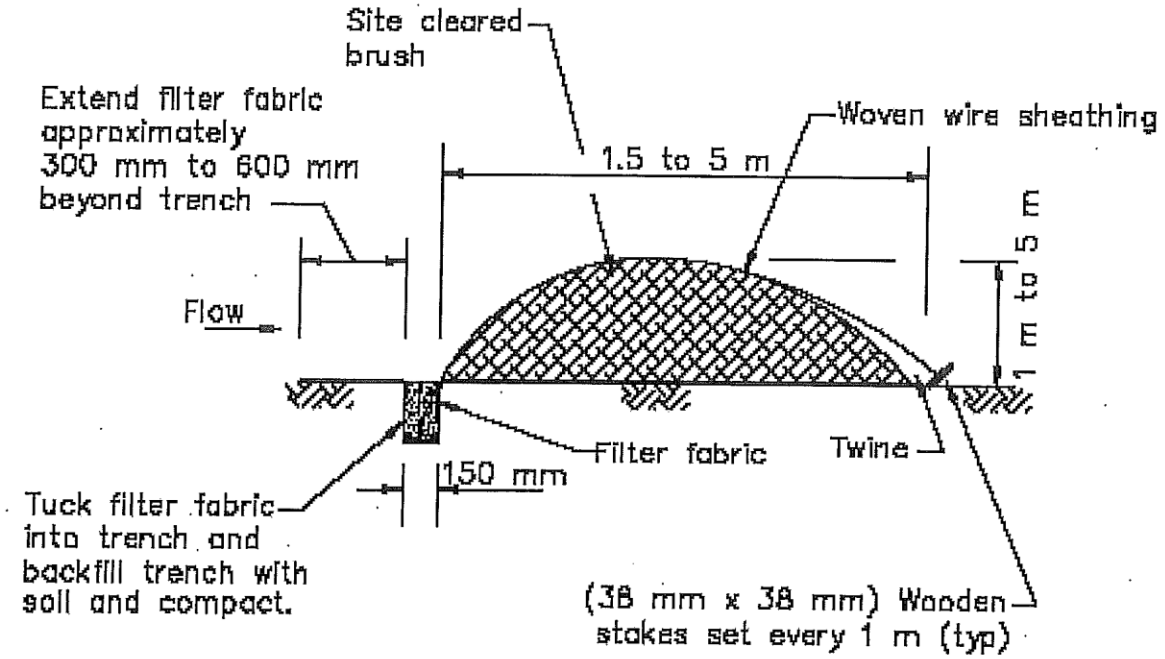
Construction Specifications:

- Use for contributing drainage areas less than or equal to 5 ac (2 hà).
- Use along the perimeter of disturbed areas; near the toe of slopes which may be subject to flow and rill erosion; around temporary spoil areas; along streams and channels; and across mildly sloped construction roads (rock filter berms, only).
- Brush and rock filters shall be installed on a level contour.
- Provide adequate areas upstream of filter to accommodate ponding.
- Brush shall consist of site-cleared brush, or alternative material approved by engineer.
- Stakes: 1.5 in x 1.5 in (38 mm x 38 mm) wooden stake, or metal stake with equal holding capabilities.
- Rock: open-graded rock, 0.75 in (19 mm) to 3 in (75 mm) to 5 in (125 mm) for concentrated flow applications.
- Woven wire sheathing: 1 in (25 mm) diameter, hexagonal mesh, galvanized 20 gauge (used with rock filters in areas of concentrated flow).
- In construction traffic areas, maximum rock berm heights shall be 12 in (300 mm). Multiple berms should be constructed every 300 ft (90 m) on slopes less than 5:100 (V:H) (5%), every 200 ft (60 m) on slopes between 5:100 (V:H) (5%) and 10:100(V:H) (10%), and every 100 ft (30 m) on slopes greater than 10:100 (V:H) (10%).

Inspection and Maintenance:

- Inspect berms before and after each significant rain event, and weekly throughout the rainy season.
- Reshape berms as needed and replace lost or dislodged rock, brush and/or filter fabric.
- Inspect for sediment accumulation, remove sediments when depth reaches 1/3 of the berm height or 12 in (300 mm), whichever occurs first.
- Filter berms should be removed upon completion of construction activities.

ROCK OR BRUSH FILTER – SC-5



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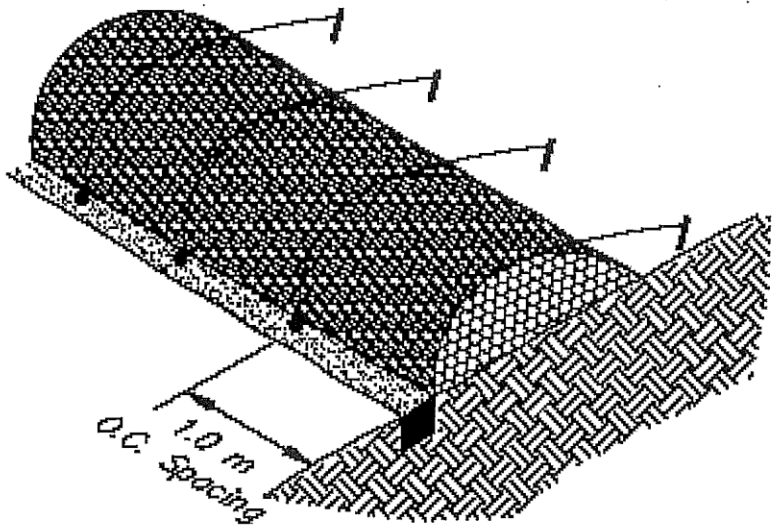
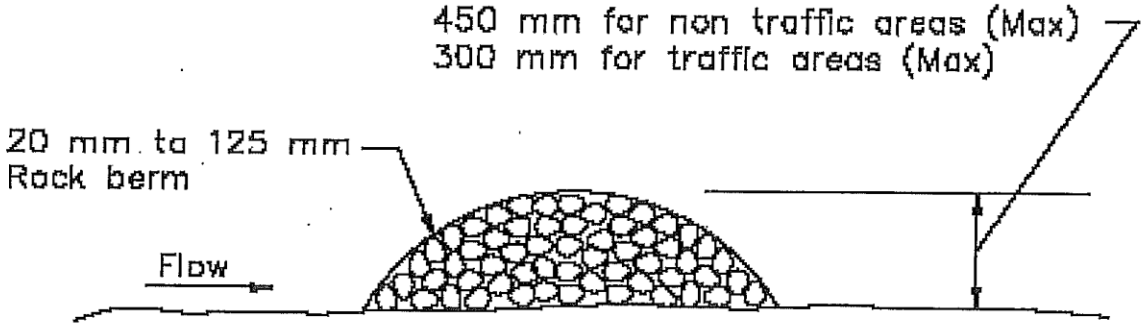


TYPICAL BRUSH FILTER
NOT TO SCALE

ROCK OR BRUSH FILTER – SC-5



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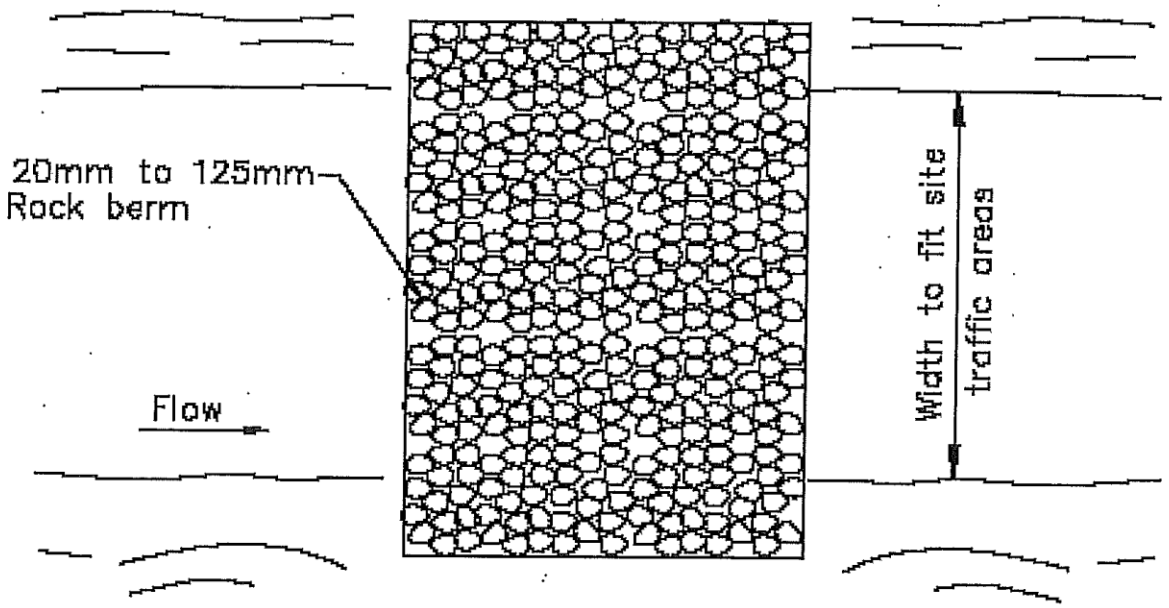
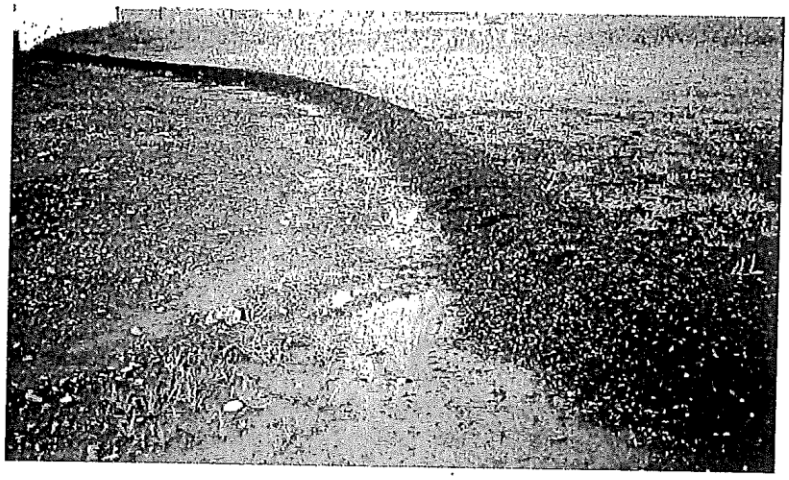


PLAN

TYPICAL ROCK FILTER
NOT TO SCALE

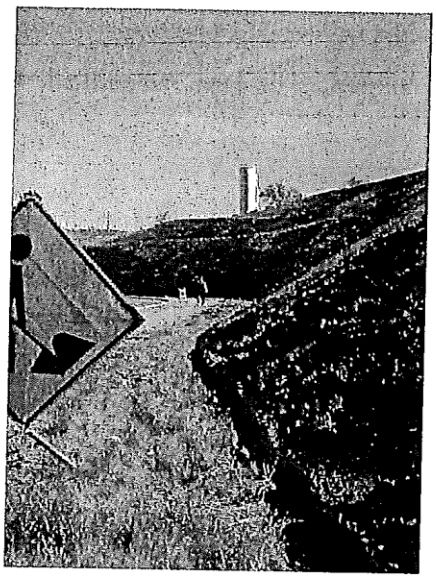
COMPOST BERMS AND SOCKS SC-6



Construction Specifications

A compost filter berm is a trapezoidal berm applied by a blower and a compost sock is compost material encased in mesh to form a tube/roll. Both techniques intercept sheet flow and pond runoff, allowing sediment to fall out of suspension, and often filtering sediment as well. Compost berms and socks provide an environmentally-sensitive and cost-effective alternative to sediment fence.

Advantages



- Compost berms and compost socks made from biodegradable mesh sometimes offer a better solution than sediment fence and other sediment control methods, because compost does not require any special trenching, construction, or removal, unlike straw bales, sediment fence or coir rolls. This makes the technique very cost-effective.
- Compost is organic, biodegradable, renewable, and can be left onsite. This is particularly important below embankments near streams, as re-entry to remove or maintain the berm can cause additional disturbance. Sediment fence has to be disposed of in landfills and is often left abandoned on jobsites.
- Compost does not leach nutrients. Field tests in Connecticut have shown that run-off from compost treated sites has very low soluble salts, and all metals and nutrients are well within pollution leaching limits.
- Compost berms can be easily and quickly fixed should something happen to them in the course of construction. Compost socks withstand heavy machinery, but frequent disturbance can decrease the effectiveness of the sock.
- Mechanical compost spreaders for compost berms are commercially available and are widely used in the Pacific Northwest.
- When properly made, compost is full of nutrients and micro-organisms that stimulate turf and increase resistance to diseases. Compost binds heavy metals and can break down hydrocarbons into carbon, salts and other innocuous compounds.

COMPOST BERMS AND SOCKS SC-6

Design Considerations

Compost filter berms and socks should be used at the base of slopes 2:1 or less. There are many types of compost, all with different properties, so it is best to determine what application the compost is being used for. For compost berms and socks, compost should have the following specifications:

- Compost needs to be stable and mature.
- Particle size: Compost should consist of both large and small pieces for maximum filtration. Finer grades (screened through 3/8-1/2") are better for vegetation establishment, long term plant nutrients, and increased infiltration rates. The coarser grades (screened 2-3") are better for increased filtration, and are less likely to be disturbed by rainfall and runoff. For berms, the ratio of coarse and fine material should be 1:1. No particle should be greater than 3".
- The recommended moisture content ranges from 20-50%. Compost that is too dry is harder to apply, while that which is too wet is heavier and harder to transport. In drier areas, use compost with a higher moisture content; in wet areas, use the drier compost, as it will absorb water.
- Organic matter content: The percentage of carbon based materials in finished compost should range between 40-70%. However, Texas DOT specifies no less than 70%.
- The pH should be between 5.0 and 8.5.
- Nitrogen Content: 0.5-2.0%.
- Compost should have a minimum of soluble salts, as these can inhibit vegetation establishment. These levels should be between 4.0 and 6.0 mmhos/cm.
- Compost must be weed and pesticide free, with manmade materials comprising less than 1%.

Construction Specifications

- For compost berms on slopes of 3:1 or less, install a compost berm 1-2 ft high and 2-4 ft wide at the base. For maximum filtration properties, install berm in a trapezoidal shape, with a 4-6 ft base, and a 2-3 ft wide top. Larger berms should be used for steeper slopes. The basic rule of thumb is that the base should be twice the height of the berm.
- Typically, compost socks can handle the same water flow or slightly more than sediment fence. However, the installation technique is especially important for them to work effectively. For most applications, standard sediment fence is replaced with 12" compost socks.
    - When placed on level contours sheet flow of water should be perpendicular to the compost sock at impact and un-concentrated.
    - Place compost socks at a 5' or greater distance away from the toe of slopes to maximize space available for sediment deposition.
    - In order to prevent water flowing around the ends of compost socks, point the ends upslope to place them at a higher elevation.

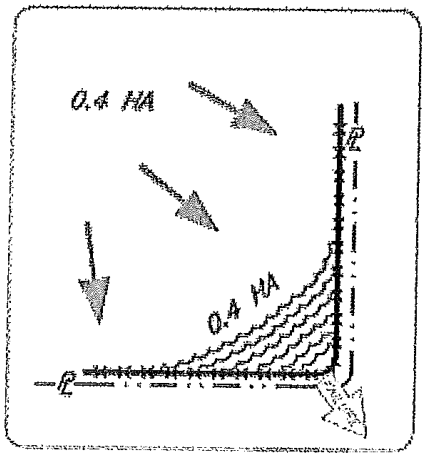
COMPOST BERMS AND SOCKS SC-6

- Compost Berms and Socks can be placed around the perimeter of affected areas, if the area is flat or the perimeter is on contour. Berms and socks should be placed using 'smiles' and j-hooks. Do not place berms and socks where they cannot pond water.
- For steeper slopes, an additional berm or sock can be constructed on the top of the slope.
- Compost berms and socks can be seeded during application. However, field tests indicate that it is best to have only a thin layer of compost over the seed in compost berms. Slopes seeded with 2- 4" of compost over the seed had less vegetation establishment than slopes with less compost over the seed.
- Do not use compost berms and socks in areas of concentrated flow, as they are intended to control and filter sheet flow only.
- Tackifiers may be applied to berms if needed to enhance performance.

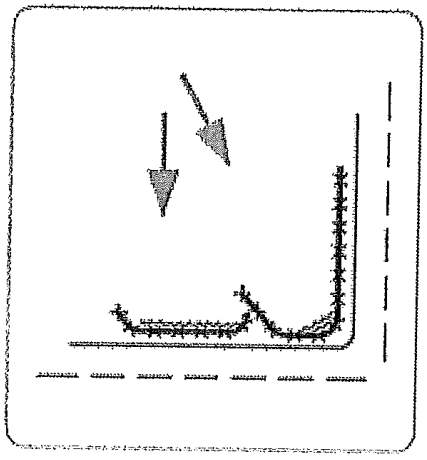
Inspection and Maintenance

- Compost berms and socks shall be inspected after each storm event and reapplied if necessary.
- Sediment retained by the berm or sock shall be removed when it has reached 1/3 of the exposed height of the berm. Alternatively, the sediment and berm or sock can be stabilized with vegetation at the end of construction.
- Berms can be left onsite and seeded, or spread out in place as a soil enhancement.

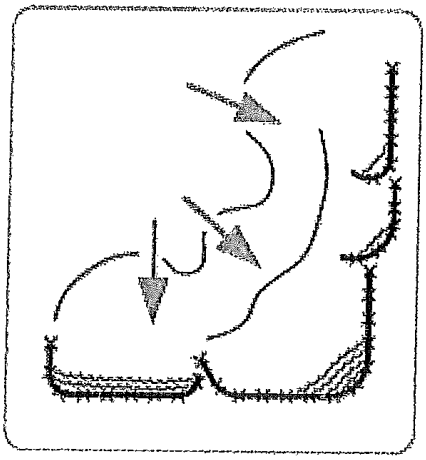
COMPOST BERMS AND SOCKS SC-6

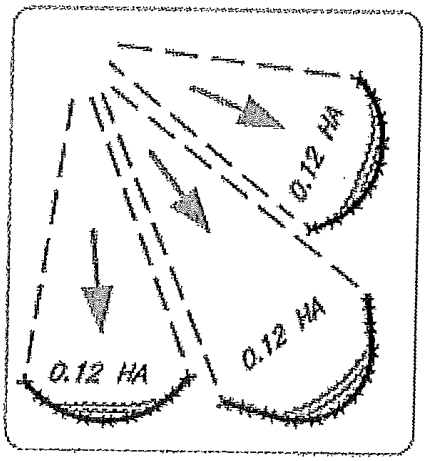


Incorrect – Do Not layout "perimeter control" compost berms along property lines. All sediment laden runoff will concentrate and overwhelm the system.



Correct – Install J-hooks



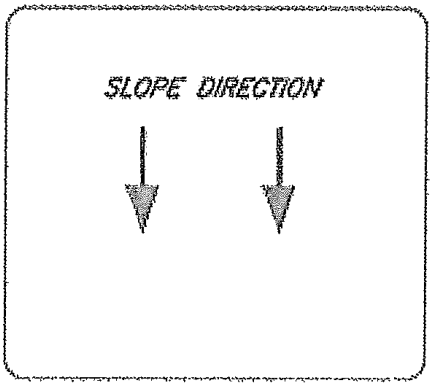


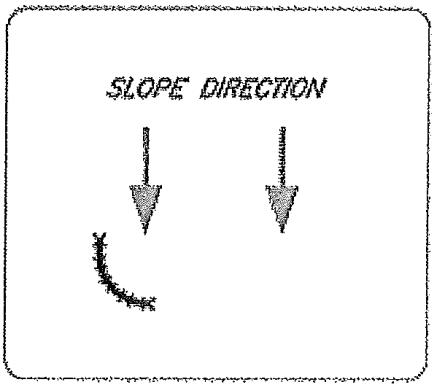
Discreet segments of compost berms, installed with J-hooks or 'smiles' will be much more effective.

COMPOST BERM PLACEMENT FOR PERIMETER CONTROL

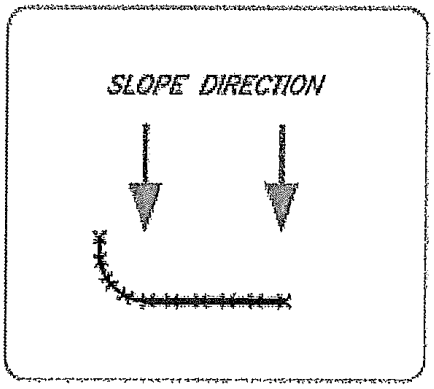
FILE CB 1

COMPOST BERMS AND SOCKS SC-6

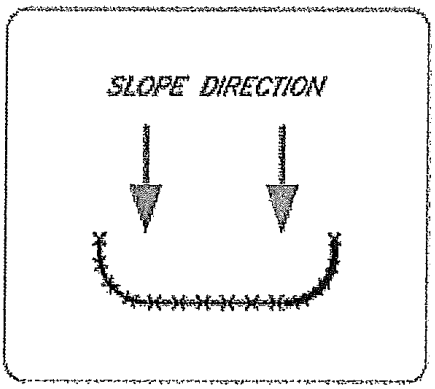




STEP 1 – CONSTRUCT LEG



STEP 2 – CONSTRUCT DAM

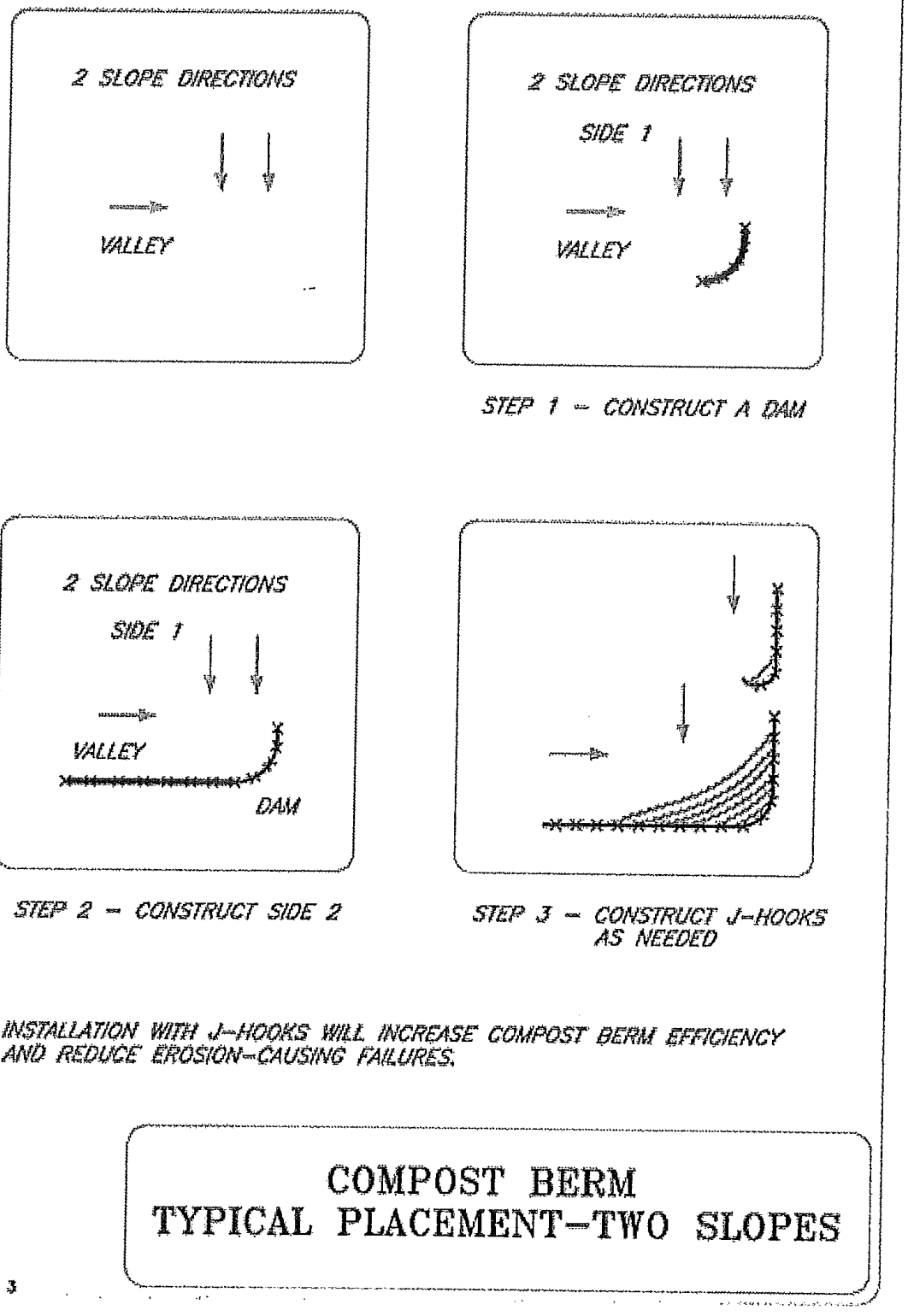


STEP 3 – CONSTRUCT LEG 2

INSTALLATION WITH J-HOOKS OR 'SMILES' INCREASE COMPOST BERM EFFICIENCY.

FILE: CB2

COMPOST BERM
TYPICAL PLACEMENT–ONE SLOPE


2 SLOPE DIRECTIONS
VALLEY
2 SLOPE DIRECTIONS
SIDE 1
VALLEY
STEP 1 – CONSTRUCT A DAM
2 SLOPE DIRECTIONS
SIDE 1
VALLEY
DAM
STEP 2 – CONSTRUCT SIDE 2
STEP 3 – CONSTRUCT J-HOOKS AS NEEDED
INSTALLATION WITH J-HOOKS WILL INCREASE COMPOST BERM EFFICIENCY AND REDUCE EROSION-CAUSING FAILURES.
COMPOST BERM
TYPICAL PLACEMENT–TWO SLOPES
© 2002 JOHN MACGILLAVRY
FILE: CB 3

FIBER ROLLS OR WATTLES SC-7

Construction Specifications

Fiber rolls are manufactured from biodegradable fibers (such as weed-free rice straw) that are wrapped in photo degradable netting. They range from approximately 8 to 20 inches in diameter by 25-30 feet (8-9 m) long. Rolls are placed and staked along the contour of newly constructed or disturbed slopes, in shallow trenches. Fiber rolls reduce slope length, and are intended to capture and keep sediment on the slopes. Fiber rolls are useful to temporarily stabilize slopes by reducing soil creep, and sheet and rill erosion until permanent vegetation can be established. Fiber rolls can catch soil that is moved down the slope by the freeze/thaw processes. Organic matter and seeds are trapped behind the rolls, which provide a stable medium for germination. Rolls trap topsoil and retain moisture from rainfall, which aids in growth of seedlings planted upslope of the rolls.

Design Considerations:

- Sites appropriate for fiber rolls are:
  - Slopes susceptible to sheet and rill erosion.
  - Slopes producing dry ravel.
  - Slopes susceptible to freeze/thaw activity.
  - Slopes difficult to vegetate because of soil movement.
- Fiber rolls are not intended for use in concentrated flow situations.
- It is imperative, especially on steeper slopes, that a sufficiently deep trench is constructed in which to place the roll. Without the trench, the roll will not function properly, runoff will scour underneath it, and trees or shrubs planted behind the roll will not have a stable environment in which to become established.
- Fiber rolls last an average of two years, depending on the fiber and mesh used in manufacturing. This is an important factor to consider when planning how long the slope will need to be mechanically stabilized.
- Fiber rolls can be staked with live stakes if site conditions warrant. The moisture retained by the fiber roll will encourage cutting establishment.

Advantages

- Fiber rolls are a relatively low-cost solution to sheet and rill erosion problems.
- They can replace sediment fences or straw bales on steep slopes.
- Rolls are a short-term solution to help establish native vegetation.
- Rolls store moisture for vegetation planted immediately upslope.
- Plastic netting will eventually photo-degrade, eliminating the need for retrieval of materials after the fiber or straw has broken down.

- The fibers become incorporated into the soil with time, adding organic material to the soil and retaining moisture for vegetation.

Disadvantages

- Rolls only function for one or two seasons.
- Pilot holes through the rolls must be pre-driven with a metal rod.
- If not installed properly with a sufficient trench, rolls may fail during the first rain event.
- Fiber rolls may require maintenance to ensure that the stakes are holding and the rolls are still in contact with the soil. This is especially true on steep slopes in sandy soil.

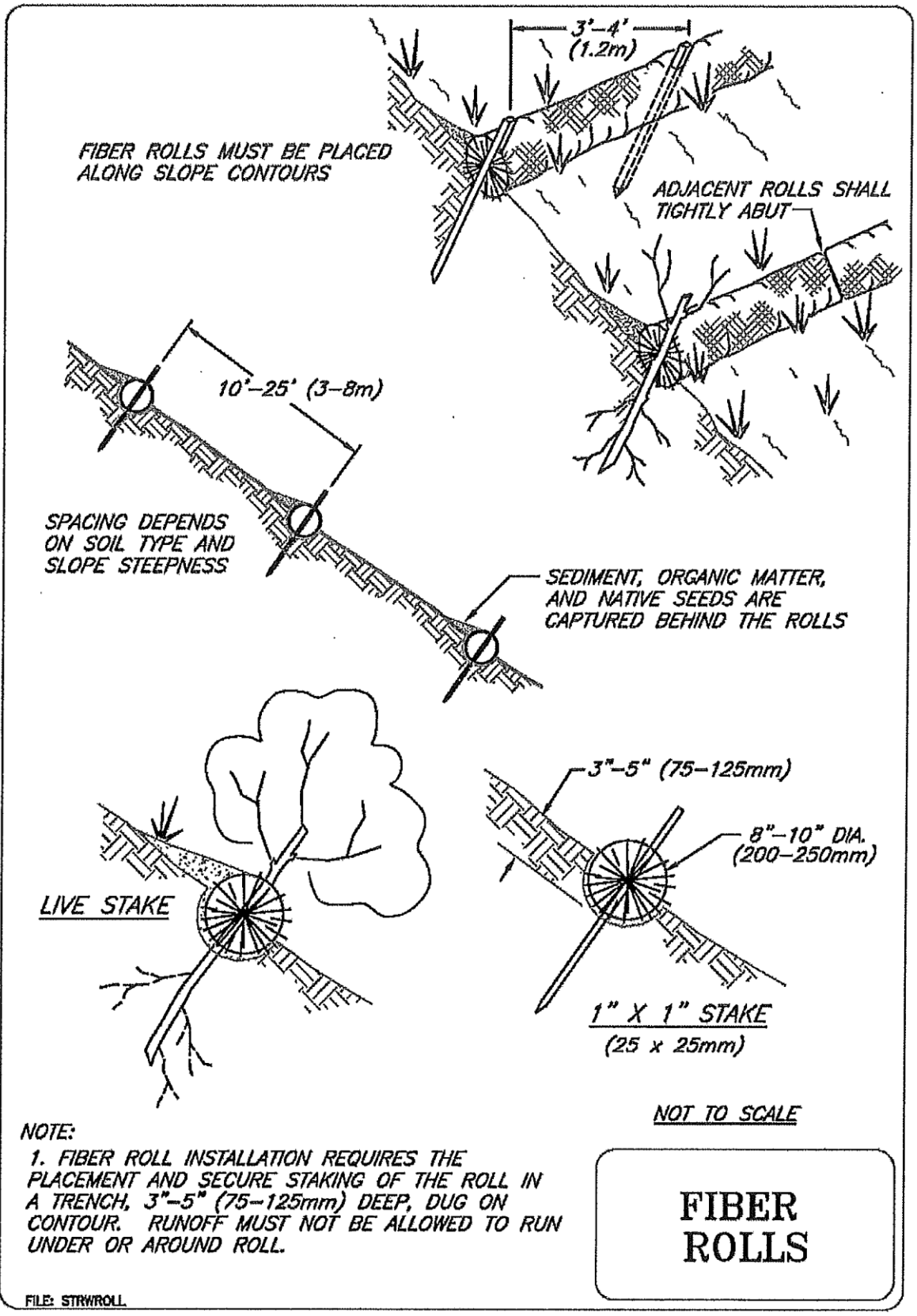
Installation

- Prepare the slope before the installation procedure is started.
- Shallow gullies should be smoothed as work progresses.
- Dig small trenches across the slope on contour, to place rolls in. The trench should be deep enough to accommodate half the thickness of the roll. When the soil is loose and uncompacted, the trench should be deep enough to bury the roll 1/3 of its thickness because the ground will settle.
- It is critical that rolls are installed perpendicular to water movement, and parallel to the slope contour.
- Start building trenches and installing rolls from the bottom of the slope and work up.
- Construct trenches at contour intervals 25-30 feet (8-10 m) apart depending on the steepness of the slope. The steeper the slope, the closer together the trenches should be.
- Lay the roll along the trenches fitting it snugly against the soil. Make sure no gaps exist between the soil and the straw wattle.
- Use a straight bar to drive holes through the roll and into the soil for the willow or wooden stakes.
- Drive the stake through the prepared hole, and into the soil. Leave only 1 or 2 inches (25 or 51 mm) of the stake exposed above roll.
- Install stakes at least every 4 feet (1.2 m) apart along the length of the wattle. Additional stakes may be driven on the downslope side of the trenches on highly erosive or very steep slopes.

Inspection and Maintenance

- Inspect the rolls and the slopes after rain events and at the frequencies required by local municipalities. Make sure the rolls are in contact with the soil.
- Repair any rills or gullies promptly.
- Reseed or replant vegetation if necessary until the slope is stabilized.

FIBER ROLLS OR WATTLES SC-7



NOTE:

1. FIBER ROLL INSTALLATION REQUIRES THE PLACEMENT AND SECURE STAKING OF THE ROLL IN A TRENCH, 3"–5" (75–125mm) DEEP, DUG ON CONTOUR. RUNOFF MUST NOT BE ALLOWED TO RUN UNDER OR AROUND ROLL.

FIBER ROLLS

FILE: STRWROLL

STORM DRAIN INLET PROTECTION – SC-8

Construction 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 filter fabric fence (Type 1) protection is illustrated on Page 3. Similar to constructing a sediment fence. See BMP SC-1, "Sediment Fence." Do not place filter fabric underneath the inlet grate since the collected sediment may fall into the drain inlet when the fabric is removed or replaced.
- DI Protection Type 2 - Excavated Drop Inlet Sediment Trap - The excavated drop inlet sediment trap (Type 2) is illustrated in Page 4. Similar to constructing a temporary sediment fence, See BMP SC-1, "Sediment Fence." Size excavated trap to provide a minimum storage capacity calculated at the rate of 67 yd^3/ac (130 m^3/ha) of drainage area.
- DI Protection Type 3 – Gravel bag - The gravel bag barrier (Type 3) is illustrated in Page 5. Flow from a severe storm shall not overtop the curb. In areas of high clay and silts, use filter fabric and gravel as additional filter media. Construct gravel bags in accordance with BMP SC-3, "Gravel Bag Berm." Gravel bags shall be used due to their high permeability.
- DI Protection Type 4 –Fiber Rolls – Fiber roll (Type 4) is placed around the inlet and keyed and anchored to the surface similar to SC-7 ("Fiber Rolls") installation. Fiber rolls are intended for use as inlet protection where the area around the inlet is unpaved and the fiber roll can be secured to the surface. On impervious surfaces use weighted or gravel-filled fiber rolls in the same configuration as specified above or as specified by the manufacturer. Type 4 DI protection functions similarly to Types 1 and 2.

Minimum BMP standards are provided on the following details. The DI Protection (Types 1-4) as illustrated was not designed to significantly inhibit flow and cause flooding. If flooding problems occur, modify the existing BMP to alleviate flooding. Do not remove the BMP and allow sediment-laden water to discharge to the storm drain.

Alternative methods may be substituted for the methods described/shown herein such as prefabricated inlet insert devices, or gutter protection devices based on review and approval by DEQ or the local agency as submitted in the project ESCP. Typical installation details for Siltsack™ inserts and biofilter bags are included with this BMP.

Inspection and Maintenance:

General

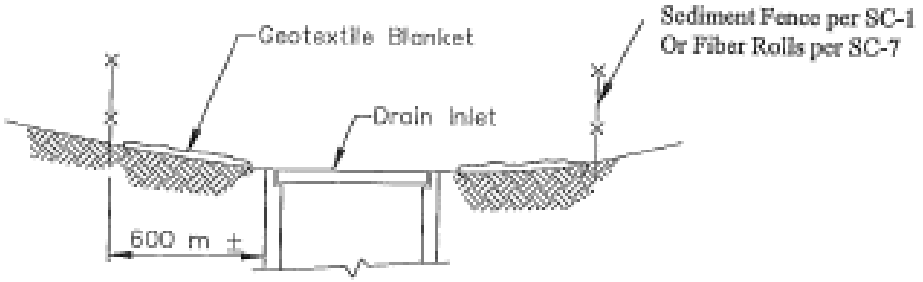
- Inspect all inlet protection devices before and after every rain event, and at the frequencies recommended by local municipalities. During extended rain events, inspect inlet protection devices at least once every 24 hours.
- Inspect the storm drain inlet after severe storms in the rainy season to check for bypassed material.
- Remove all inlet protection devices 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.
    - Clean and re-grade area around the inlet and clean the inside of the storm drain inlet as it must be free of sediment and debris at the time of final inspection.

STORM DRAIN INLET PROTECTION – SC-6

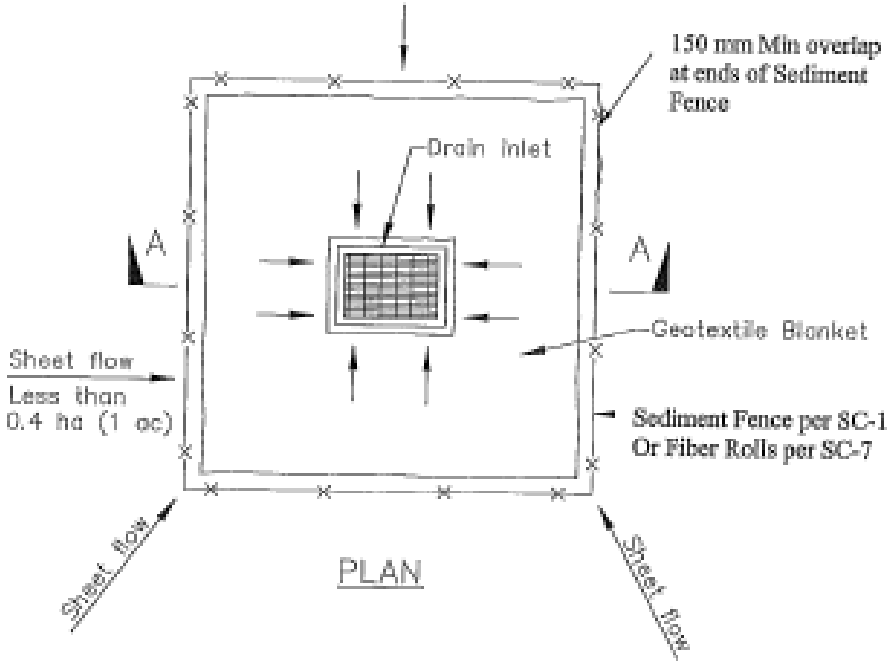
Requirements by Method

- Type 1 - Filter Fabric Fence
  - 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 stakes are securely driven in the ground and are structurally sound (i.e., not bent, cracked, or splintered, and are reasonably perpendicular to the ground). Replace damaged stakes.
  - Replace or clean 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 properly.
- 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 asphalt concrete (AC) or paved surfaces.
  - Inspect bags for holes, gashes, and snags.
  - Check gravel bags for proper arrangement and displacement. Remove the sediment behind the barrier when it reaches one-third the height of the barrier. Removed sediment shall be incorporated in the project or disposed of properly
- Type 4 Fiber Rolls
  - This method may be used for drain inlets requiring protection in areas that have been cleared and grubbed, and where exposed soil areas subject to grading.
  - Use weighted or gravel-filled fiber rolls on impervious surfaces. Check that fiber rolls are in good contact with the surface without gaps or preferential flow paths.
  - Check fiber roll for proper arrangement and displacement. Remove the sediment behind the barrier when it reaches one-third the height of the barrier. Removed sediment shall be incorporated in the project or disposed of properly.

STORM DRAIN INLET PROTECTION – SC-8



SECTION A–A



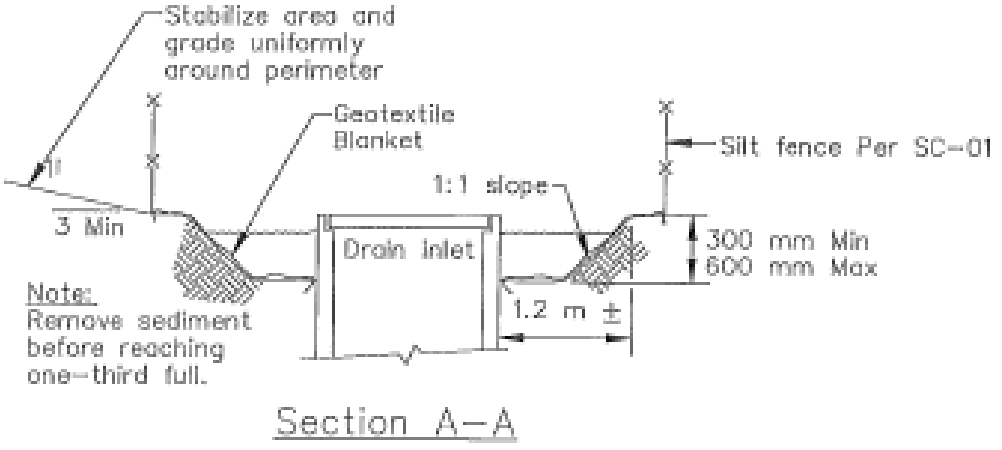
PLAN

DI PROTECTION TYPE 1 AND TYPE 4
Not to scale

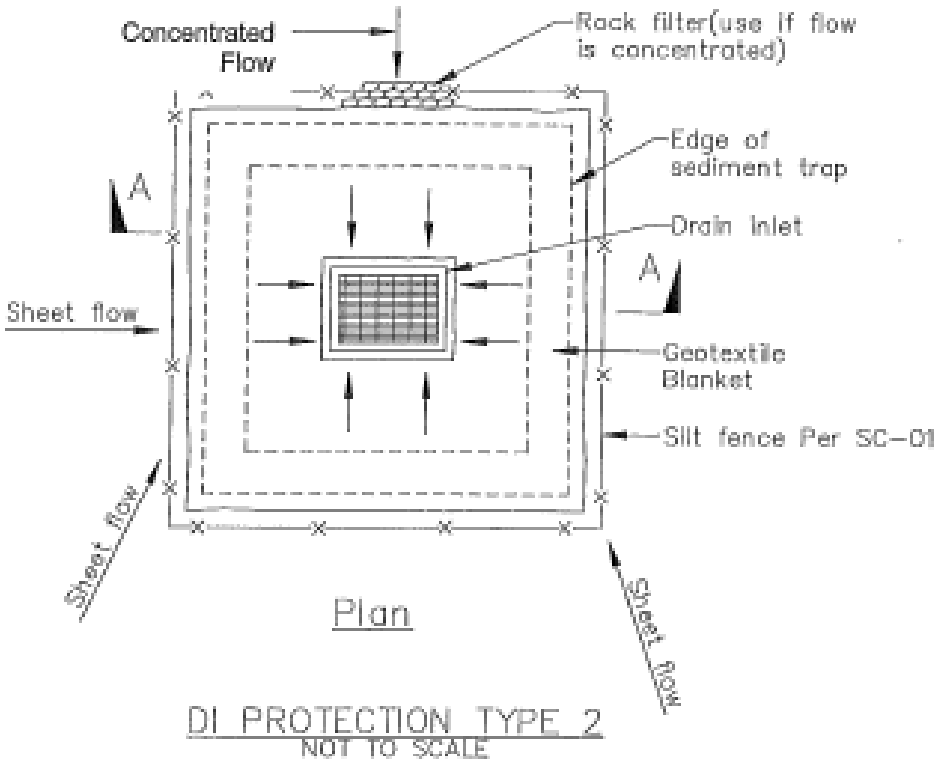
NOTES:

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.

STORM DRAIN INLET PROTECTION – SC-8



Section A–A

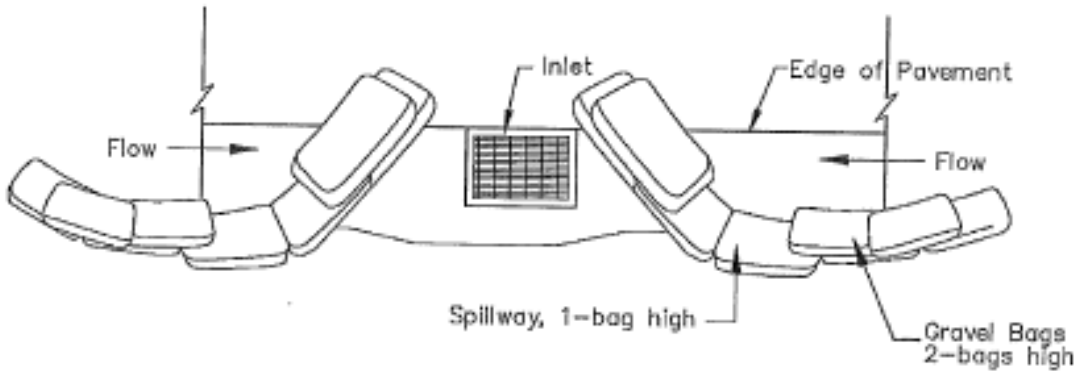


Plan

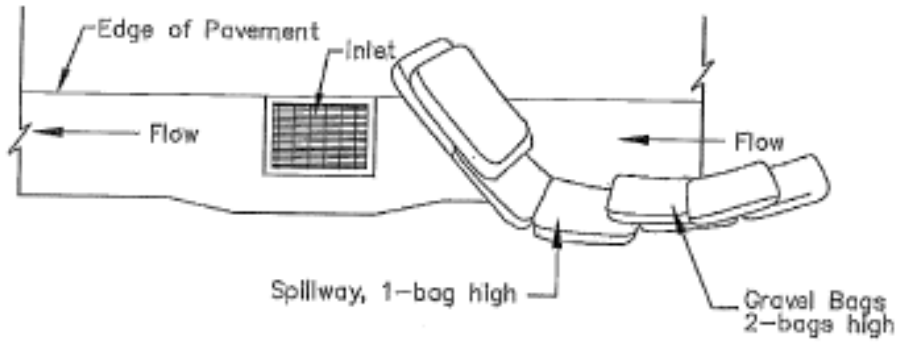
DI PROTECTION TYPE 2
NOT TO SCALE

Notes
1. For use in cleared and grubbed and in graded areas.
2. Shape basin so that longest inflow area faces longest length of trap.
3. For concentrated flows, shape basin in 2:1 ratio with length oriented towards direction of flow.

STORM DRAIN INLET PROTECTION – SC-8



TYPICAL PROTECTION FOR INLET WITH OPOSING FLOW DIRECTIONS



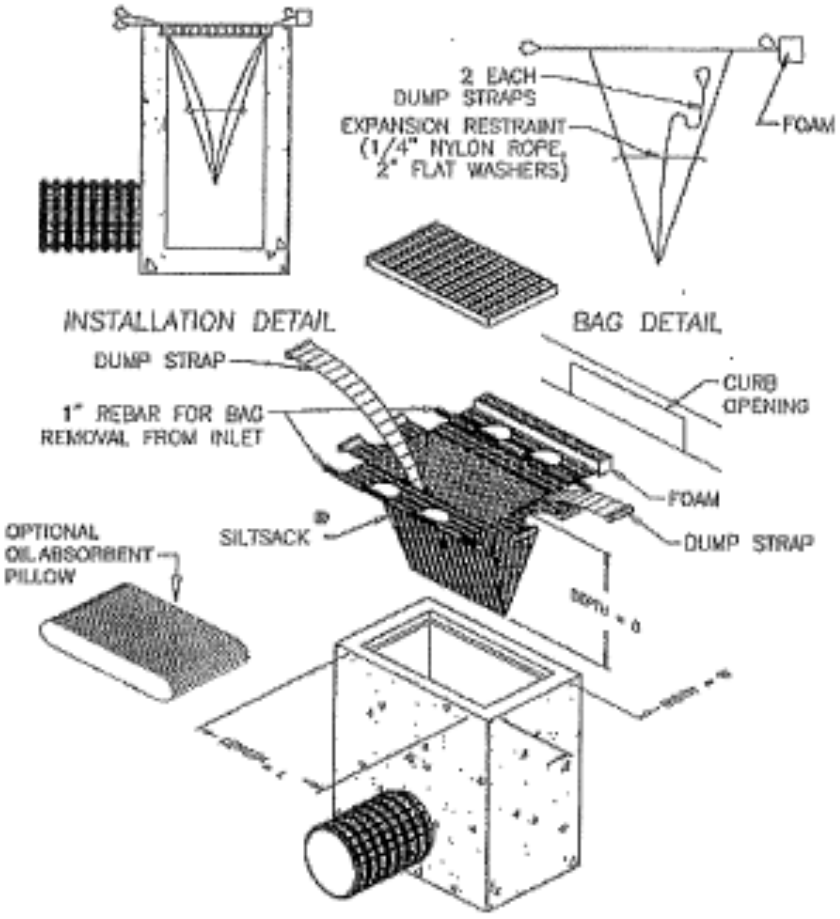
TYPICAL PROTECTION FOR INLET WITH SINGLE FLOW DIRECTION

NOTES:

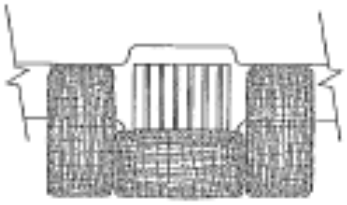
1. Intended for short–term use.
2. Use to inhibit non–storm water flow.
3. Allow for proper maintenance and cleanup.
4. Bags must be removed after adjacent operation is completed
5. Not applicable in areas with high silts and clays without filter fabric.

STORM DRAIN INLET PROTECTION – SC-8

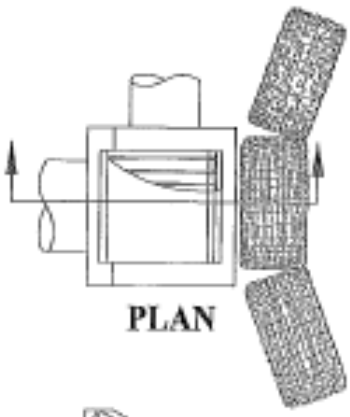
Typical Siltsack® Construction



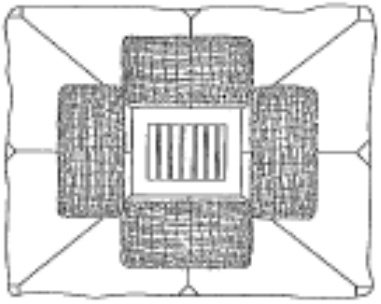
STORM DRAIN INLET PROTECTION – SC-8



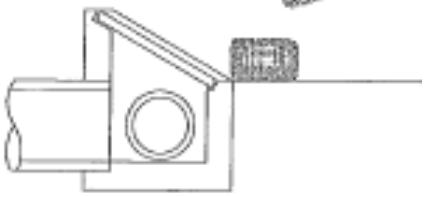
CATCH BASIN



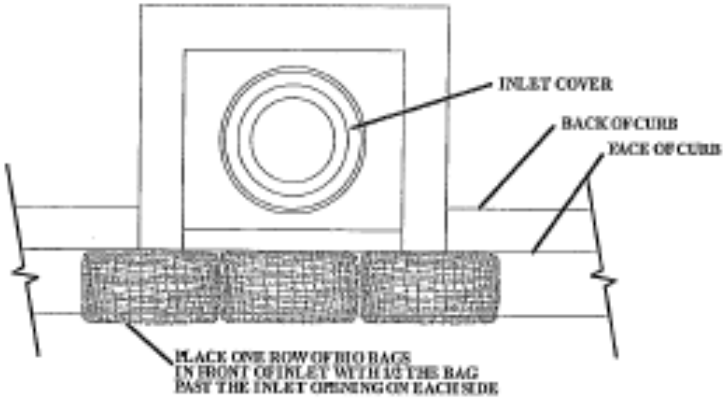
PLAN



AREA DRAIN



DITCH INLET



CURB INLET CATCH BASIN
BIO BAG INLET PROTECTION

NTS

TEMPORARY SEDIMENT BASIN –SC-9

Construction Specifications:

A sediment basin is a temporary basin with a controlled release structure, formed by excavating or constructing an earthen embankment across a waterway or low drainage area. Sediment basins may be placed where sediment laden storm water may enter a storm drain or watercourse, and around and/or up-slope from storm drain inlet protection measures. The sediment basin shall follow one of the four design options summarized below:

1. A sediment basin designed pursuant to local ordinance provided that the design efficiency is as protective, or more protective of water quality than Option No. 3.
2. A sediment basin designed with a minimum capacity of 3,600 cubic feet of storage per acre of disturbed land in a watershed equivalent to or more efficient than Option No. 3.
3. A sediment basin designed using the following equation:

   $(V) = 1.2Q/Vs_{SD}$ where:

   V = settling zone volume,

   Q = flow rate based on peak discharge from a specified design storm (where $Q = CiA$; see Section 2.4), and

   Vs_{SD} = settling velocity of the design soil particle.
4. A basin designed using an equivalent surface area design equation, equivalent to or more efficient than Option No. 3.

- In accordance with the requirements of the NPDES 1200-C General Permit, all sediment basins must be designed by a professional engineer licensed in Oregon.
- Construct the basin by excavating or building an embankment before any clearing or grading work begins.
- Areas under the embankment and any structural works shall be cleared, grubbed and stripped of any vegetation and rootmat as shown on the grading plan.
- In order to facilitate cleanout and restoration, the basin area shall be cleared, grubbed and stripped of any vegetation.
- A cut-off trench shall be excavated along the centerline of the earth fill embankments. The minimum depth shall be 2 feet (0.6 m). The cut-off trench shall extend up both abutments to the spillway elevation.
- Fill material for the embankment shall be clean mineral soil free of roots, woody vegetation, oversized stones, rocks or other objectionable material, and sufficiently moist for compaction.
- Fill material shall be placed in 6 inch (0.2 m) lifts, continuous layers over the entire length of the fill. Compaction shall be obtained by routing the hauling equipment over the fill so that the entire surface of each layer of the fill is traversed by at least one wheel or tread track of the equipment, or by the use of a compactor.
- The embankment should be constructed to an elevation of 10 percent higher than the design height to allow for settlement if compacting is achieved with hauling equipment. If compactors are used for compacting, the overbuild may be reduced to not less than 5 percent. The basin shall have means for dewatering within 7 days following a storm event.
- The principal spillway riser shall be securely attached to the discharge pipe by welding all around. All connections shall be watertight. A trash rack shall be installed on the top of the riser to prevent clogging of the discharge pipe.

TEMPORARY SEDIMENT BASIN –SC-9

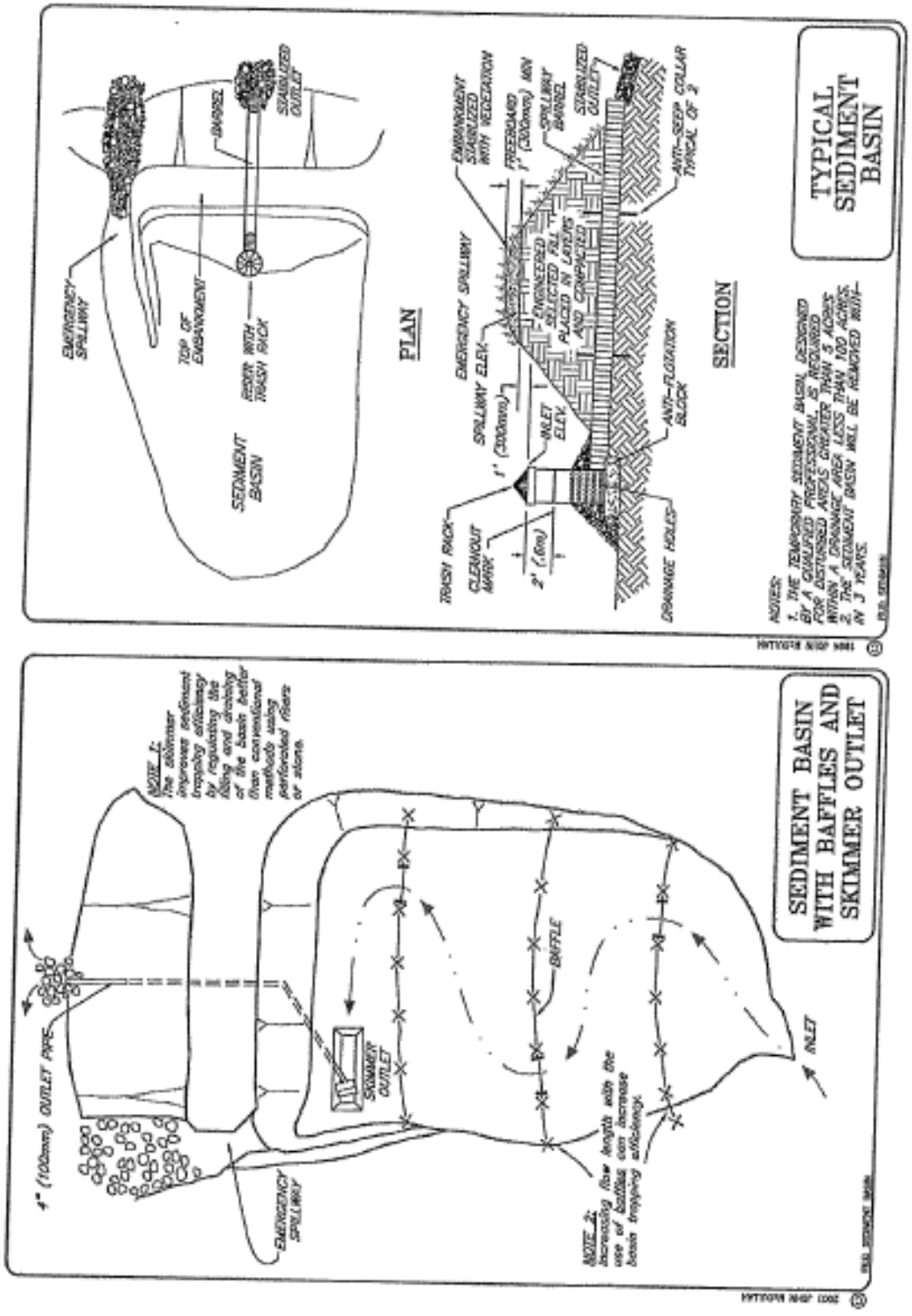
- The pipe and riser shall be placed on a firm, smooth soil foundation. The connection between the riser and the riser base shall be watertight. Pervious materials such as sand, gravel or crushed stone shall not be used as backfill around the pipe or anti-seep collars.
- The fill material around the pipe spillway shall be placed in 4-inch (101 mm) layers and compacted under the shoulders and around the pipe to at least the same density as the adjacent embankment. A minimum of 2 feet (0.6 m) of compacted backfill shall be placed over the pipe spillway before crossing it with construction equipment.
- Steel base plates shall have at least 2 1/2 feet (0.8 m) of compacted earth, stone or gravel over them to prevent flotation.
- The emergency spillway shall not be installed in fill. Elevations, design width, and entrance and exit channel slopes are critical to the successful operation of the emergency spillway.
- If used, baffles shall be constructed of 4 inch (101 mm) by 4 inch (101 mm) posts and of 4 foot (1.2 m) by 8 foot (2.4 m) - 1/2inch (12.7 mm) exterior plywood. The posts shall be set at least 3 feet (0.9 m) into the ground, no further apart than 8 feet (2.4 m) center to center, and shall reach a height 6 inches (0.2 m) below the riser crest elevation. Alternatively, earthen berms, metal sheeting, or other methods may be used as approved by DEQ or the local agency in the project ESCP.
- The embankment and emergency spillway shall be stabilized with vegetation immediately following construction. The outflow shall be provided with outlet protection to prevent erosion and scour of the embankment and channel.
- Construction operations shall be carried out in such a manner that erosion and water pollution will be minimized.
- Local and state requirements shall be met concerning fencing and signs warning the public of hazards of soft sediment and floodwater.

Minimum BMP standards are provided on the following details.

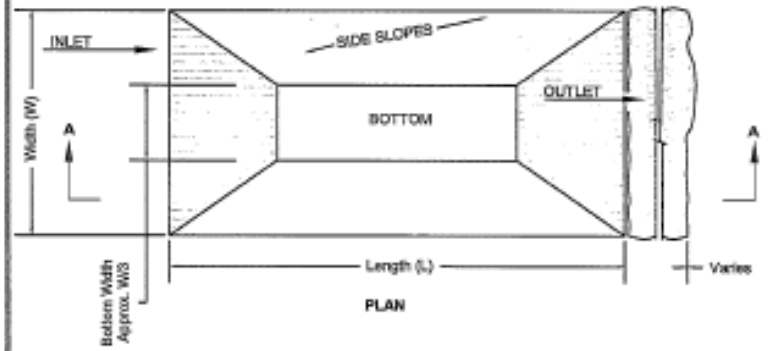
Inspection and Maintenance:

- Inspect before during, and after each rain event.
- All damages caused by soil erosion or construction equipment shall be repaired before the end of each working day.
- Remove sediment when the sediment storage zone is half full. This sediment shall be placed in such a manner that it will not erode from the site. The sediment shall not be deposited downstream from the embankment or in or adjacent to a stream or floodplain.
- When temporary structures have served their intended purpose and the contributing drainage area has been properly stabilized, the embankment and resulting sediment deposit shall be leveled or otherwise disposed of in accordance with the approved erosion and sediment control plan.

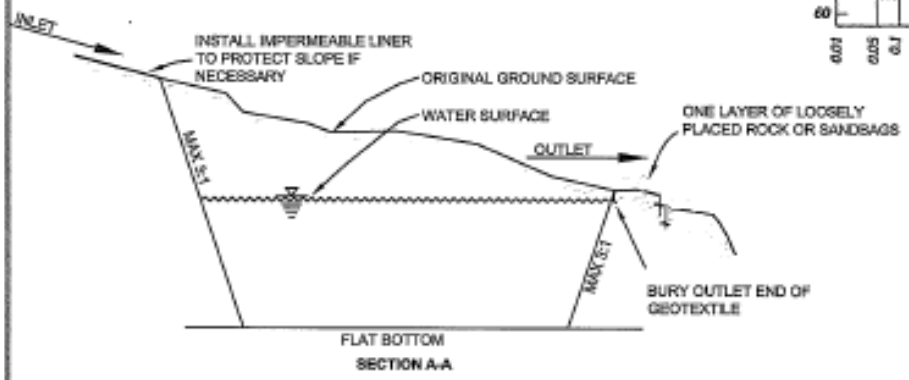
TEMPORARY SEDIMENT BASIN –SC-9



TEMPORARY SEDIMENT TRAP



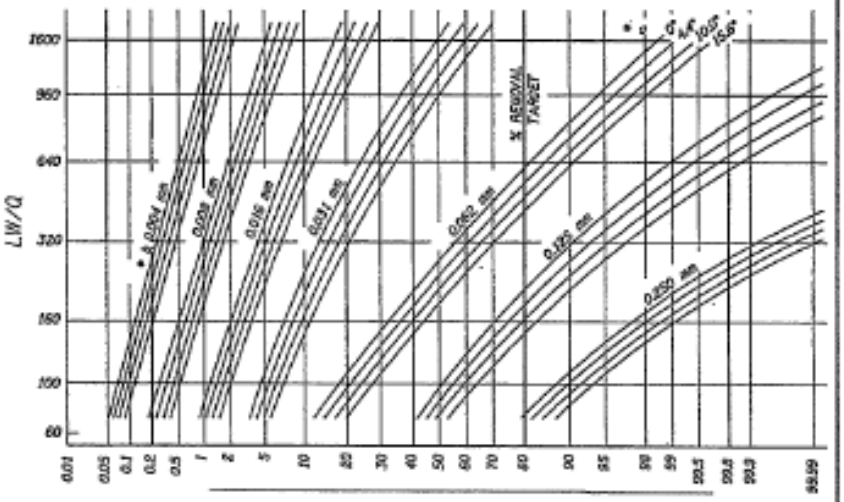
PLAN



SECTION A-A

TEMPORARY SEDIMENT TRAP

Sediment Removal Table



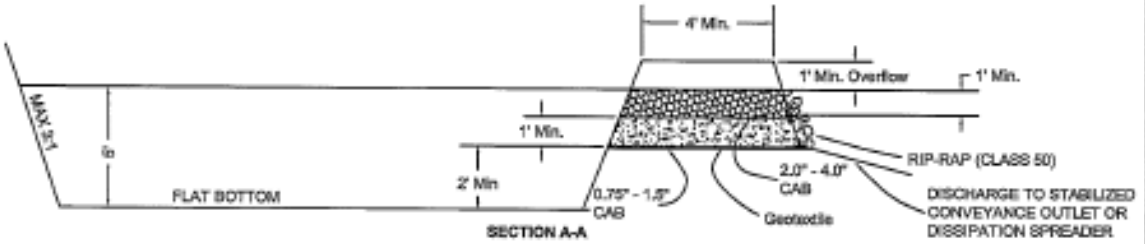
$$\% \text{ REMOVED} \left(1 - \frac{W_f}{W_0}\right) 100$$

* a TEMPERATURE °C
* b PARTICLE SIZE

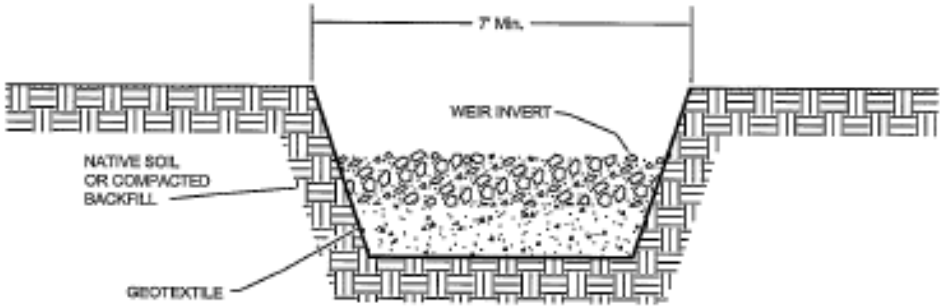
Notes:

1. **Maximum Drainage Area Per Sediment Trap is 5 acres.**
2. **Size Sediment Trap Using a 25-Year Peak Flow and the Sediment Removal Table.**
3. **Construct Sediment Trap Prior to Upslope Clearing, Grubbing or Excavation**

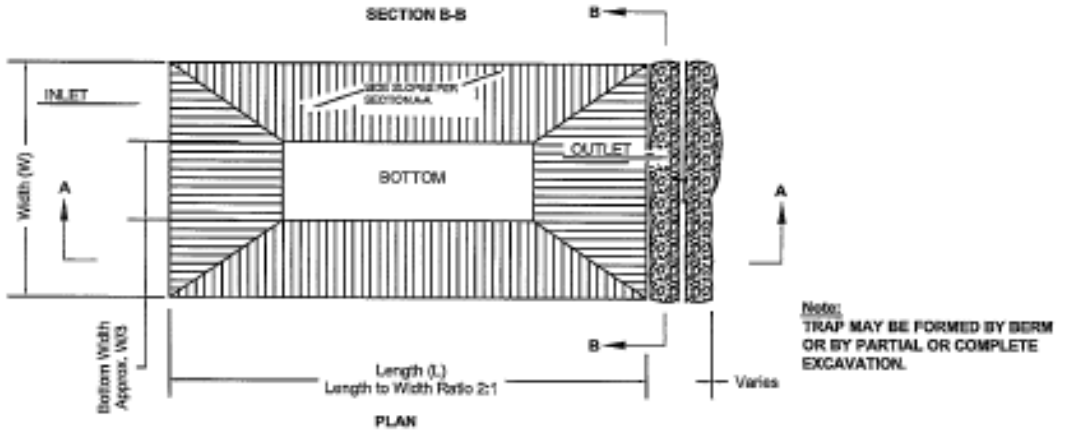
DRAWING SC-9A
(N.T.S.)



SECTION A-A



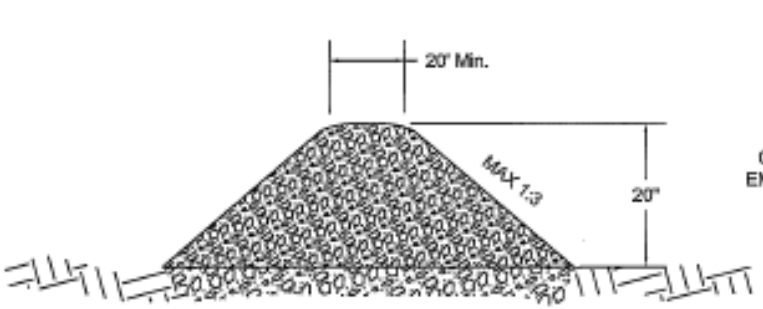
SECTION B-B



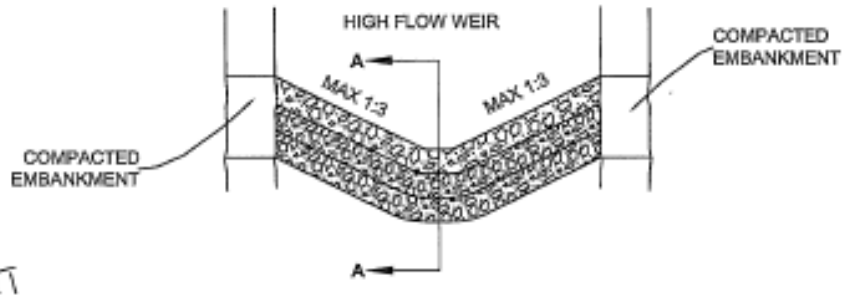
PLAN

Note:
TRAP MAY BE FORMED BY BERM OR BY PARTIAL OR COMPLETE EXCAVATION.

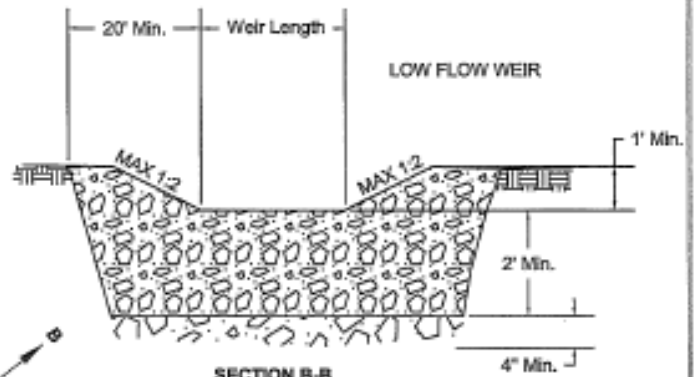
DRAWING SC-9B (N.T.S.)



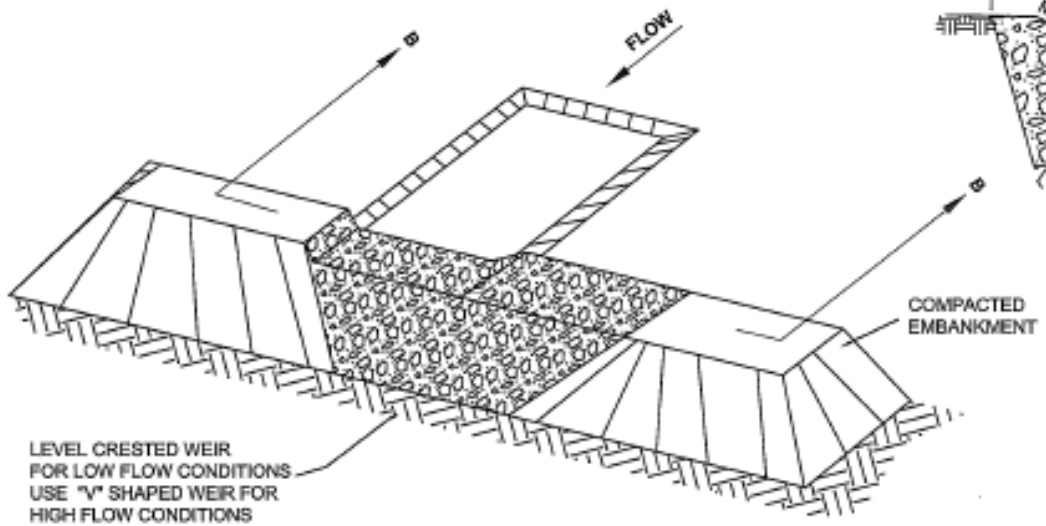
SECTION A-A



PLAN
"V" SHAPE DAM



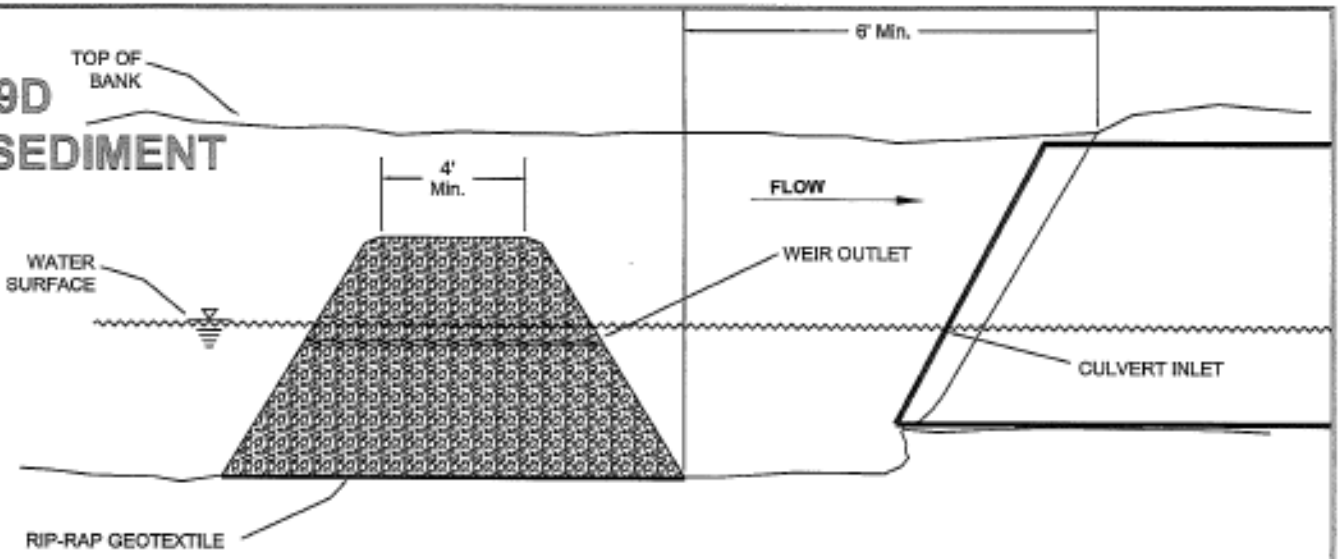
SECTION B-B
LEVEL CRESTED WEIR



FILTER DAM AT
SEDIMENT TRAP
OUTLET

DRAWING SC-9C
TEMPORARY
SEDIMENT TRAP
TYPE 3
(N.T.S.)

DRAWING SC-9D TEMPORARY SEDIMENT TRAP (N.T.S.)



PROFILE

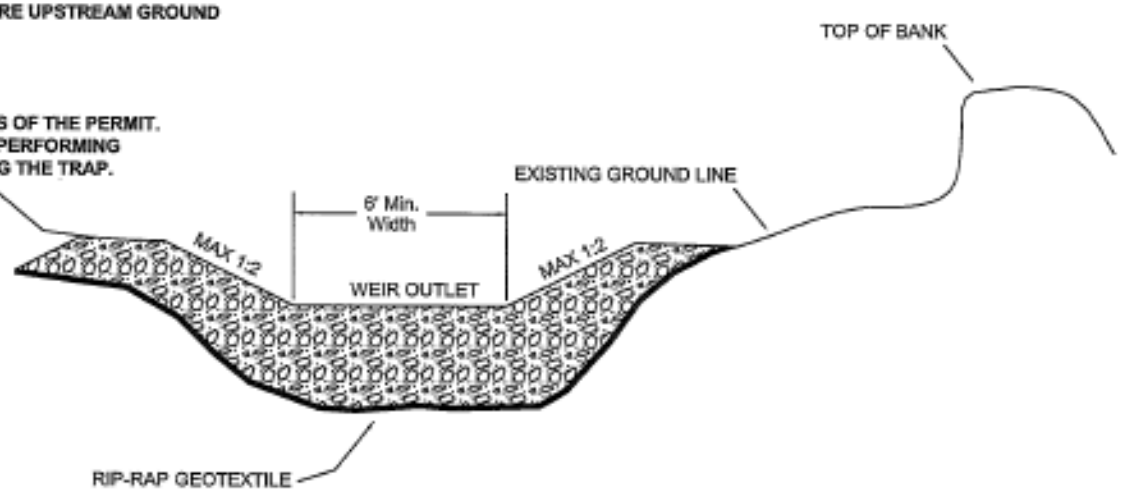
NOTES

LIMIT EXISTING VEGETATION REMOVAL. TRIM RATHER THAN REMOVE.

INSTALL TEMPORARY SEDIMENT TRAP BEFORE UPSTREAM GROUND DISTURBANCE BEGINS.

HAND PLACE GEOTEXTILE AND RIP-RAP.

FOLLOW THE MAINTENANCE SPECIFICATIONS OF THE PERMIT. PREVENT SEDIMENT RE-SUSPENSION WHEN PERFORMING MAINTENANCE AND WHEN DECOMMISSIONING THE TRAP.



SECTION

ENTRANCE / EXIT TRACKING CONTROLS – SC-10

Tracking controls reduce offsite tracking of sediment and other pollutants by providing a stabilized entrance at defined construction site entrances and exits and/or providing methods to clean-up sediment or other materials to prevent them from entering a storm drain by sweeping or vacuuming.

Construction Specifications:

- Stabilize entrances should be implemented on a project-by-project basis in addition to other BMPs.
- Sweeping or vacuuming should be implemented when sediment is tracked from the project site onto public or private paved roads, typically at points of site exit.
- Use stabilized entrances and/or sweeping at construction sites:
  - Where dirt or mud is tracked onto public roads;
  - Adjacent to water bodies;
  - Where poor soils are encountered, such as soils containing clay;
  - Where dust is a problem during dry weather conditions.

Stabilized Construction Entrances

- Limit the points of entrance/exit to the construction site by designating combination or single purpose entrances and exits. Require all employees, subcontractors and others to use them. Limit speed of vehicles to control dust. Clearly mark entrances and exits with appropriate signage.
- Locate construction entrances and exits to limit sediment leaving the site and to provide for maximum utility by all construction vehicles. Avoid entrances which have steep grades and entrances at curves in public roads.
- Grade each construction entrance/exit to prevent runoff from leaving the construction site.
- Design stabilized entrance/exit to support heaviest vehicles and equipment that will use it.
- Select construction access stabilization (aggregate, asphaltic concrete, concrete) based on longevity, required performance, and site conditions.
- Use of constructed or constructed/manufactured steel plates with ribs (e.g., shaker / rumble plates or corrugated steel plates) for entrance/exit access is allowable (See below).
- The aggregate size for construction of the pad shall be 3-6 inch (76-152 mm) stone. Place the gravel to the specific grade and dimensions shown on the plans, and smooth it.
- The thickness of the pad shall not be less than 8 inches (203 mm). Use geotextile fabric, if necessary, to improve stability of the foundation in locations subject to seepage or high water table.
- The width of the pad shall not be less than the full width of all points of ingress or egress and in any case shall not be less than 12 feet (3.6 m) wide.
- The length of the pad is as required, but not less than 50 feet (15.2 m).
- All sediment spilled, dropped, washed or tracked onto public rights-of-way shall be removed as soon as possible by hand sweeping or mechanized sweeper. Washing of sediment from the public right-of-way shall be prohibited.
- Provide drainage to carry water to a sediment trap or other suitable outlet.
- When necessary, wheels shall be cleaned to remove sediment prior to entrance onto public rights-of-way (see SC-11, Entrance / Exit Tire Wash).
- All sediment shall be reduced or prevented from entering any storm drain, ditch or watercourse through use of sediment fence, gravel bags, sediment barriers, or other approved methods.

ENTRANCE / EXIT TRACKING CONTROLS – SC-10

Minimum BMP standards are provided on the following detail.

Entrance with Shaker Plates

- Incorporate with a stabilized construction entrance/exit.
- Construct on level ground when possible, on a pad of coarse aggregate, greater than 3 inches (76 mm) and smaller than 6 inches (150 mm). A geotextile fabric shall be placed below the aggregate.
- Install constructed or manufactured steel plates with ribs (e.g., rumble plates or corrugated steel plates) at the entrance/exit in addition to the aggregate.
- Steel shaker plates shall be designed and constructed/manufactured for anticipated traffic loads.

Street Sweeping and Vacuum Sweeping

- Inspect potential sediment tracking locations daily.
- Visible sediment tracking should be swept or vacuumed as needed. Manual sweeping is appropriate for small jobs.
- For larger projects, it is preferred to use mechanical broom or vacuum sweepers that collect and contain removed sediment and material.

If not mixed with debris or trash, incorporate the removed sediment back into the project or depose of it at an approved disposal site.

Inspection and Maintenance:

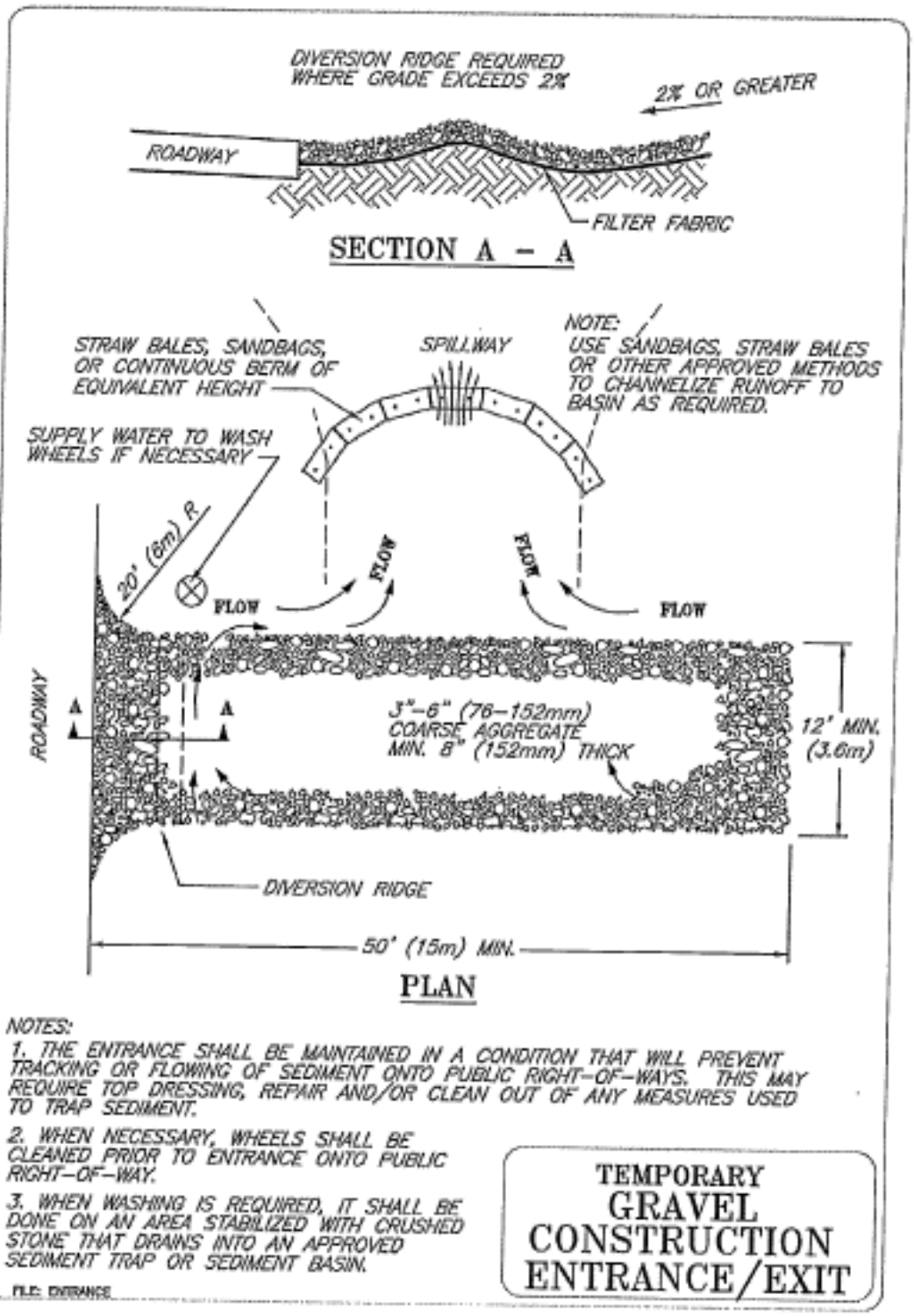
Stabilized Construction Entrance

- Inspect routinely for damage and assess effectiveness. Repair if access is clogged with sediment.
- Where tracking has occurred on roadways sweeping should be conducted the same day. Preferably water should not be used to wash sediment off the streets. If water is used, it should be captured preventing sediment-laden water from running off the site.
- Keep all temporary roadway ditches clear.
- The entrance shall be maintained in a condition that will reduce or prevent tracking or flowing of sediment onto public rights-of-way. This may require periodic top dressing with additional stone as conditions demand, and repair and/or maintenance of any measures used to trap sediment.
- Maintain the gravel pad in a condition to prevent mud or sediment from leaving the construction site. Replace gravel material when surface voids are visible.
- After each rainfall, inspect all gravel construction entrances and clean it out as necessary.
- As soon as possible remove all objectionable materials spilled, washed, or tracked onto public roadways. Remove all sediment deposited on paved roadways immediately.

Street Sweeping and Vacuuming

- Inspect entrance and exit points daily and sweep tracked sediment as needed.
- Be careful not to sweep up any unknown substance or any object that may be potentially hazardous.
- After sweeping is finished, properly dispose of sweeper wastes.

ENTRANCE / EXIT TRACKING CONTROLS – SC-10



ENTRANCE / EXIT TIRE WASH – SC-11

Construction Specifications:

- Incorporate with a stabilized construction entrance/exit. See BMP SC-10, "Entrance / Exit Tracking Controls."

Manual/Hose Tire Wash

- Construct on level ground when possible, on a pad of coarse aggregate, greater than 3 inches (75 mm) and smaller than 6 inches (150 mm). A geotextile fabric shall be placed below the aggregate.
- Tire wash shall be designed and constructed/manufactured for anticipated traffic loads.
- Provide a drainage conveyance that will convey the runoff from the wash area to a sediment trapping device. The drainage ditch shall be of sufficient grade, width, and depth to carry the wash runoff.
- Require that all employees, subcontractors, and others that leave the site with mud-caked tires and/or under-carriages use the wash facility.

Temporary Drive-Through Tire Wash

- Minimum dimensions: 40 feet by 12 feet by 1.5 feet (length, width, and sump depth; 12.2 m by 3.7 m by 0.46 m). The minimum length includes ingress and egress from the sump.
- The aggregate size for construction of the pad shall be 4-6 inch (101-152 mm) stone. Place the gravel to the specific grade and dimensions shown on the plans, and smooth it.
- The thickness of the pad shall not be less than 8 inches (203 mm). Use geotextile fabric under the gravel to improve stability of the foundation.
- Alternatively, install a 3 in. asphalt lift over a stable roadway base with the same dimensions identified above.
- The run out pad should extend 50 feet (15.2 m) past the egress ramp and drain back into the sump or to a suitable collection and treatment facility.
- Install fencing, as necessary, to manage vehicle traffic.

Minimum BMP standards are provided on the following illustrations.

Inspection and Maintenance:

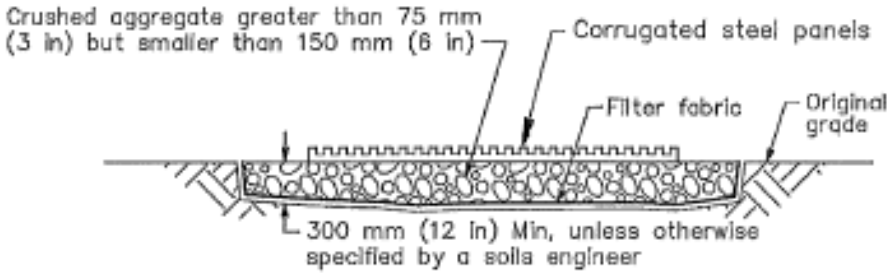
Manual/Hose Tire Wash

- Remove accumulated sediment in tire wash and/or sediment trap to maintain system performance.
- Inspect routinely for damage and repair as needed.

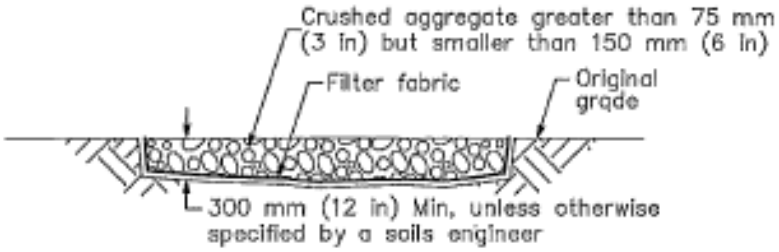
Temporary Drive-Through Tire Wash

- Inspect routinely to assess the water levels within the sump, the depth of accumulated sediment, and identify any areas that require maintenance.
- Remove accumulated sediment from the tire wash facility to maintain tire wash sump depth. Sediment may be pumped, piped or vacuumed to a suitable collection and treatment facility.
- Clean or replace rock when clogged with sediment and re-grade as needed.
- Maintain the run-out pad as necessary to prevent sediment accumulation.
- Immediately remove any rock that is carried from the pad to the roadway.
- Ensure that wash water drainage, collection and treatment system is functioning.

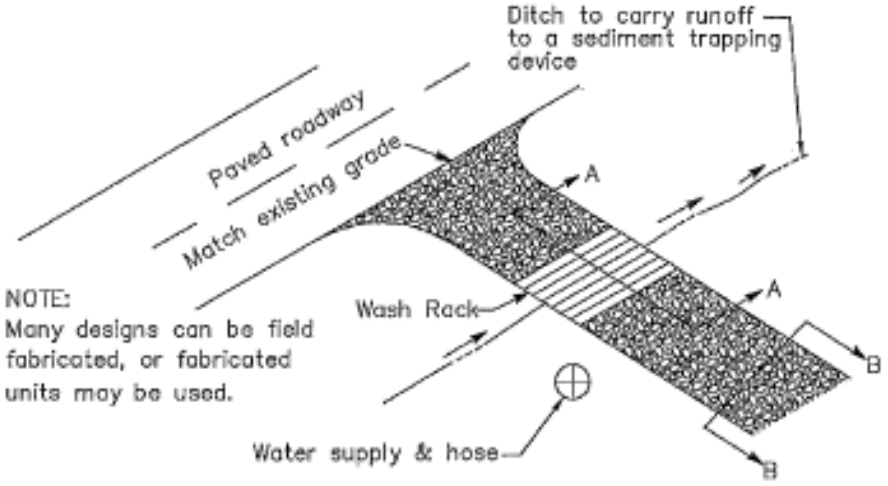
ENTRANCE / EXIT TIRE WASH – SC-11



SECTION A–A
NOT TO SCALE



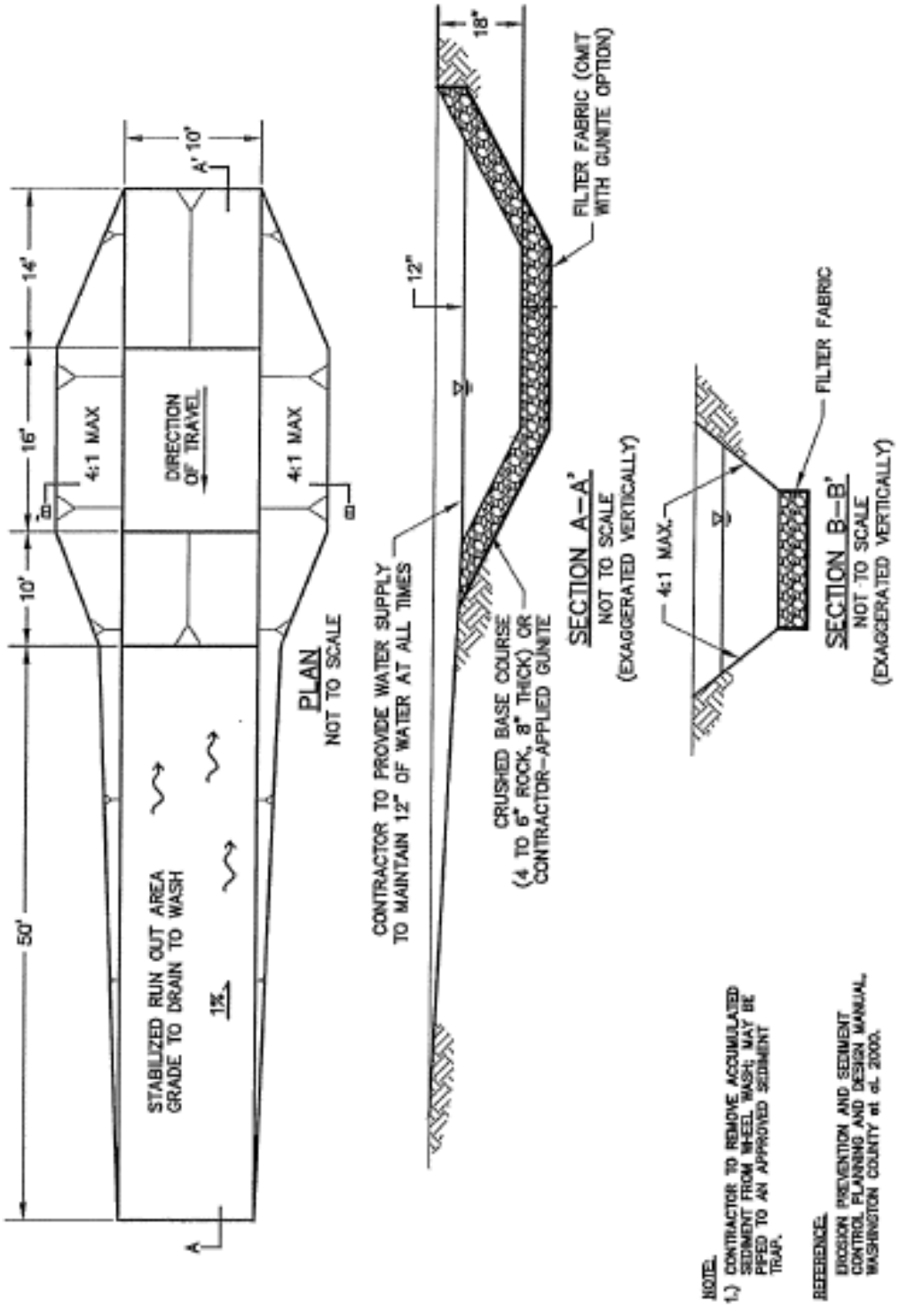
SECTION B–B
NTS



TYPICAL TIRE WASH
NOT TO SCALE

MANUAL / HOSE TIRE WASH

ENTRANCE / EXIT TIRE WASH – SC-11



TEMPORARY DRIVE THROUGH TIRE WASH