

Disturbed Area Stabilization Plan

**Farming First Holdings LLC
9500 Batchelder Road
Los Alamos, California 93440**

April 2026

Prepared for:

Farming First Holdings LLC
5156 McGrath Street, Suite 106
Ventura, CA 93003

Prepared by:

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Disturbed Area Stabilization Plan

Farming First Holdings LLC
Los Alamos, California

April 2026

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1.0 Introduction

Site Name and Address:

Farming First LLC
9500 Batchelder Road
Los Alamos, CA 93440
APN: 099-010-060

Property Owner:

FF 9500 LLC
5675 Ralston Street, Suite A
Ventura, CA 93003

Cultivator:

9451 Cultivators LLC and 9500 Cultivators LLC, William Terry
5156 McGrath Street, Suite 103
Ventura, CA 93005

¹This Disturbed Area Stabilization Plan (DASP) was prepared in response to the Central Coast Regional Water Quality Control Board's (CCRWQCB) Notice of Violation (NOV) dated February 3, 2026, for the Farming First LLC cannabis cultivation facility (Facility) located at 9451 and 9500 Batchelder Road, Los Alamos, California. This DASP was prepared in accordance with the requirements of the State Water Resources Control Board's General Waste Discharge Requirements and Waiver of Waste Discharge Requirements for Discharges of Waste Associated with Cannabis Cultivation, Order WQ 2023-0102-DWQ (Order). The approved cannabis cultivation plan set (Flowers & Associates Inc, 2022) proposed a phased approach to development of the operational areas; however, only Phase 1 of the design was implemented at the Facility. ²Therefore, this DASP covers only those areas associated with Phase 1 disturbances.

In accordance with the Order (Attachment D, pp D13-D15), the ³~~Site Management Plan~~ must contain the following items:

- I. Site Description, including environmental conditions, a site map, history of disturbance, and vegetation descriptions;
- II. Erosion prevention best practical treatment and control (BPTC) measures that have been, or will be taken to prevent or limit erosion;
- III. Sediment control BPTC measures that have been, or will be, implemented to capture sediment that has been eroded;
- IV. Maintenance activities to ensure the erosion prevention and sediment control BPTCs will function as intended over time;
- V. Long term stabilization measures that may occur at either the beginning or end of the precipitation season; and
- VI. Compliance strategy with the General Order schedule limits

The following resources were consulted in the preparation of this plan:

- State Water Resources Control Board, Order WQ 2023-0102-DWQ, General Waste Discharge Requirements and Waiver of Waste Discharge Requirements for Discharges of Waste Associated with Cannabis Cultivation Activities;
- California Stormwater Quality Association. 2024. California Stormwater Best Management Practice Handbook – Construction. California Stormwater Quality Association, Menlo Park, California; ⁴and

Summary of Comments on Microsoft Word - FarmingFirst_DASP_v1.0

Page: 3

 Number: 1 Author: Aaron Katona Subject: Comment on Text Date: 6/10/2026 10:53:17 AM

Summary of Review

This proposal includes sections of a Disturbed Area Stabilization Plan as described in Attachment D: Technical Report Guidance and gives a summary of proposed technical work, however, there are some deficiencies:

- **Site specific technical completeness.** The proposal does not include- or at best, minimally includes- site specific quantitative information.

- **Specific technical application of BMPs tailored to the Site.** There is a reliance on generalized BMPs taken from handbooks that are not fully fleshed out for the specifics of this site. "Site specific" doesn't necessarily need to be additional figures (though additional figures can be added if appropriate), but there at least needs to be quantitative information in the text that is tailored to the particulars of this location. If any of the specific values shown in the figure are being proposed, than justification for using those values needs to be given.

- **An enforceable work schedule.** This should include at minimum, work implementation deadlines, the scope of work to be done including any long term monitoring. The schedule should be tied to demonstrable success criteria for both the short and long term proposed work.

- **Identification of other state and local agencies regulations.** Several other regulatory agencies such as CDFW, and Santa Barbara County have regulatory authority tied to this site. The documents needs to make it clear that the entity performing the proposed work understands which regulatory agencies need to be involved, and that the proposed work will be implemented in compliance with all state and local agency requirements.

 Number: 2 Author: Aaron Katona Subject: Comment on Text Date: 6/2/2026 2:57:23 PM

The DASP needs to cover any and all land disturbed by cannabis cultivation and associated activities that occurred on the land parcel. This includes, but is not limited to the work done to implement Phase 1.

 Number: 3 Author: Aaron Katona Subject: Cross-Out Date: 6/2/2026 4:16:47 PM

'DASP' needs to be used here instead of 'Site Management Plan'. A Site Management Plan is term with a specific meaning in the Cannabis General Order. It is not synonymous with the term DASP.

 Number: 4 Author: Aaron Katona Subject: Comment on Text Date: 6/2/2026 4:17:09 PM

and...Is there supposed to be more here after the 'and'?

2.0 Site Description

¹ The Facility is located at 9500 Batchelder Road in Los Alamos, California, within a rural agricultural area characterized by surrounding agricultural and ranching operations and undeveloped hillsides. The Facility is accessed via Batchelder Road, and no stream crossings are required to access the Facility. Adjacent land uses include agricultural operations to the north, open space to the east and south, and agricultural uses and an intermittent watercourse to the west.

The Facility is gently sloped to the southwest towards the adjacent intermittent watercourse. The surrounding area consists of agricultural and ranching operations, and hilly, undeveloped open space dominated by grassland and scrubland vegetation communities. Site elevations range from approximately 580 to 680 feet above mean sea level (AMSL). The area experiences a Mediterranean climate characterized by cool, wet winters and warm, dry summers, with average annual precipitation of approximately 15.31 inches, based on data from the County of Santa Barbara Flood Control District. Soils onsite predominantly consist of clay loams and sandy loams, according to the Natural Resources Conservation Service (NRCS) Web Soil Survey.

² Surface water runoff from the Facility generally flows southwest via overland flow and earthen drainage conveyance channels. During ³ larger storm events, runoff may exceed channel capacity and discharge to the adjacent intermittent watercourse to the southwest of the Facility. Additional details are provided in Appendix A, including the site map depicting the intermittent watercourse, applicable setbacks, identified disturbed areas within setbacks, and storm water runoff sampling locations.

The Facility has been historically disturbed by prior agricultural operations, including grading and traditional crop cultivation that predate the current cannabis cultivation activities. These historical uses contributed to baseline erosion and sedimentation conditions onsite. Subsequent site modifications associated with cannabis cultivation, particularly the installation of impervious hoop houses, ⁴ have increased the potential for soil erosion by increasing the volume of surface runoff generated during storm events.

Runoff from the hoop houses is concentrated within access rows between cultivation areas and conveyed via earthen drainage channels to the southwest, where it combines with surface runoff from the upslope hoop house areas. Surface runoff enters the existing gullies that convey runoff from the agricultural terrace to the adjacent ⁵ intermittent watercourse. Although these gullies were present under historical conditions, increased runoff associated with cannabis cultivation activities has exacerbated erosion and sedimentation within these gullies. As a result, the gullies represent the primary disturbed areas identified in the CCRWQCB's NOV and associated inspection report.

Native and naturalized vegetation historically present within the disturbed areas likely consisted of a mix of ruderal, coastal scrub, and riparian scrub plant communities.

-
-  Number: 1 Author: Aaron Katona Subject: Comment on Text Date: 6/2/2026 4:19:24 PM
The Site Description needs to be clear that any part of the land parcel (APN: 099-010-060) affected by cannabis cultivation and related activities are considered part of the Site and need to be considered for remediation in the DASP, even if no work is being proposed for a particular section.. The current wording is vague and seems -to me- too narrow, limiting the extent of the site to only the hoop houses.
-
-  Number: 2 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 3:16:55 PM
I think this is a mischaracterization. "During large storm events" suggests that erosion, or the possibility of erosion (i.e., threat or possible threat to water quality), is only occurring during above average precipitation events. It's my understanding that most precipitation events (average, below, or above) have or have the potential to discharge surface water runoff and move sediment. If the discharger believes runoff and sediment from the hoop house area into the riparian setback and the adjacent intermittent watercourse only occurs during large storm events, a drainage study would likely be required to verify that claim.
-
-  Number: 3 Author: Aaron Katona Subject: Cross-Out Date: 5/12/2026 12:43:40 PM
-
-  Number: 4 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 3:19:37 PM
The evidence from available historic satellite imagery indicates the installation of the hoop houses increased not only the potential for high rates of soil erosion, but did increased the actual rate of soil erosion. I don't know if this phrase necessarily needs to be revised, but I did want to point out the ambiguity.
-
-  Number: 5 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 3:20:15 PM
No mention in the document of the downstream receiving waters i.e. San Antonio Creek. San Antonio Creek is the primary watercourse that the intermittent stream converges with. This is an important detail to add, it contextualizes which waters of the state and the associated beneficial uses identified in the Basin Plan have, or have the potential to be threatened; and which threats the proposed work is intended to remediate.

3.0 Erosion and Sedimentation Prevention BPTC Measures

¹ A combination of physical and biological Best Practical Treatment and Control (BPTC) measures will be implemented to stabilize disturbed areas, limit erosion, and capture sediment associated with storm water runoff. The locations of all proposed BPTC measures are shown on the figures included in Appendix A. The fact sheets for the proposed BPTCs are included in Appendix B.

Physical BPTC Measures

² Check Dams (SE-4)

Check dams will be installed at ³ regular intervals within the ⁴ improved earthen conveyance channels (EC-9) to reduce flow velocities and promote sediment deposition. The existing storm water conveyance channels will be improved to include compacted earthen dikes and channel configurations as described in the applicable fact sheet design criteria included in Appendix B. Check dams will be constructed within the improved earthen conveyance channels using appropriately sized rock or other durable materials and spaced based on channel slope. Please refer to Figure 2 for the proposed approximate locations of the check dams. The exact locations of the proposed check dams will be determined on-site at the time of construction.

Grading Eroded Slopes

Grading will be conducted within the identified gullies to establish stable slopes that resemble the pre-disturbance topographic contours and remediate the incised erosional features. The grading operations will be conducted to prepare the disturbed areas for installation of additional BPTCs (i.e., slope drains, velocity dissipation devices, straw wattles, etc.) and stabilization (i.e., hydroseeding and hydraulic mulch). ⁵ The proposed grading operations will be balanced on-site, resulting in no net export or import of material to achieve the proposed grading design. Please refer to Figures 2 and 3 for the location of the slopes that are proposed to be graded, including a proposed slope design with a 4:1 (horizontal:vertical) slope ratio. Finish graded areas will be prepared in accordance with techniques identified in EC-15. ⁶ The erosional features located near the stream bank will be disconnected from the existing on-site drainage conveyance channels by an earthen dike and hydroseeded to prevent further disturbance.

Straw Wattles (SE-5)

Following grading, ⁷ straw wattles (fiber rolls) will be installed along contours on the graded slopes and within the conveyance channels, as appropriate, to minimize surficial erosion. Wattles will be trenched and keyed into the graded slopes and ⁸ installed at 20-foot intervals. Please refer to Figure 2 for the proposed approximate locations of the straw wattle. The exact locations of the proposed straw wattle will be determined on-site at the time of construction.

Earth Dikes and Drainage Swales (EC-9)

The existing storm water conveyance channels will be improved to include drainage swales and compacted earthen dikes as described in the applicable fact sheet design criteria included in Appendix B. The earthen dikes and drainage swales will convey storm water runoff from the Facility to the proposed slope drains and velocity dissipation devices, as described below, or to discharge point near the entrance of the Facility. The earthen dikes will prevent storm water runoff from discharging along the banks of the adjacent intermittent watercourse. Please refer to Figure 2 for the proposed locations of the earthen dikes and drainage swales.

Number: 1 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 3:26:16 PM

A multifaceted approach that combines different erosion control techniques is often appropriate, but some of the proposed measures are designed with a different goal for what we have for stabilization at this location. BPTCs should focus on obtaining sheet flow and infiltration rather than channelized flow, creating slope stability to slow down erosion rates, and re-vegetating.

A second concern revolves around the increased amount of disturbance the installation some of these measures would cause, and the extended time it would take to install them, compared to the net gain to the long term rehabilitation of the Site.

Regardless of the specific BPTCs agreed on, this section still needs :

- **Quantified disturbed/impacted/eroded acreage.** No quantitative data is given for the length, area, and/or volume of the eroded surfaces or the expected area impacted by the proposed work.

- **Numeric/quantitative estimations that are site specific.** The figures and diagrams referenced in the appendices are generic. Site specific values, even if only estimated, are needed. These values are important because they are tied to tracking successful BPTC implementation and project success criteria that all involved parties can refer to.

Number: 2 Author: Aaron Katona Subject: Comment on Text Date: 5/13/2026 10:16:15 AM

I am concerned that by not filling in the conveyance channels completely and trying to establish a vegetation cover, leaving the channels relatively in place and installing check dams, could prolong or exacerbate the problem of increased channelized flow in an area that would be less prone to erosion if sheet flow could be established.

Number: 3 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 3:28:11 PM

- What is a 'regular interval' numerically speaking? 10-12 inches, 3 -8 feet, 1-2 miles? An estimated interval range and unit of measurement should be indicated. There is room to deviate from the plan -if deemed appropriate and is authorized- but to deviate requires having something to deviate from.

- Also, a basis (technical reasoning and sources) for choosing numerical values such as runoff volume and rate of flow, need to be included or referred to. If the numerical values supplied in the figures are going to be used, justification for why they are applicable to this site needs to be given.

Number: 4 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 3:29:18 PM

Water Board does not agree that excavating/reinforcing the drainage channel for channelized flow is an improvement over current conditions, or that this approach would protect downstream beneficial uses.

Number: 5 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 3:31:43 PM

Is this reasonable? One of the primary issues at this site is the erosion and transport of sediment from the Site to off-site locations.

I could see the potential need to import material for filling in eroded surfaces. Including an option to import material, if needed, may be warranted.

Number: 6 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 3:33:06 PM

Hydroseeding, is not inherently problematic. However, infill and slope stabilization are preferred over leaving channels in place, creating a raised earthen dike/ berm, or artificially centralizing channelized flow.

Number: 7 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 11:00:26 AM

Not a problem per se, just make sure the wattles -and any other materials used for erosion control- are compliant with the Cannabis General Order, Attachment A - Section 2, Erosion Control, item 11.

Number: 8 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 3:34:56 PM

Is there a particular reason an interval value of 20 ft. was chosen?

¹ Silt Fence (SE-1)

Silt fences will be installed along the top slope of the intermittent watercourse to capture the minimal sediment and runoff that may be generated between the earthen dikes and the bank of the intermittent watercourse. The earthen dikes and swales are proposed to divert storm water to the proposed slope drains, so the silt fencing will function as a secondary BPTC to redirect storm water runoff. Please refer to Figure 2 for the proposed locations of the silt fences.

² Slope Drains (EC-11) and Velocity Dissipation Devices (EC-10)

Two slope drain systems will be installed to convey storm water from the top of the graded slope to the base of the drainage feature. An earthen dike will be graded at the top of the slope to convey storm water into the slope drain inlets. The slope drains will be anchored in place to prevent movement during storm events. Riprap will be installed at the slope drain outlets to provide energy dissipation and minimize sediment mobilization at the discharge point. Please refer to Figures 3 and 4 for the proposed slope drain and velocity dissipation device design. ³ The slope drains must have a minimum pipe diameter of 24 inches to accommodate runoff.

Biological BPTC Measures

Hydroseeding (EC-4), and Hydraulic Mulch (EC-3) and/or Soil Binders (EC-5)

Disturbed areas will be stabilized using hydroseeding following completion of grading and installation of structural controls. The ⁴ seed mix will consist of native plants that are adequate for erosion control. Hydroseeding will be applied with mulch and soil binders, ⁵ as needed, to promote vegetation establishment and provide additional sediment stabilization. Please refer to Figure 2 for the proposed locations to be hydroseeded.

⁶ Implementation Schedule

Erosion and sediment control BPTC measures will be implemented prior to the onset of the wet season, ⁷ where feasible. Physical controls will be installed first, followed by hydroseeding. Specific erosion and sediment control BMPs that will be implemented at the Facility are listed below and the BMP fact sheets are included in Appendix B:

- EC-2 Preservation of Existing Vegetation
- EC-3 Hydraulic Mulch and/or EC-5 Soil Binders
- EC-4 Hydroseeding
- EC-9 Earth Dikes and Drainage Swales
- EC-10 Velocity Dissipation Devices
- EC-11 Slope Drains
- EC-15 Soil Preparation/Roughening
- EC-16 Non-Vegetated Stabilization (if slopes remain unvegetated temporarily)
- SE-1: Silt Fence
- SE-4 Check Dams
- SE-5 Fiber Rolls

4.0 Maintenance Activities for Erosion Prevention and Sediment Control

Erosion prevention and sediment control BPTC measures will be periodically inspected and maintained to ensure continued effectiveness. Inspections will occur during the wet season and following storm

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-  Number: 1 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 11:09:56 AM
As with the straw wattles, make sure the materials used are compliant with the Cannabis General Order, Attachment A - Section 2, Erosion Control, item 11.
-
-  Number: 2 Author: Aaron Katona Subject: Comment on Text Date: 5/13/2026 10:35:10 AM
Historic satellite imagery shows that most of the accelerated erosion appeared to occur after the hoop houses were erected (sometime between March 10, 2022 and April 27, 2023. If the hoop houses are removed, and the cultivation area and soils in the riparian setback are adequately re-vegetated will this impact the need to use slope drains and VDDs?
-
-  Number: 3 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 3:36:28 PM
- What is the engineering basis for the 24 inches of minimal pipe diameter? I don't recall reading a value given for the Site's maximum drainage area that would correspond to the table listed in the appendices under section EC-11.

- The intent of this remediation is to discourage concentrated and high velocity stormwater flow; and to encourage sheet flow and infiltration. Ideally, no RSP/Rip rap is required. Are there specific, anticipated velocities of flow?

- If the proposed rip rap is used, will it be sourced from a location on site, or imported from off site. If imported, is this in conflict with the statement earlier on that states: "the proposed grading operations will be balanced on-site, resulting in no net export or import of material...."?
-
-  Number: 4 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 3:37:02 PM
Seed mix must be compliant with the Cannabis General Order, Attachment A - Section 2, Erosion Control, item 9..
-
-  Number: 5 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 3:37:28 PM
This is vague. Who or what decides 'as needed', the site manager, the gardener, the neighbor?
-
-  Number: 6 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 3:39:38 PM
- A proposed and detailed work schedule with anticipated dates tied to specific work milestones is needed.

- What proposed dates is work expected to start and end on? What projected dates will specific BMPs be started/completed? When does the winter period (wet season) begin/end in Santa Barbara County and how is that related to the proposed work? When does the post-work monitoring begin, and when is it projected to end?

If there is a reasonable need and if the Water Board approves, projected dates can be modified However, there currently are no dates to modify.
-
-  Number: 7 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 11:30:29 AM
Further in the document, under section 6.0 it states: "All erosion control, sediment control, and stabilization measures described herein are anticipated to be implemented prior to the onset of the next winter period."

These two statements are not blatantly contradictory, but they do create some ambiguity. Some clarification is needed.

events that generate runoff. Maintenance will be performed as needed and may include repair or replacement of damaged BMPs, removal of sediment/debris, reinstallation of fiber rolls / silt fence, stabilization of eroded areas, and reseeding where vegetation has not been successfully established. The down drain and outlet protection will be maintained to ensure proper function, and any erosion or scour will be stabilized as needed.

Sediment captured by BPTC measures will be managed to prevent re-mobilization. Accumulated sediment will be removed from check dams, fiber rolls, silt fences, and sediment retention areas as needed to maintain capacity. ¹Removed sediment will be stabilized onsite in areas away from drainage features using appropriate measures (e.g., grading and/or cover), or disposed of offsite at an appropriate location in accordance with ²applicable regulations.

³Sufficient quantities of temporary sediment control materials will be maintained on-site throughout the rainy season to allow implementation of temporary erosion and sediment controls in the event of predicted rain.

Before and after each winter, the Facility will be inspected to determine if BMP improvements are necessary to help stabilize exposed surfaces, or to conduct maintenance in areas where erosion has occurred.

5.0 ⁴Long Term Stabilization Measures

Revegetation will be implemented to provide long-term stabilization of disturbed areas. Following completion of grading and installation of erosion and sediment control BPTC measures, disturbed areas will be hydroseeded with an ⁵appropriate native seed mix suited to site conditions.

⁶Hydroseeding will occur at the end of the precipitation season to promote establishment during the subsequent growing period. The ⁷seed mix will consist of native species consistent with surrounding vegetation communities and suitable for the site's soils and climate, so no irrigation is proposed. Hydroseeding will be applied with mulch and soil binders, as needed, to support germination and establishment.

⁸Revegetated areas will be monitored before and after each winter, and reseeding will be conducted as necessary until adequate vegetative cover for long-term stabilization is achieved.

6.0 ⁹Compliance with General Order Schedule Limits

All erosion control, sediment control, and stabilization measures described herein are anticipated to be implemented prior to the onset of the ¹¹next winter period. ¹⁰As such, a compliance schedule extending beyond the next winter period is not required.

-
-  Number: 1 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 11:35:37 AM
This is vague. Where on the site will the sediment be stabilized? Some detail is needed describing what the 'appropriate measures' are.
-
-  Number: 2 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 3:44:49 PM
Whose regulations would be 'applicable'? Federal, state, local? What specific regulations or references to regulations can be provided?
-
-  Number: 3 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 3:46:42 PM
How are 'sufficient quantities' determined ? What proposed value(s) are reasonable?
-
-  Number: 4 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 11:39:29 AM
Annual re-vegetation monitoring reports are required for at least 5 years or until success criteria for re-vegetation have been met. These reports will be due at the end of the preceding winter period. Mention of these should be included in the DASP.
-
-  Number: 5 Author: Aaron Katona Subject: Comment on Text Date: 5/13/2026 11:44:11 AM
Too vague. See related comment above under Biological BPTC Measures.
-
-  Number: 6 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 3:49:22 PM
- Is 'precipitation season' synonymous with the Winter Period as it is defined in the Cannabis General Order? Does this mean the long term measures will extend beyond the 2026-2027 winter period, and if so, which consecutive Winter Periods?
- This part seems to conflict with what is stated further in the document under Section 6.0, where it states: "All erosion control, sediment control, and stabilization measures described herein are anticipated to be implemented prior to the onset of the next winter period." Is hydroseeding not being considered a stabilization measure?
- It's my understanding that hydroseeding shortly before the rainy season begins (late September-October) is preferred to promote faster germination and root establishment.
-
-  Number: 7 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 3:50:12 PM
What specific species, or reference document ? See comments above under Biological BPTC Measures.
-
-  Number: 8 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 3:51:31 PM
Document should include language that specifies: At least five years of post-project re-vegetation monitoring must be performed and a minimum 85 percent vegetation survivable coverage must be achieved before monitoring is no longer required.
-
-  Number: 9 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 4:00:09 PM
Who needs to be contacted if significant hazardous material or releases occur during remediation work? See Cannabis General Order, Attachment A - Section 1, General Requirements and Prohibitions.
-
-  Number: 10 Author: Aaron Katona Subject: Comment on Text Date: 6/3/2026 3:53:40 PM
A compliance schedule extending beyond the next winter period may be required if the proposed work is not implemented as anticipated. A proposed extended schedule/dates for work needs to be included in the document.
-
-  Number: 11 Author: Aaron Katona Subject: Comment on Text Date: 5/13/2026 11:45:46 AM
Which one is the next. Is it the 2026-2027 Winter Period?
-

7.0 Certification

I certify that this Disturbed Area Stabilization Plan (DASP) was prepared under my responsible charge and supervision in accordance with Order WQ 2023 0102 DWQ and is consistent the Provision C.1.c and Attachment D (Technical Report Guidance) of the Order.

I am a qualified professional, as defined in Attachment A of the Cannabis Cultivation Policy (October 17, 2017) and as required by Order WQ 2023 0102 DWQ, and am licensed and/or certified in the State of California in a discipline applicable to the work performed. The DASP is based on site specific conditions and is intended to stabilize disturbed areas and minimize sediment discharge in a manner protective of water quality.

I further certify that the information, findings, analyses, and conclusions presented herein are, to the best of my knowledge and professional judgment, true, accurate, and complete, and were prepared in conformance with the requirements of the Cannabis Cultivation Policy and the applicable Order.



Pearce Swerdfeger, P.E.

Printed Name of Registered Professional Engineer

A handwritten signature in blue ink, appearing to read "A. Pearce Swerdfeger".

04/27/2027

Signature of Registered Professional Engineer

Date

C87466

09/30/26

CA

Registration No.

Expiration

State

APPENDIX A

FIGURES

**FARMING FIRST HOLDING LLC
9500 BATCHELDER ROAD
LOS ALAMOS, CALIFORNIA 93440**

1. COVER SHEET
2. SITE OVERVIEW
3. SITE PLAN
4. DETAILS

THE FACILITY IS LOCATED AT 9500 BATCHELDER ROAD IN LOS ALAMOS, CALIFORNIA, WITHIN A RURAL AGRICULTURAL AREA CHARACTERIZED BY SURROUNDING AGRICULTURAL AND RANCHING OPERATIONS. THE FACILITY IS ACCESSED VIA BATCHELDER ROAD, AND NO STREAM CROSSINGS ARE REQUIRED TO ACCESS THE FACILITY. ADJACENT LAND USES INCLUDE AGRICULTURAL OPERATIONS TO THE NORTH, OPEN SPACE TO THE EAST AND SOUTH, AND AGRICULTURAL USES AND AN INTERMITTENT WATERCOURSE TO THE WEST.

THIS DISTURBED AREA STABILIZATION PLAN (DASP) WAS PREPARED IN RESPONSE TO THE CENTRAL COAST REGIONAL WATER QUALITY CONTROL BOARD'S (CCRWQCB) NOTICE OF VIOLATION (NOV) DATED FEBRUARY 3, 2026, FOR THE FARMING FIRST LLC CANNABIS CULTIVATION FACILITY (FACILITY). THIS DASP WAS PREPARED IN ACCORDANCE WITH THE REQUIREMENTS OF THE STATE WATER RESOURCES CONTROL BOARD'S GENERAL WASTE DISCHARGE REQUIREMENTS AND WAIVER OF WASTE DISCHARGE REQUIREMENTS FOR DISCHARGES OF WASTE ASSOCIATED WITH CANNABIS CULTIVATION, ORDER QW 013-2022-DWG (ORDER).

EARTHWORK ASSOCIATED WITH THIS DASP SHALL BE CONDUCTED IN ACCORDANCE WITH APPLICABLE REQUIREMENTS FROM THE COUNTY OF SANTA BARBARA PUBLIC WORKS DEPARTMENT, THE STATE WATER RESOURCES CONTROL BOARD, AND THE CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE, AS APPLICABLE.



AERIAL:
TOPOGRAPHY:

CONTOUR INTERVAL:
DATUM:

GOOGLE EARTH, 06/27/2025
UNITED STATES GEOLOGIC SURVEY (USGS)
LIDAR POINTCLOUD, PUBLISHED DATE
2025-04-07
2 FEET
HORZ= NAD83, CALIFORNIA ZONE 5, US
FOOT
VERT= NAVD88

[illegible]

A Trinity Consultants Company
374 Poli Street, Suite 200 • Ventura, CA 93001
(805) 275-1515 • www.sespeconsulting.com

	DATE	NAME
DRAWN BY		GJC
CHECKED		DCT
APPROVED		

CLIENT:	FARMING FIRST LLC
PROJECT:	DISTURBED AREA STABILIZATION PLAN
TITLE:	COVER SHEET

PLOT DATE:
04/24/26

SHEET:
1

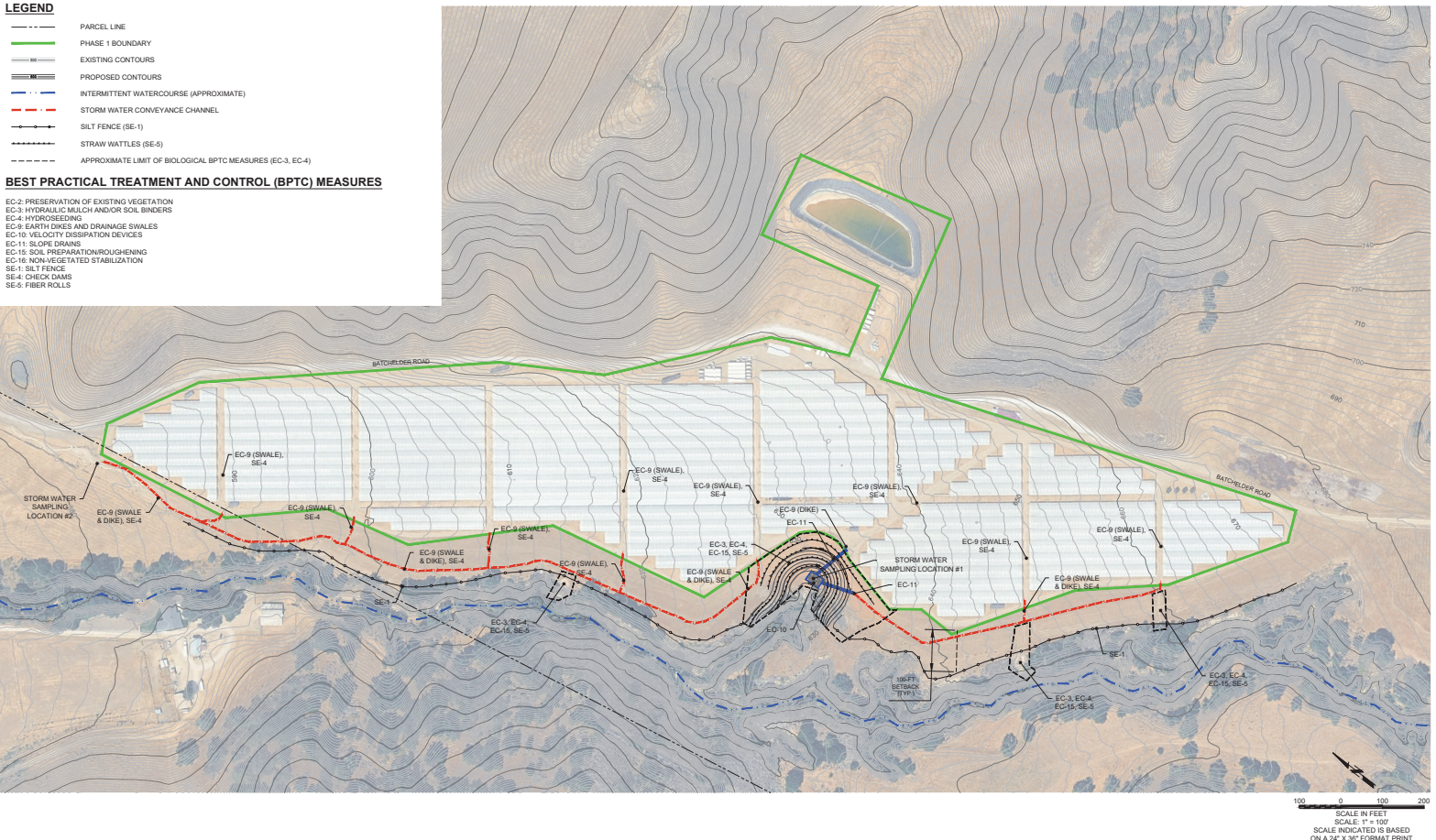
REV: 0

LEGEND

- PARCEL LINE
- PHASE 1 BOUNDARY
- EXISTING CONTOURS
- PROPOSED CONTOURS
- INTERMITTENT WATERCOURSE (APPROXIMATE)
- STORM WATER CONVEYANCE CHANNEL
- SILT FENCE (SE-1)
- STRAW WATTLES (SE-5)
- APPROXIMATE LIMIT OF BIOLOGICAL BPTC MEASURES (EC-3, EC-4)

BEST PRACTICAL TREATMENT AND CONTROL (BPTC) MEASURES

- EC-2: PRESERVATION OF EXISTING VEGETATION
- EC-3: HYDRAULIC MULCH AND/OR SOIL BINDERS
- EC-4: HYDROSEEDING
- EC-9: EARTH DIKES AND DRAINAGE SWALES
- EC-10: VELOCITY DISSIPATION DEVICES
- EC-11: SLOPE DRAINS
- EC-15: SOIL PREPARATION/ROUGHENING
- EC-16: NON-VEGETATED STABILIZATION
- SE-1: SILT FENCE
- SE-4: CHECK DAMS
- SE-5: FIBER ROLLS



BASIS OF DATA:

AERIAL TOPOGRAPHY: GOOGLE EARTH, 06/27/2025
UNITED STATES GEOLOGIC SURVEY (USGS)
LIDAR POINTCLOUD, PUBLISHED DATE 2025-04-07
CONTOUR INTERVAL: 2 FEET
DATUM: NAD83, CALIFORNIA ZONE 5, US FOOT
VERT: NAVD83

REVISIONS				
NO.	DATE	DESCRIPTION	BY	CHKD



SESPE
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CHECKED BY:	CLC
APPROVED BY:	CLC

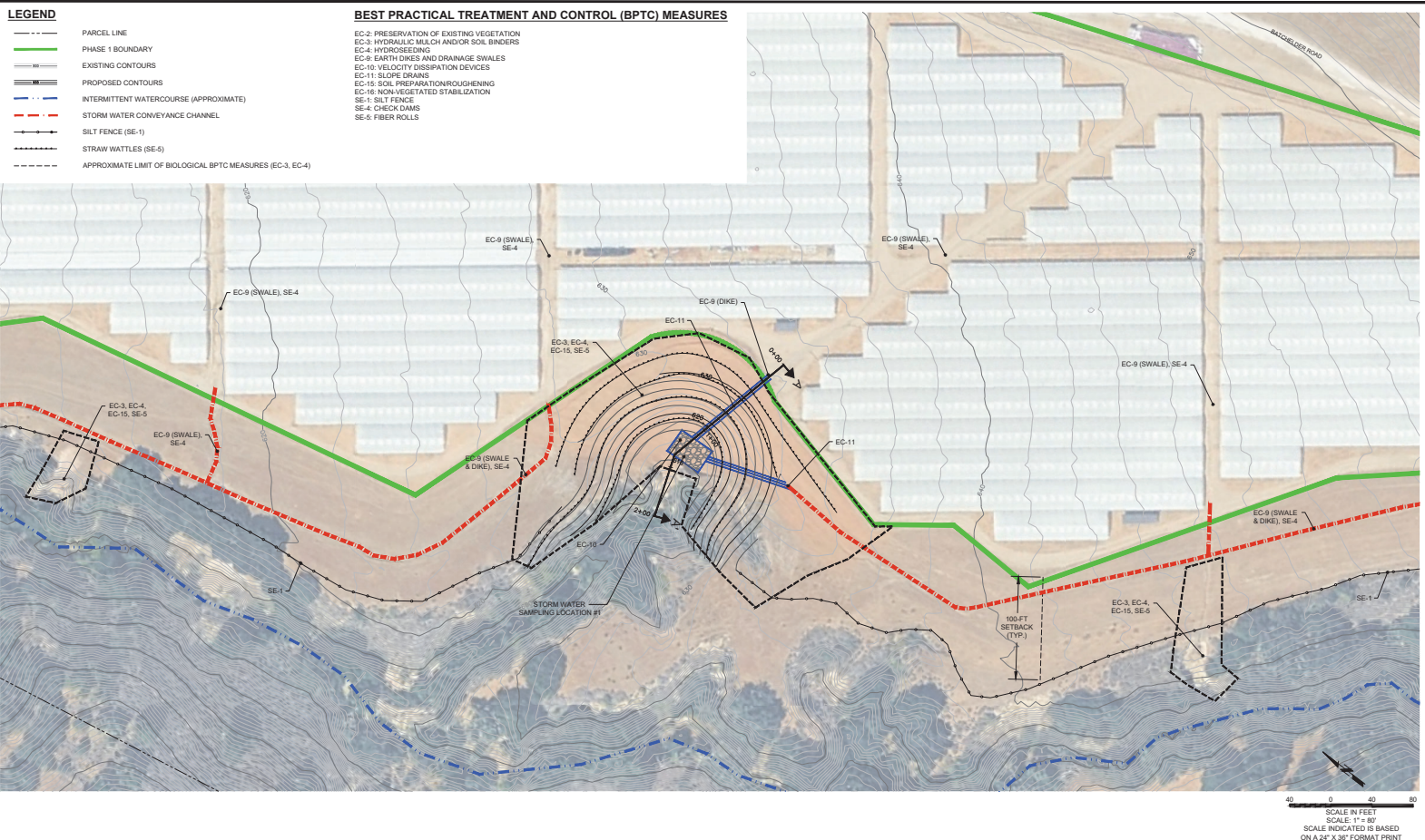
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PROJECT: DISTURBED AREA STABILIZATION PLAN
TITLE: SITE OVERVIEW
SESPE PROJECT NUMBER: 2005006.0041

PLOT DATE:	04/24/26
SHEET:	2
REV:	0

Legend:

- PARCEL LINE
- PHASE 1 BOUNDARY
- EXISTING CONTOURS
- PROPOSED CONTOURS
- INTERMITTENT WATERCOURSE (APPROXIMATE)
- STORM WATER CONVEYANCE CHANNEL
- SILT FENCE (SE-1)
- STRAW WATTLES (SE-5)
- APPROXIMATE LIMIT OF BIOLOGICAL BPTC MEASURES (EC-3, EC-4)

- EC-2: PRESERVATION OF EXISTING VEGETATION
- EC-3: HYDRAULIC MULCH AND/OR SOIL BINDERS
- EC-4: HYDROSEEDING
- EC-9: EARTH DIKES AND DRAINAGE SWALES
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- SE-1: SILT FENCE
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- SE-5: FIBER ROLLS



AERIAL: GOOGLE EARTH, 06/27/2025
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LIDAR POINTCLOUD, PUBLISHED DATE
2025-04-07
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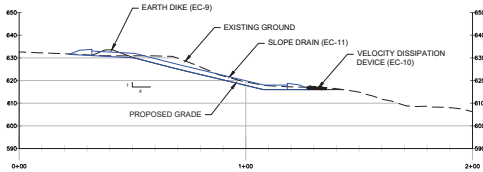
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<i>PROJECT:</i>	DISTURBED AREA STABILIZATION PLAN
<i>TITLE:</i>	SITE PLAN

SESPE PROJECT NUMBER: 260509.0041

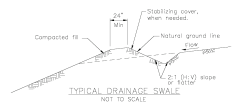
PLOT DATE:
04/24/26

SHEET:
3



SECTION A: SLOPE DRAIN
SCALE: 1" = 20'

Earth Dikes and Drainage Swales EC-9

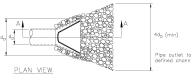
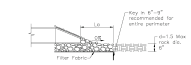


NOTES:
1. Stabilize inlet, outlets and slopes.
2. Properly compact the subgrade.



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Velocity Dissipation Devices EC-10

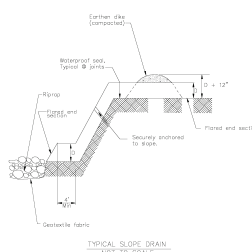


Pipe Diameter (inches)	Headshape (ft)	Apex Length (ft)	Tip Hole Dia. (inches)
18	1	12	4
24	1	12	6
30	1	12	8
36	1	12	10
42	1	12	12
48	1	12	14
54	1	12	16
60	1	12	18

For more information, see Appendix C, Regional CDD Regions.

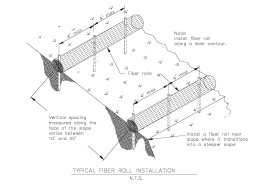
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Slope Drains EC-11



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Fiber Rolls SE-5



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BASIS OF DATA:

AERIAL: GOOGLE EARTH, 06/27/2025
TOPOGRAPHY: UNITED STATES GEOLOGIC SURVEY (USGS)
LIDAR POINTCLOUD, PUBLISHED DATE 2025-04-07
CONTOUR INTERVAL: 2 FEET
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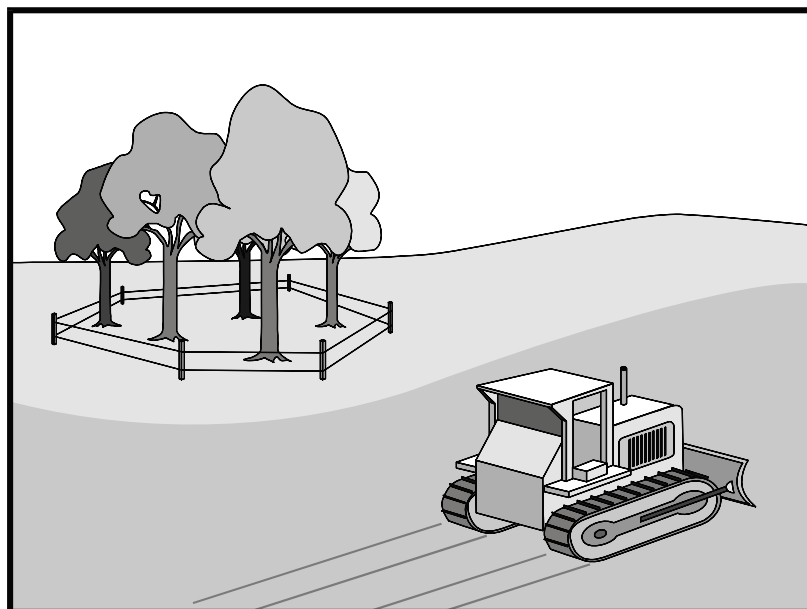
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CLIENT:	FARMING FIRST LLC	PLOT DATE:	04/24/26
PROJECT:	DISTURBED AREA STABILIZATION PLAN	SHEET:	4
TITLE:	DETAILS	REV:	6
SESPE PROJECT NUMBER:	2005006.0041		

APPENDIX B

Best Management Practices Fact Sheets

Preservation of Existing Vegetation EC-2



Description and Purpose

Carefully planned preservation of existing vegetation minimizes the potential of removing or injuring existing trees, vines, shrubs, and grasses that protect soil from erosion.

Suitable Applications

Preservation of existing vegetation is suitable for use on most projects. Large project sites often provide the greatest opportunity for use of this BMP. Suitable applications include the following:

- Areas within the site where no construction activity occurs or occurs at a later date. This BMP is especially suitable to multi year projects where grading can be phased.
- Areas where natural vegetation exists and is designated for preservation. Such areas often include steep slopes, watercourse, and building sites in wooded areas.
- Areas where local, state, and federal government require preservation, such as vernal pools, wetlands, marshes, certain oak trees, etc. These areas are usually designated on the plans, or in the specifications, permits, or environmental documents.
- Where vegetation designated for ultimate removal can be temporarily preserved and be utilized for erosion control and sediment control.
- Protecting existing vegetation buffers and swales.

Categories

EC	Erosion Control	☒
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

- ☒ **Primary Objective**
- ☒ **Secondary Objective**

Targeted Constituents

Sediment	☒
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

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Preservation of Existing Vegetation EC-2

Limitations

- Requires forward planning by the owner/developer, contractor, and design staff.
- Limited opportunities for use when project plans do not incorporate existing vegetation into the site design.
- For sites with diverse topography, it is often difficult and expensive to save existing trees while grading the site satisfactory for the planned development.

Implementation

The best way to prevent erosion is to not disturb the land. In order to reduce the impacts of new development and redevelopment, projects may be designed to avoid disturbing land in sensitive areas of the site (e.g., natural watercourses, steep slopes), and to incorporate unique or desirable existing vegetation into the site's landscaping plan. Clearly marking and leaving a buffer area around these unique areas during construction will help to preserve these areas as well as take advantage of natural erosion prevention and sediment trapping.

Existing vegetation to be preserved on the site must be protected from mechanical and other injury while the land is being developed. The purpose of protecting existing vegetation is to ensure the survival of desirable vegetation for shade, beautification, and erosion control. Mature vegetation has extensive root systems that help to hold soil in place, thus reducing erosion. In addition, vegetation helps keep soil from drying rapidly and becoming susceptible to erosion. To effectively save existing vegetation, no disturbances of any kind should be allowed within a defined area around the vegetation. For trees, no construction activity should occur within the drip line of the tree.

Timing

- Provide for preservation of existing vegetation prior to the commencement of clearing and grubbing operations or other soil disturbing activities in areas where no construction activity is planned or will occur at a later date.

Design and Layout

- Mark areas to be preserved with temporary fencing. Include sufficient setback to protect roots.
 - Orange colored plastic mesh fencing works well.
 - Use appropriate fence posts and adequate post spacing and depth to completely support the fence in an upright position.
- Locate temporary roadways, stockpiles, and layout areas to avoid stands of trees, shrubs, and grass.
- Consider the impact of grade changes to existing vegetation and the root zone.
- Maintain existing irrigation systems where feasible. Temporary irrigation may be required.
- Instruct employees and subcontractors to honor protective devices. Prohibit heavy equipment, vehicular traffic, or storage of construction materials within the protected area.

Preservation of Existing Vegetation EC-2

- Consider pruning or mowing vegetation instead of removing it to allow for regrowth.
- If possible, retain vegetation buffer around the site and adjacent waterways.

Inspection and Maintenance

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

- Verify that protective measures remain in place. Restore damaged protection measures immediately.
- Serious tree injuries shall be attended to by an arborist.
- Damage to the crown, trunk, or root system of a retained tree shall be repaired immediately.
- Trench as far from tree trunks as possible, usually outside of the tree drip line or canopy. Curve trenches around trees to avoid large roots or root concentrations. If roots are encountered, consider tunneling under them. When trenching or tunneling near or under trees to be retained, place tunnels at least 18 in. below the ground surface, and not below the tree center to minimize impact on the roots.
- Do not leave tree roots exposed to air. Cover exposed roots with soil as soon as possible. If soil covering is not practical, protect exposed roots with wet burlap or peat moss until the tunnel or trench is ready for backfill.
- Cleanly remove the ends of damaged roots with a smooth cut.
- Fill trenches and tunnels as soon as possible. Careful filling and tamping will eliminate air spaces in the soil, which can damage roots.
- If bark damage occurs, cut back all loosened bark into the undamaged area, with the cut tapered at the top and bottom and drainage provided at the base of the wood. Limit cutting the undamaged area as much as possible.
- Aerate soil that has been compacted over a trees root zone by punching holes 12 in. deep with an iron bar and moving the bar back and forth until the soil is loosened. Place holes 18 in. apart throughout the area of compacted soil under the tree crown.
- Fertilization:
 - Fertilize trees in the late fall or early spring. Although to note, many native species do not require fertilization.
 - Apply fertilizer to the soil over the feeder roots and in accordance with label instructions, but never closer than 3 ft to the trunk. Increase the fertilized area by one-fourth of the crown area for conifers that have extended root systems.
- Retain protective measures until all other construction activity is complete to avoid damage during site cleanup and stabilization.

Preservation of Existing Vegetation EC-2

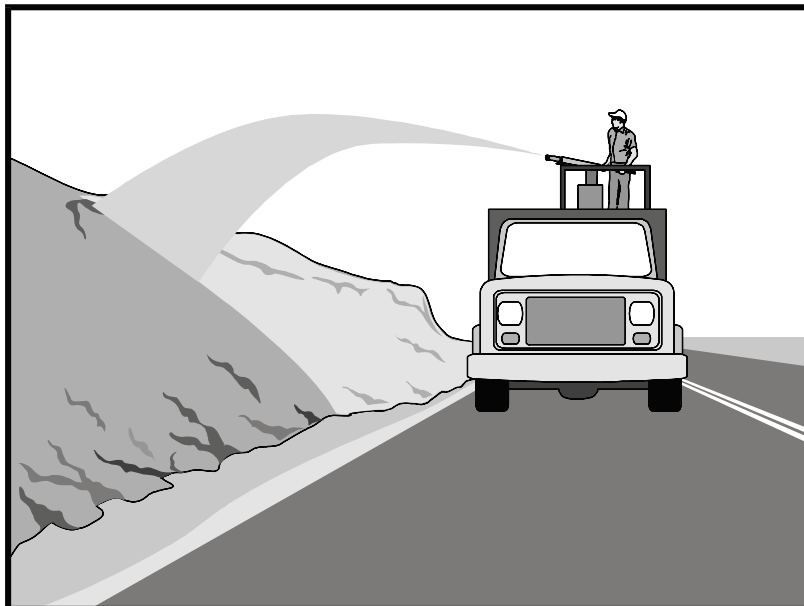
References and Additional Resources

Construction Site Best Management Practices (BMPs) Manual, CTSW-RT-24-425.11.1, California Department of Transportation (Caltrans), March 2024.

County of Sacramento Tree Preservation Ordinance, September 1981.

Storm Water Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for The Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



Description and Purpose

Hydraulic Mulch consists of various types of fibrous materials mixed with water and sprayed onto the soil surface in slurry form to provide a layer of temporary protection from wind and water erosion.

Suitable Applications

Hydraulic mulch as a temporary, stand alone, erosion control BMP is suitable for disturbed areas that require temporary protection from wind and water erosion until permanent soil stabilization activities commence. Examples include:

- Rough-graded areas that will remain inactive for longer than permit-required thresholds (e.g., 14 days) or otherwise require stabilization to minimize erosion or prevent sediment discharges.
- Soil stockpiles.
- Slopes with exposed soil between existing vegetation such as trees or shrubs.
- Slopes planted with live, container-grown vegetation or plugs.
- Slopes burned by wildfire.
- To stabilize earthen berms

Categories

EC	Erosion Control	☒
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

- ☒ **Primary Category**
- ☒ **Secondary Category**

Targeted Constituents

Sediment	☒
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

- EC-4 Hydroseeding
- EC-5 Soil Binders
- EC-6 Straw Mulch
- EC-7 Geotextiles and Mats
- EC-8 Wood Mulching
- EC-14 Compost Blanket
- EC-16 Non-Vegetative Stabilization

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- Areas seeded by broadcasting or drilling
- Temporary stabilization during high wind conditions

Hydraulic mulch can also be applied to augment other erosion control BMPs such as:

- In conjunction with straw mulch (see EC-6 Straw Mulch) where the rate of hydraulic mulch is reduced to 100-500 lbs per acre and the slurry is applied over the straw as a tackifying agent to hold the straw in place.
- Supplemental application of soil amendments, such as fertilizer, lime, gypsum, soil bio-stimulants or compost.

Limitations

In general, hydraulic mulch is not limited by slope length, gradient or soil type. However, the following limitations typically apply:

- Most hydraulic mulch applications, particularly bonded fiber matrices (BFMs), require at least 24 hours to dry before rainfall occurs.
- Temporary applications (i.e., without a vegetative component) may require a second application in order to remain effective for an entire rainy season.
- Treatment areas must be accessible to hydraulic mulching equipment.
- Availability of water sources in remote areas for mixing and application.
- As a stand-alone temporary BMP, hydraulic mulches may need to be re-applied to maintain their erosion control effectiveness, typically after 6-12 months depending on the type of mulch used.
- Availability of hydraulic mulching equipment may be limited just prior to the rainy season and prior to storms due to high demand.
- Cellulose fiber mulches alone may not perform well on steep slopes or in course soils.
- This BMP consists of a mixture of several constituents (e.g., fibers/mulches, compost, tackifiers, and other chemical constituents), some of which may be proprietary and may come pre-mixed by the manufacturer. The water quality impacts of these constituents are relatively unknown, and some may have water quality impacts due to their chemical makeup. Refer to specific chemical properties identified in the product Safety Data Sheet (may not include ecological information); products should be evaluated for project-specific implementation by the SWPPP Preparer. Refer to factsheet EC-05 for further guidance on selecting soil binders.
- A water supply is needed to refill hydro mulch equipment tank.
- Cannot be disturbed by walking or driving on the surface after application.
- Recommend using in conjunction with other BMPs (i.e., fiber rolls, etc.).

Implementation

- Where feasible, it is preferable to prepare soil surfaces prior to application by roughening embankments and fill areas with a crimping or punching type roller or by track walking.
- The majority of hydraulic mulch applications do not necessarily require surface/soil preparation (See EC-15 Soil Preparation) although in almost every case where re-vegetation is included as part of the practice, soil preparation can be beneficial. One of the advantages of hydraulic mulch over other erosion control methods is that it can be applied in areas where soil preparation is precluded by site conditions, such as steep slopes, rocky soils, or inaccessibility.
- Avoid mulch over spray onto roads, sidewalks, drainage channels, existing vegetation, etc.
- Hydraulic mulching is generally performed utilizing specialized machines that have a large water-holding/mixing tank and some form of mechanical agitation or other recirculation method to keep water, mulch and soil amendments in suspension. The mixed hydraulic slurry can be applied from a tower sprayer on top of the machine or by extending a hose to areas remote from the machine.
- Where possible apply hydraulic mulch from multiple directions to adequately cover the soil. Application from a single direction can result in shadowing, uneven coverage and failure of the BMP.
- Hydraulic mulch can also include a vegetative component, such as seed, rhizomes, or stolons (see EC-4 Hydraulic Seed).
- Typical hydraulic mulch application rates range from 2,000 pounds per acre for standard mulches (SMs) to 3,500 lbs. per acre for BFMs. However, the required amount of hydraulic mulch to provide adequate coverage of exposed topsoil may appear to exceed the standard rates when the roughness of the soil surface is changed due to soil preparation methods (see EC-15 Soil Preparation) or by slope gradient.
- Other factors such as existing soil moisture and soil texture can have a profound effect on the amount of hydraulic mulch required (i.e. application rate) applied to achieve an erosion-resistant covering.
- Avoid use of mulch without a tackifier component, especially on slopes.
- Mulches used in the hydraulic mulch slurry can include:
 - Cellulose fiber (paper- or corn-based)
 - Wood fibers
 - Cotton
 - Synthetics
 - Compost (see EC-14, Compost Blanket)
 - Straw

- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix B of the Handbook.

Categories of Hydraulic Mulches

Standard Hydraulic Mulch (SM)

Standard hydraulic mulches are generally applied at a rate of 2,000 lbs. per acre and are manufactured containing around 5% tackifier (i.e. soil binder), usually a plant-derived guar or psyllium type. Most standard mulches are green in color derived from food-color based dyes.

Hydraulic Matrices (HM) and Stabilized Fiber Matrices (SFM)

Hydraulic matrices and stabilized fiber matrices are slurries which contain increased levels of tackifiers/soil binders; usually 10% or more by weight. HMs and SFMs have improved performance compared to a standard hydraulic mulch (SM) because of the additional percentage of tackifier and because of their higher application rates, typically 2,500 – 4,000 lbs. per acre. Hydraulic matrices can include a mixture of fibers, for example, a 50/50 blend of paper and wood fiber. In the case of an SFM, the tackifier/soil binder is specified as a polyacrylamide (PAM).

Bonded Fiber Matrix (BFM)

Bonded fiber matrices (BFMs) are hydraulically-applied systems of fibers, adhesives (typically guar- or polymer-based) and chemical cross-links. Upon drying, the slurry forms an erosion-resistant blanket that prevents soil erosion and promotes vegetation establishment. The cross-linked adhesive in the BFM should be biodegradable and should not dissolve or disperse upon re-wetting. BFMs are typically applied at rates from 3,000 to 4,000 lbs. per acre based on the manufacturer's recommendation. BFMs should not be applied immediately before, during or immediately after rainfall or if the soil is saturated. Depending on the product, BFMs typically require 12 to 24 hours to dry and become effective.

Hydraulic Compost Matrix (HCM)

Hydraulic compost matrix (HCM) is a field-derived practice whereby finely graded or sifted compost is introduced into the hydraulic mulch slurry. A guar-type tackifier can be added for steeper slope applications as well as any specified seed mixtures. An HCM can help to accelerate seed germination and growth. HCMs are particularly useful as an in-fill for three-dimensional re-vegetation geocomposites, such as turf reinforcement mats (TRM) (see EC-7 Geotextiles and Mats).

Inspection and Maintenance

- Maintain an unbroken, temporary mulched ground cover throughout the period of construction when the soils are not being reworked.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Areas where erosion is evident should be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.

- Compare the number of bags or weight of applied mulch to the area treated to determine actual application rates and compliance with specifications.

References and Additional Resources

Construction Site Best Management Practices (BMPs) Manual CTSW-RT-24-425.11.1, California Department of Transportation (Caltrans), March 2024.

Controlling Erosion of Construction Sites, Agricultural Information #347, U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service – SCS).

Guidance for Temporary Soil Stabilization, California Department of Transportation (Caltrans), July 2003.

Guides for Erosion and Sediment Control in California, USDA Soils Conservation Service, January 1991.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

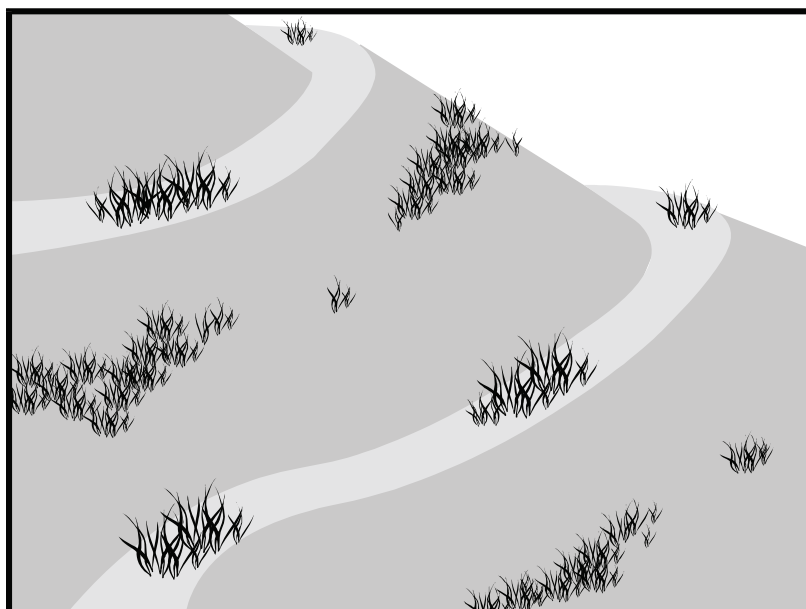
Sedimentation and Erosion Control, an Inventory of Current Practices Draft, US EPA, April 1990.

Soil Erosion by Water, Agriculture Information Bulletin #513, U.S. Department of Agriculture, Soil Conservation Service.

Soil Stabilization BMP Research for Erosion and Sediment Controls: Cost Survey Technical Memorandum, State of California Department of Transportation (Caltrans), July 2007.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



Description and Purpose

Hydroseeding typically consists of applying a mixture of a hydraulic mulch, seed, and water with the possible addition of tackifier, compost, mycorrhizae inoculant, fertilizer, and/or soil conditioner, to temporarily protect exposed soils from erosion by water and wind. Hydraulic seeding, or hydroseeding, is simply the method by which temporary or permanent seed is applied to the soil surface and temporary erosion control is established by means of the mulch component.

Suitable Applications

Hydroseeding is suitable for disturbed areas requiring temporary protection until permanent stabilization is established, for disturbed areas that will be re-disturbed following an extended period of inactivity, or to apply permanent stabilization measures. Hydroseeding without mulch or other cover (e.g., EC-7, Geotextiles and Mats) is not a stand-alone erosion control BMP and should be combined with additional measures until vegetation establishment.

Typical applications for hydroseeding include:

- Disturbed soil/graded areas where permanent stabilization or continued earthwork is not anticipated prior to seed germination.
- Cleared and graded areas exposed to seasonal rains or temporary irrigation.
- To vegetate swales and earthen berms.
- Areas not subject to heavy wear by construction equipment or high traffic.

Categories

EC	Erosion Control	☒
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

- ☒ **Primary Category**
- ☒ **Secondary Category**

Targeted Constituents

Sediment	☒
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

- EC-3 Hydraulic Mulch
- EC-5 Soil Binders
- EC-6 Straw Mulch
- EC-7 Geotextiles and Mats
- EC-8 Wood Mulching
- EC-14 Compost Blanket
- EC-16 Non-Vegetative Stabilization

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Limitations

- Availability of hydroseeding equipment may be limited just prior to the rainy season and prior to storms due to high demand.
- Hydraulic seed should be applied with hydraulic mulch or a stand-alone hydroseed application should be followed by one of the following:
 - Straw mulch (see Straw Mulch EC-6)
 - Rolled erosion control products (see Geotextiles and Mats EC-7)
 - Application of Compost Blanket (see Compost Blanket EC-14)

Hydraulic seed may be used alone only on small flat surfaces when there is sufficient time in the season to ensure adequate vegetation establishment and coverage to provide adequate erosion control.

- Hydraulic seed without mulch does not provide immediate erosion control.
- Temporary seeding may not be appropriate for steep slopes (i.e., slopes readily prone to rill erosion or without sufficient topsoil).
- Temporary seeding may not be appropriate in dry periods without supplemental irrigation.
- Temporary vegetation may have to be removed before permanent vegetation is applied.
- Temporary vegetation may not be appropriate for short term inactivity (i.e., less than 3-6 months).
- Vegetation may not establish when hydroseed is applied to very compact soils.
- Mulch may inhibit germination when applied at high rates.
- This BMP consists of a mixture of several constituents (e.g., fibers/mulches, tackifiers, and other chemical constituents), some of which may be proprietary and may come pre-mixed by the manufacturer. The water quality impacts of these constituents are relatively unknown, and some may have water quality impacts due to their chemical makeup. Additionally, these constituents may require non-visible pollutant monitoring. Refer to specific chemical properties identified in the product's Safety Data Sheet (SDS), although, note that not all SDS's provide ecological information; products should be evaluated for project-specific implementation by the QSD. Refer to fact sheet EC-05, Soil Binders, for further guidance on selecting soil binders.

Implementation

In order to select appropriate hydraulic seed mixtures, an evaluation of site conditions should be performed with respect to:

- | | |
|---|----------------------------|
| - Soil conditions | - Maintenance requirements |
| - Site topography and exposure (sun/wind) | - Sensitive adjacent areas |

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

The local office of the U.S.D.A. Natural Resources Conservation Service (NRCS), Resource Conservation Districts and Agricultural Extension Service can provide information on appropriate seed mixes.

The following steps should be followed for implementation:

- Where appropriate or feasible, soil should be prepared to receive the seed by disking or otherwise scarifying (See EC-15, Soil Preparation) the surface to eliminate crust, improve air and water infiltration and create a more favorable environment for germination and growth.
- Avoid use of hydraulic seed in areas where the BMP would be incompatible with future earthwork activities.
- Hydraulic seed can be applied using a multiple step or one step process.
 - In a multiple step process, hydraulic seed is applied first, followed by mulch or a Rolled Erosion Control Product (RECP).
 - In the one step process, hydraulic seed is applied with hydraulic mulch in a hydraulic matrix. When the one step process is used to apply the mixture of fiber, seed, etc., the seed rate should be increased to compensate for all seeds not having direct contact with the soil.
- All hydraulically seeded areas should have mulch, or alternate erosion control cover to keep seeds in place and to moderate soil moisture and temperature until the seeds germinate and grow.
- All seeds should be in conformance with the California State Seed Law of the Department of Agriculture. Each seed bag should be delivered to the site sealed and clearly marked as to species, purity, percent germination, dealer's guarantee, and dates of test. The container should be labeled to clearly reflect the amount of Pure Live Seed (PLS) contained. All legume seed should be pellet inoculated. Inoculant sources should be species specific and should be applied at a rate of 2 lb of inoculant per 100 lb seed.
- Commercial fertilizer should conform to the requirements of the California Food and Agricultural Code, which can be found at: https://www.cdfa.ca.gov/is/docs/Fertilizer_Law_and_Regs.pdf. Fertilizer should be pelleted or granular form.
- Follow up applications should be made as needed to cover areas of poor coverage or germination/vegetation establishment and to maintain adequate soil protection.
- Avoid over spray onto roads, sidewalks, drainage channels, existing vegetation, etc.
- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix B "Guidance on Selection of Temporary Slope Stabilization Techniques" of the CASQA Construction BMP Handbook.

Inspection and Maintenance

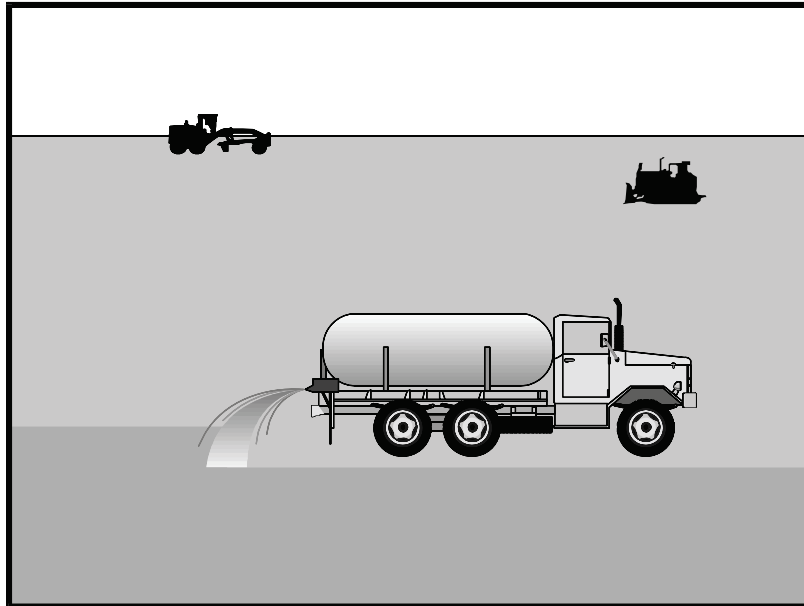
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Areas where erosion is evident should be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- Where seeds fail to germinate, or they germinate and die, the area must be re-seeded, fertilized, and mulched within the planting season, using not less than half the original application rates.
- Irrigation systems, if applicable, should be inspected daily while in use to identify system malfunctions and line breaks. When line breaks are detected, the system must be shut down immediately and breaks repaired before the system is put back into operation.
- Irrigation systems should be inspected for complete coverage and adjusted as needed to maintain complete coverage.

References and Additional Resources

Construction Site Best Management Practices (BMPs) Manual CTSW-RT-24-425.11.1, California Department of Transportation (Caltrans), March 2024.

Guidance for Temporary Soil Stabilization, California Department of Transportation (Caltrans), July 2003.

Soil Stabilization BMP Research for Erosion and Sediment Controls: Cost Survey Technical Memorandum, State of California Department of Transportation (Caltrans), July 2007.



Description and Purpose

Soil binding consists of application and maintenance of a soil stabilizer to exposed soil surfaces. Soil binders are materials applied to the soil surface to temporarily prevent water and wind induced erosion of exposed soils on construction sites.

Suitable Applications

Soil binders are typically applied to disturbed areas requiring temporary protection. Because soil binders, when used as a stand-alone practice, can often be incorporated into the soil, they are a good alternative to mulches in areas where grading activities will soon resume. Soil binders are commonly used in the following areas:

- Rough graded soils that will be inactive for a short period of time.
- Soil stockpiles.
- Temporary haul roads prior to placement of crushed rock.
- Compacted soil road base.
- Construction staging, materials storage, and layout areas.
- Slopes and areas requiring stabilization prior to rain.
- Disturbed areas subject to high winds.

Categories

EC	Erosion Control	☒
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

- ☒ **Primary Category**
- ☒ **Secondary Category**

Targeted Constituents

Sediment	☒
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

- EC-3 Hydraulic Mulch
- EC-4 Hydroseeding
- EC-6 Straw Mulch
- EC-7 Geotextiles and Mats
- EC-8 Wood Mulching

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Limitations

- Soil binders are temporary in nature and may need reapplication.
- Soil binders require a minimum curing time until fully effective, as prescribed by the manufacturer. Curing time may be 24 hours or longer. Soil binders may need reapplication after a storm event.
- Soil binders will generally experience spot failures during heavy rainfall events. If runoff penetrates the soil at the top of a slope treated with a soil binder, it is likely that the runoff will undercut the stabilized soil layer and discharge at a point further down slope.
- Plant-material-based soil binders do not generally hold up to pedestrian or vehicular traffic across treated areas as well as polymeric emulsion blends or cementitious-based binders.
- Soil binders may not sufficiently penetrate compacted soils.
- Some soil binders are soil texture specific in terms of their effectiveness. For example, polyacrylamides (PAMs) work very well on silt and clayey soils but their performance decreases dramatically in sandy soils.
- Some soil binders may not perform well with low relative humidity. Under rainy conditions, some agents may become slippery or leach out of the soil.
- Soil binders may not cure if low temperatures occur within 24 hours of application.
- The water quality impacts of some chemical soil binders are relatively unknown, and some may have water quality impacts due to their chemical makeup. Additionally, these chemicals may require non-visible pollutant monitoring. Products should be evaluated for project-specific implementation by the QSD preparing SWPPP. Refer to the product Material Safety Data Sheet for chemical properties.

Implementation

General Considerations

- Soil binders should conform to local municipality specifications and requirements.
- Site soil types will dictate appropriate soil binders to be used.
- A soil binder must be environmentally benign (non-toxic to plant and animal life), easy to apply, easy to maintain, economical, and should not stain paved or painted surfaces. Soil binders should not pollute stormwater when cured. Obtain a Safety Data Sheet (SDS) from the manufacturer to ensure non-toxicity (note however, the SDS may not include ecological information).
- Stormwater runoff from PAM treated soils should pass through one of the following sediment control BMP prior to discharging to surface waters.
 - When the total drainage area is greater than or equal to 5 acres, PAM treated areas should drain to a sediment basin.

- Areas less than 5 acres should drain to sediment control BMPs, such as a sediment trap, or a series of check dams. The total number of check dams used should be maximized to achieve the greatest amount of settlement of sediment prior to discharging from the site. Each check dam should be spaced evenly in the drainage channel through which stormwater flows are discharged off site.
- Performance of soil binders depends on temperature, humidity, and traffic across treated areas.
- Avoid over spray onto roads, sidewalks, drainage channels, existing vegetation, etc.
- Some soil binders are designed for application to roads.
- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

Selecting a Soil Binder

Properties of common soil binders used for erosion control are provided on Table 1 at the end of this Fact Sheet. Use Table 1 to select an appropriate soil binder. Refer to WE-1, Wind Erosion Control, for dust control soil binders.

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

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

Plant-Material-Based (Short Lived, <6 months) Binders

Guar: Guar is a non-toxic, biodegradable, natural galactomannan-based hydrocolloid treated with dispersant agents for easy field mixing. It should be mixed with water at the rate of 11 to 15 lb per 1,000 gallons. Recommended minimum application rates are as follows:

Application Rates for Guar Soil Stabilizer

Slope (H:V):	Flat	4:1	3:1	2:1	1:1
lb/acre:	40	45	50	60	70

Psyllium: Psyllium is composed of the finely ground muciloid coating of plantago seeds that is applied as a dry powder or in a wet slurry to the surface of the soil. It dries to form a firm but rewettable membrane that binds soil particles together but permits germination and growth of seed. Psyllium requires 12 to 18 hours drying time. Application rates should be from 80 to 200 lb/acre, with enough water in solution to allow for a uniform slurry flow.

Starch: Starch is non-ionic, cold water soluble (pre-gelatinized) granular cornstarch. The material is mixed with water and applied at the rate of 150 lb/acre. Approximate drying time is 9 to 12 hours.

Plant-Material-Based (Long Lived, 6-12 months) Binders

Pitch and Rosin Emulsion: Generally, a non-ionic pitch and rosin emulsion has a minimum solids content of 48%. The rosin should be a minimum of 26% of the total solids content. The soil stabilizer should be non-corrosive, water dilutable emulsion that upon application cures to a water insoluble binding and cementing agent. For soil erosion control applications, the emulsion is diluted and should be applied as follows:

- For clayey soil: 5 parts water to 1-part emulsion
- For sandy soil: 10 parts water to 1-part emulsion

Application can be by water truck or hydraulic seeder with the emulsion and product mixture applied at the rate specified by the manufacturer.

Polymeric Emulsion Blend Binders

Acrylic Copolymers and Polymers: Polymeric soil stabilizers should consist of a liquid or solid polymer or copolymer with an acrylic base that contains a minimum of 55% solids. The polymeric compound should be handled and mixed in a manner that will not cause foaming or should contain an anti-foaming agent. The polymeric emulsion should not exceed its shelf life or expiration date; manufacturers should provide the expiration date. Polymeric soil stabilizer should be readily miscible in water, non-injurious to seed or animal life, non-flammable, should provide surface soil stabilization for various soil types without totally inhibiting water infiltration, and should not re-emulsify when cured. The applied compound typically requires 12 to 24 hours drying time. Liquid copolymer should be diluted at a rate of 10 parts water to 1-part polymer and the mixture applied to soil at a rate of 1,175 gallons/acre.

Liquid Polymers of Methacrylates and Acrylates: This material consists of a tackifier/sealer that is a liquid polymer of methacrylates and acrylates. It is an aqueous 100% acrylic emulsion blend of 40% solids by volume that is free from styrene, acetate, vinyl, ethoxylated surfactants or silicates. For soil stabilization applications, it is diluted with water in accordance with the manufacturer's recommendations and applied with a hydraulic seeder at the rate of 20 gallons/acre. Drying time is 12 to 18 hours after application.

Copolymers of Sodium Acrylates and Acrylamides: These materials are non-toxic, dry powders that are copolymers of sodium acrylate and acrylamide. They are mixed with water and applied to the soil surface for erosion control at rates that are determined by slope gradient:

Slope Gradient (H:V)	lb/acre
Flat to 5:1	3.0 – 5.0
5:1 to 3:1	5.0 – 10.0
2:1 to 1:1	10.0 – 20.0

Poly-Acrylamide (PAM) and Copolymer of Acrylamide: Linear copolymer polyacrylamide for use as a soil binder is packaged as a dry flowable solid, as a liquid. Refer to the manufacturer's recommendation for dilution and application rates as they vary based on liquid or dry form, site conditions and climate.

■ Limitations specific to PAM are as follows:

- Do not use PAM on a slope that flows into a water body without passing through a sediment trap or sediment basin.
- The specific PAM copolymer formulation must be anionic. Cationic PAM should not be used in any application because of known aquatic toxicity problems. Only the highest drinking water grade PAM, certified for compliance with ANSI/NSF Standard 60 for drinking water treatment, should be used for soil applications.
- PAM designated for erosion and sediment control should be “water soluble” or “linear” or “non-cross linked”.
- PAM should not be used as a stand-alone BMP to protect against water-based erosion. When combined with mulch, its effectiveness increases dramatically.

Hydro-Colloid Polymers: Hydro-Colloid Polymers are various combinations of dry flowable poly-acrylamides, copolymers and hydro-colloid polymers that are mixed with water and applied to the soil surface at rates of 55 to 60 lb/acre. Drying times are 0 to 4 hours.

Cementitious-Based Binders

Gypsum: This is a formulated gypsum-based product that readily mixes with water and mulch to form a thin protective crust on the soil surface. It is composed of high purity gypsum that is ground, calcined and processed into calcium sulfate hemihydrate with a minimum purity of 86%. It is mixed in a hydraulic seeder and applied at rates 4,000 to 12,000 lb/acre. Drying time is 4 to 8 hours.

Applying Soil Binders

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

- Follow manufacturer's written recommendations for application rates, pre-wetting of application area, and cleaning of equipment after use.
- Prior to application, roughen embankment and fill areas.
- Consider the drying time for the selected soil binder and apply with sufficient time before anticipated rainfall. Soil binders should not be applied during or immediately before rainfall.
- Avoid over spray onto roads, sidewalks, drainage channels, sound walls, existing vegetation, etc.
- Soil binders should not be applied to frozen soil, areas with standing water, under freezing or rainy conditions, or when the temperature is below 40°F during the curing period.
- More than one treatment is often necessary, although the second treatment may be diluted or have a lower application rate.
- Generally, soil binders require a minimum curing time of 24 hours before they are fully effective. Refer to manufacturer's instructions for specific cure time.
- For liquid agents:
 - Crown or slope ground to avoid ponding.
 - Uniformly pre-wet ground at 0.03 to 0.3 gal/yd² or according to manufacturer's recommendations.
 - Apply solution under pressure. Overlap solution 6 to 12 in.
 - Allow treated area to cure for the time recommended by the manufacturer; typically, at least 24 hours.
 - Apply second treatment before first treatment becomes ineffective, using 50% application rate.
 - In low humidities, reactivate chemicals by re-wetting with water at 0.1 to 0.2 gal/yd².

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Areas where erosion is evident should be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- Reapply the selected soil binder as needed to maintain effectiveness.

Table 1 Properties of Soil Binders for Erosion Control				
Evaluation Criteria	Binder Type			
	Plant Material Based (Short Lived)	Plant Material Based (Long Lived)	Polymeric Emulsion Blends	Cementitious-Based Binders
Relative Cost	Low	Moderate to High	Low to High	Low to Moderate
Resistance to Leaching	High	High	Low to Moderate	Moderate
Resistance to Abrasion	Moderate	Low	Moderate to High	Moderate to High
Longevity	Short to Medium	Medium	Medium to Long	Medium
Minimum Curing Time before Rain	9 to 18 hours	19 to 24 hours	0 to 24 hours	4 to 8 hours
Compatibility with Existing Vegetation	Good	Poor	Poor	Poor
Mode of Degradation	Biodegradable	Biodegradable	Photodegradable/ Chemically Degradable	Photodegradable/ Chemically Degradable
Labor Intensive	No	No	No	No
Specialized Application Equipment	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher
Liquid/Powder	Powder	Liquid	Liquid/Powder	Powder
Surface Crusting	Yes, but dissolves on rewetting	Yes	Yes, but dissolves on rewetting	Yes
Clean Up	Water	Water	Water	Water
Erosion Control Application Rate	Varies ⁽¹⁾	Varies ⁽¹⁾	Varies ⁽¹⁾	4,000 to 12,000 lbs/acre

(1) See Implementation for specific rates.

References and Additional Resources

Construction Site Best Management Practices (BMPs) Manual CTSW-RT-24-425.11.1, California Department of Transportation (Caltrans), March 2024.

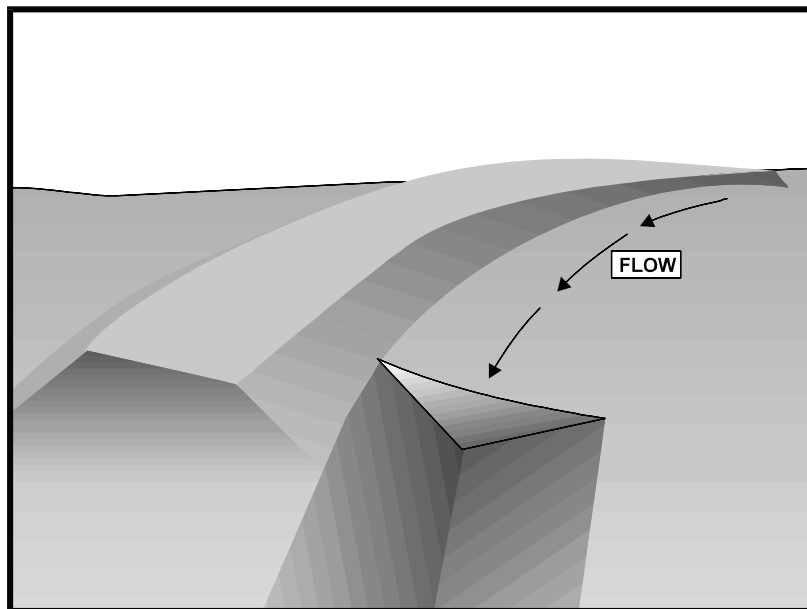
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Guidance for Temporary Soil Stabilization, California Department of Transportation (Caltrans), July 2003.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Sedimentation and Erosion Control, An Inventory of Current Practices Draft, US EPA, April 1990.

Storm Water Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.



Description and Purpose

An earth dike is a temporary berm or ridge of compacted soil used to divert runoff or channel water to a desired location. A drainage swale is a shaped and sloped depression in the soil surface used to convey runoff to a desired location. Earth dikes and drainage swales are used to divert off site runoff around the construction site, divert runoff from stabilized areas and disturbed areas, and direct runoff into sediment basins or traps.

Suitable Applications

Earth dikes and drainage swales are suitable for use, individually or together, where runoff needs to be diverted from one area and conveyed to another.

- Earth dikes and drainage swales may be used:
 - To convey surface runoff down sloping land
 - To intercept and divert runoff to avoid sheet flow over sloped surfaces
 - To divert and direct runoff towards a stabilized watercourse, drainage pipe or channel
 - To intercept runoff from paved surfaces
 - To intercept and divert run-on
 - Below steep grades where runoff begins to concentrate

Categories

EC	Erosion Control	☒
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

- ☒ **Primary Objective**
- ☒ **Secondary Objective**

Targeted Constituents

Sediment	☒
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

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- Along roadways and facility improvements subject to flood drainage
- At the top of slopes to divert runoff from adjacent or undisturbed slopes
- At bottom and mid slope locations to intercept sheet flow and convey concentrated flows
- Divert sediment laden runoff into sediment basins or traps

Limitations

Dikes should not be used for drainage areas greater than 10 acres or along slopes greater than 10 percent. For larger areas more permanent drainage structures should be built. All drainage structures should be built in compliance with local municipal requirements.

- Earth dikes may create more disturbed area on site and become barriers to construction equipment.
- Earth dikes must be stabilized immediately, which adds cost and maintenance concerns.
- Diverted stormwater may cause downstream flood damage.
- Dikes should not be constructed of soils that may be easily eroded.
- Regrading the site to remove the dike may add additional cost.
- Temporary drains and swales or any other diversion of runoff should not adversely impact upstream or downstream properties.
- Temporary drains and swales must conform to local floodplain management requirements.
- Earth dikes/drainage swales are not suitable as sediment trapping devices.
- It may be necessary to use other soil stabilization and sediment controls such as check dams, plastics, and blankets, to prevent scour and erosion in newly graded dikes, swales, and ditches.
- Sediment accumulation, scour depressions, and/or persistent non-stormwater discharges can result in areas of standing water suitable for mosquito production in drainage swales.

Implementation

The temporary earth dike is a berm or ridge of compacted soil, located in such a manner as to divert stormwater to a sediment trapping device or a stabilized outlet, thereby reducing the potential for erosion and offsite sedimentation. Earth dikes can also be used to divert runoff from off site and from undisturbed areas away from disturbed areas and to divert sheet flows away from unprotected slopes.

An earth dike does not itself control erosion or remove sediment from runoff. A dike prevents erosion by directing runoff to an erosion control device such as a sediment trap or directing runoff away from an erodible area. Temporary diversion dikes should not adversely impact adjacent properties and must conform to local floodplain management regulations and should not be used in areas with slopes steeper than 10%.

Slopes that are formed during cut and fill operations should be protected from erosion by runoff. A combination of a temporary drainage swale and an earth dike at the top of a slope can divert runoff to a location where it can be brought to the bottom of the slope (see EC-11, Slope Drains). A combination dike and swale is easily constructed by a single pass of a bulldozer or grader and compacted by a second pass of the tracks or wheels over the ridge. Diversion structures should be installed when the site is initially graded and remain in place until post construction BMPs are installed and the slopes are stabilized.

Diversion practices concentrate surface runoff, increasing its velocity and erosive force. Thus, the flow out of the drain or swale must be directed onto a stabilized area or into a grade stabilization structure. If significant erosion will occur, a swale should be stabilized using vegetation, chemical treatment, rock rip-rap, matting, or other physical means of stabilization. Any drain or swale that conveys sediment laden runoff must be diverted into a sediment basin or trap before it is discharged from the site.

General

- Care must be applied to correctly size and locate earth dikes, drainage swales. Excessively steep, unlined dikes, and swales are subject to erosion and gully formation.
- Conveyances should be stabilized.
- Use a lined ditch for high flow velocities.
- Select flow velocity based on careful evaluation of the risks due to erosion of the measure, soil types, overtopping, flow backups, washout, and drainage flow patterns for each project site.
- Compact any fills to prevent unequal settlement.
- Do not divert runoff onto other property without securing written authorization from the property owner.
- When possible, install and utilize permanent dikes, swales, and ditches early in the construction process.
- Provide stabilized outlets.

Earth Dikes

Temporary earth dikes are a practical, inexpensive BMP used to divert stormwater runoff. Temporary diversion dikes should be installed in the following manner:

- All dikes should be compacted by earth moving equipment.
- All dikes should have positive drainage to an outlet.
- All dikes should have 2:1 or flatter side slopes, 18 in. minimum height, and a minimum top width of 24 in. Wide top widths and flat slopes are usually needed at crossings for construction traffic.

- May be covered with hydro mulch, hydroseed, wood mulch, compost blanket, or RECP for stabilization.
- The outlet from the earth dike must function with a minimum of erosion. Runoff should be conveyed to a sediment trapping device such as a Sediment Trap (SE-3) or Sediment Basin (SE-2) when either the dike channel or the drainage area above the dike are not adequately stabilized.
- Temporary stabilization may be achieved using seed and mulching for slopes less than 5% and either rip-rap or sod for slopes in excess of 5%. In either case, stabilization of the earth dike should be completed immediately after construction or prior to the first rain.
- If riprap is used to stabilize the channel formed along the toe of the dike, the following typical specifications apply:

Channel Grade	Riprap Stabilization
0.5-1.0%	4 in. Rock
1.1-2.0%	6 in. Rock
2.1-4.0%	8 in. Rock
4.1-5.0%	8 in. -12 in. Riprap

- The stone riprap, recycled concrete, etc. used for stabilization should be pressed into the soil with construction equipment.
- Filter cloth may be used to cover dikes in use for long periods.
- Construction activity on the earth dike should be kept to a minimum.

Drainage Swales

Drainage swales are only effective if they are properly installed. Swales are more effective than dikes because they tend to be more stable. The combination of a swale with a dike on the downhill side is the most cost-effective diversion.

Standard engineering design criteria for small open channel and closed conveyance systems should be used (see the local drainage design manual). Unless local drainage design criteria state otherwise, drainage swales should be designed as follows:

- No more than 5 acres may drain to a temporary drainage swale.
- Place drainage swales above or below, not on, a cut or fill slope.
- Swale bottom width should be at least 2 ft.
- Depth of the swale should be at least 18 in.
- Side slopes should be 2:1 or flatter.
- Drainage or swales should be laid at a grade of at least 1 %, but not more than 15 %.

- The swale must not be overtopped by the peak discharge from a 10-year storm, irrespective of the design criteria stated above.
- Remove all trees, stumps, obstructions, and other objectionable material from the swale when it is built.
- Compact any fill material along the path of the swale.
- Stabilize all swales immediately. Seed and mulch swales at a slope of less than 5 % and use rip-rap or sod for swales with a slope between 5 and 15 %. For temporary swales, geotextiles and mats (EC-7) may provide immediate stabilization.
- Irrigation may be required to establish sufficient vegetation to prevent erosion.
- Do not operate construction vehicles across a swale unless a stabilized crossing is provided.
- Permanent drainage facilities must be designed by a professional engineer (see the local drainage design criteria for proper design).
- At a minimum, the drainage swale should conform to predevelopment drainage patterns and capacities.
- Construct the drainage swale with a positive grade to a stabilized outlet.
- Provide erosion protection or energy dissipation measures if the flow out of the drainage swale can reach an erosive velocity.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspect ditches and berms for washouts. Replace lost riprap, damaged linings or soil stabilizers as needed.
- Inspect channel linings, embankments, and beds of ditches and berms for erosion and accumulation of debris and sediment. Remove debris and sediment and repair linings and embankments as needed.
- Temporary conveyances should be completely removed as soon as the surrounding drainage area has been stabilized or at the completion of construction

References and Additional Resources

Construction Site Best Management Practices (BMPs) Manual CTSW-RT-24-425.11.1, California Department of Transportation (Caltrans), March 2024.

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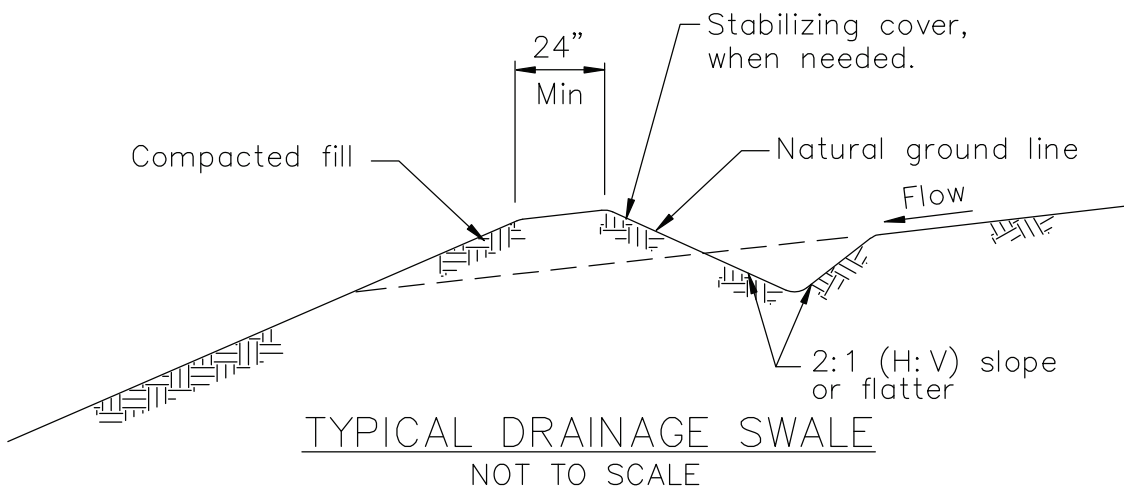
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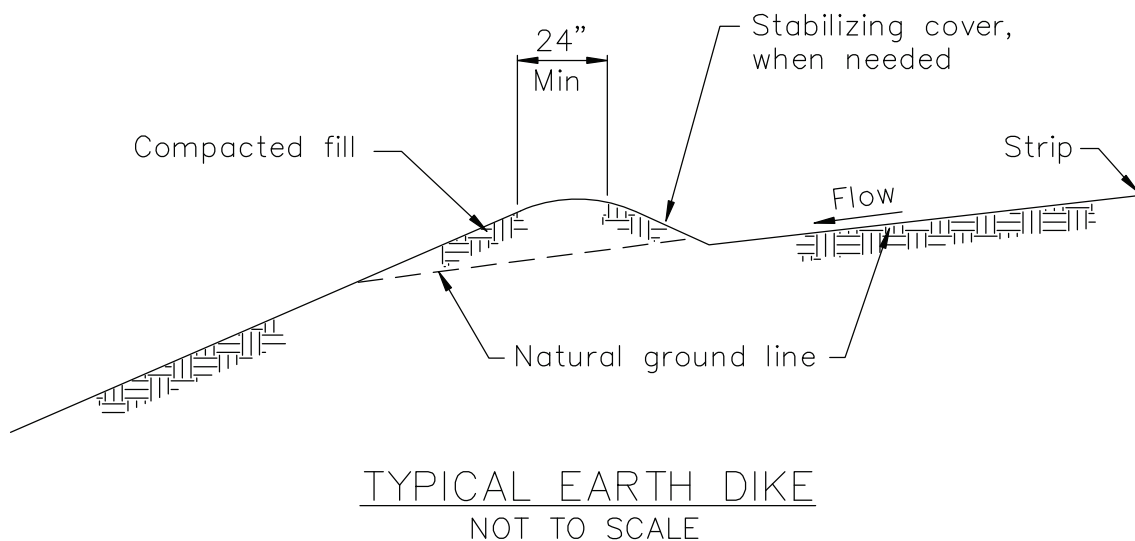
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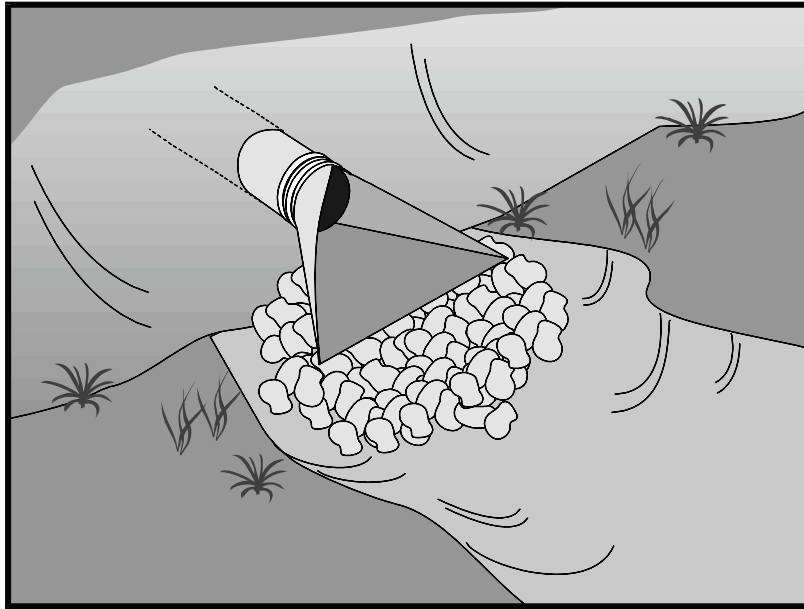
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NOTES:

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





Description and Purpose

Outlet protection is a physical device composed of rock, grouted riprap, or concrete rubble, which is placed at the outlet of a pipe or channel to prevent scour of the soil caused by concentrated, high velocity flows.

Suitable Applications

Whenever discharge velocities and energies at the outlets of culverts, conduits, or channels are sufficient to erode the next downstream reach. This includes temporary diversion structures to divert runoff during construction.

- These devices may be used at the following locations:
 - Outlets of pipes, drains, culverts, slope drains, diversion ditches, swales, conduits, or channels.
 - Outlets located at the bottom of mild to steep slopes.
 - Discharge outlets that carry continuous flows of water.
 - Outlets subject to short, intense flows of water, such as flash floods.
 - Points where lined conveyances discharge to unlined conveyances.

Limitations

- Large storms or high flows can wash away the rock outlet protection and leave the area susceptible to erosion.

Categories

EC	Erosion Control	☒
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

- ☒ **Primary Objective**
- ☒ **Secondary Objective**

Targeted Constituents

Sediment	☒
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

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- Sediment captured by the rock outlet protection may be difficult to remove without removing the rock.
- Outlet protection may negatively impact the channel habitat.
- Grouted riprap may break up in areas of freeze and thaw.
- If there is not adequate drainage, and water builds up behind grouted riprap, it may cause the grouted riprap to break up due to the resulting hydrostatic pressure.
- Sediment accumulation, scour depressions, and/or persistent non-stormwater discharges can result in areas of standing water suitable for mosquito production in velocity dissipation devices.

Implementation

General

Outlet protection is needed where discharge velocities and energies at the outlets of culverts, conduits or channels are sufficient to erode the immediate downstream reach. This practice protects the outlet from developing small eroded pools (plunge pools) and protects against gully erosion resulting from scouring at a culvert mouth.

Design and Layout

As with most channel design projects, depth of flow, roughness, gradient, side slopes, discharge rate, and velocity should be considered in the outlet design. Compliance to local and state regulations should also be considered while working in environmentally sensitive streambeds. General recommendations for rock size and length of outlet protection mat are shown in the rock outlet protection figure in this BMP and should be considered minimums. The apron length and rock size gradation are determined using a combination of the discharge pipe diameter and estimate discharge rate: Select the longest apron length and largest rock size suggested by the pipe size and discharge rate. Where flows are conveyed in open channels such as ditches and swales, use the estimated discharge rate for selecting the apron length and rock size. Flows should be same as the culvert or channel design flow but never the less than the peak 5-year flow for temporary structures planned for one rainy season, or the 10-year peak flow for temporary structures planned for two or three rainy seasons.

- There are many types of energy dissipaters, with rock being the one that is represented in the attached figure.
- Best results are obtained when sound, durable, and angular rock is used.
- Install riprap, grouted riprap, or concrete apron at selected outlet. Riprap aprons are best suited for temporary use during construction. Grouted or wired tied rock riprap can minimize maintenance requirements.
- Rock outlet protection is usually less expensive and easier to install than concrete aprons or energy dissipaters. It also serves to trap sediment and reduce flow velocities.
- Carefully place riprap to avoid damaging the filter fabric.

- Stone 4 in. to 6 in. may be carefully dumped onto filter fabric from a height not to exceed 12 in.
 - Stone 8 in. to 12 in. must be hand placed onto filter fabric, or the filter fabric may be covered with 4 in. of gravel and the 8 in. to 12 in. rock may be dumped from a height not to exceed 16 in.
 - Stone greater than 12 in. shall only be dumped onto filter fabric protected with a layer of gravel with a thickness equal to one half the D_{50} rock size, and the dump height limited to twice the depth of the gravel protection layer thickness.
- For proper operation of apron: Align apron with receiving stream and keep straight throughout its length. If a curve is needed to fit site conditions, place it in upper section of apron.
 - Outlets on slopes steeper than 10 percent should have additional protection.

Inspection and Maintenance

- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subjected to non-stormwater discharges daily while non-stormwater discharges occur. Minimize areas of standing water by removing sediment blockages and filling scour depressions.
- Inspect apron for displacement of the riprap and damage to the underlying fabric. Repair fabric and replace riprap that has washed away. If riprap continues to wash away, consider using larger material.
- Inspect for scour beneath the riprap and around the outlet. Repair damage to slopes or underlying filter fabric immediately.
- Temporary devices should be completely removed as soon as the surrounding drainage area has been stabilized or at the completion of construction.

References and Additional Resources

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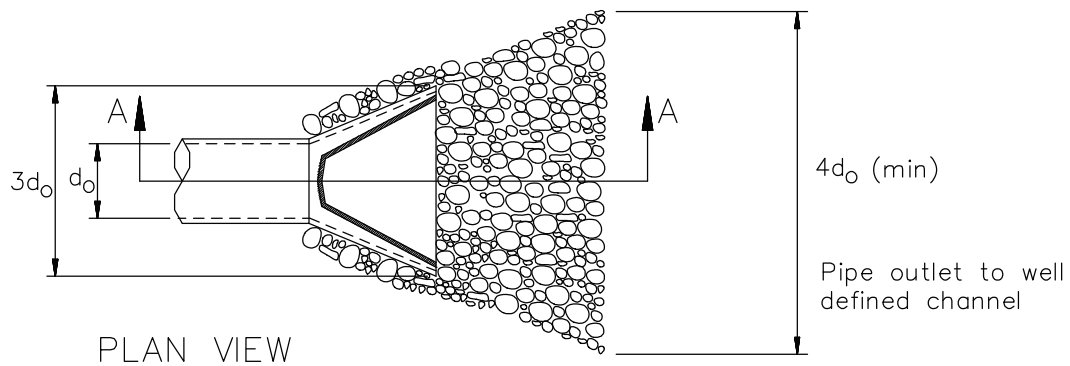
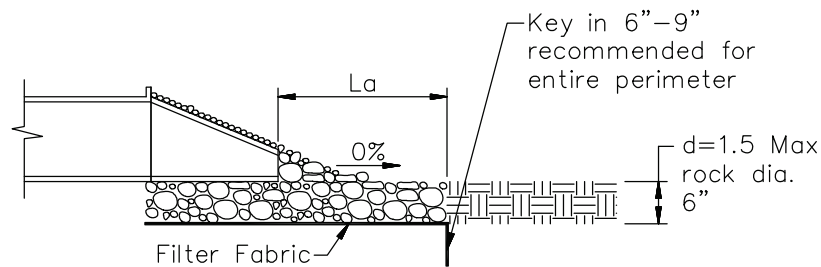
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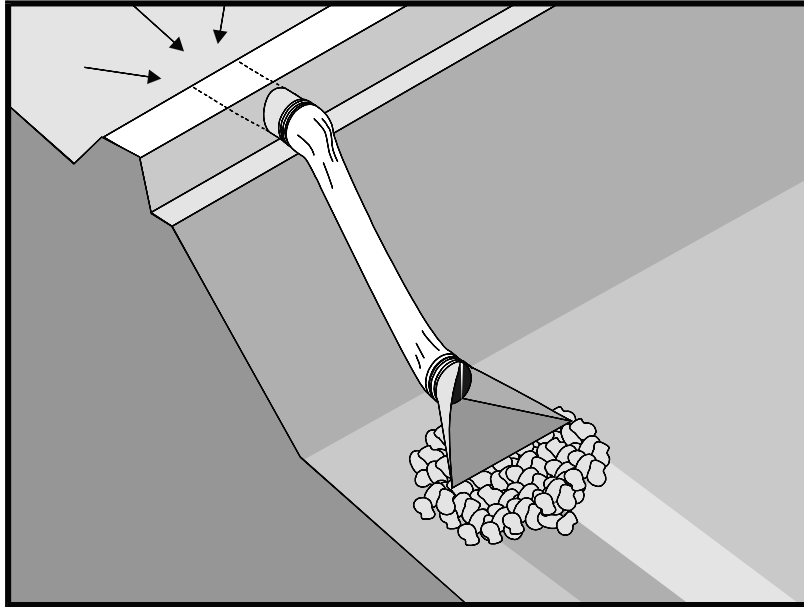
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Pipe Diameter inches	Discharge ft ³ /s	Apron Length, L _a ft	Rip Rap D ₅₀ Diameter Min inches
12	5	10	4
	10	13	6
18	10	10	6
	20	16	8
	30	23	12
	40	26	16
24	30	16	8
	40	26	8
	50	26	12
	60	30	16

For larger or higher flows consult a Registered Civil Engineer
Source: USDA - SCS



Description and Purpose

A slope drain is a pipe used to intercept and direct surface runoff or groundwater into a stabilized watercourse, trapping device, or stabilized area. Slope drains are used with earth dikes and drainage ditches to intercept and direct surface flow away from slope areas to protect cut or fill slopes.

Suitable Applications

- Where concentrated flow of surface runoff must be conveyed down a slope in order to prevent erosion.
- Drainage for top of slope diversion dikes or swales.
- Drainage for top of cut and fill slopes where water can accumulate.
- Emergency spillway for a sediment basin.

Limitations

Installation is critical for effective use of the pipe slope drain to minimize potential gully erosion.

- Maximum drainage area per slope drain is 10 acres. (For large areas use a paved chute, rock lined channel, or additional pipes.)
- Severe erosion may result when slope drains fail by overtopping, piping, or pipe separation.

Categories

EC	Erosion Control	☒
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

- ☒ **Primary Objective**
- ☒ **Secondary Objective**

Targeted Constituents

Sediment	☒
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-9 Earth Dike, Drainage Swales

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- During large storms, pipe slope drains may become clogged or over charged, forcing water around the pipe and causing extreme slope erosion.
- If the sectional down drain is not sized correctly, the runoff can spill over the drain sides causing gully erosion and potential failure of the structure.
- Dissipation of high flow velocities at the pipe outlet is required to avoid downstream erosion.
- Sediment accumulation, scour depressions, and/or persistent non-stormwater discharges can result in areas of standing water suitable for mosquito production in energy dissipaters associated with slope drain outlets.

Implementation

General

The slope drain is applicable for any construction site where concentrated surface runoff can accumulate and must be conveyed down the slope in order to prevent erosion. The slope drain is effective because it prevents the stormwater from flowing directly down the slope by confining all the runoff into an enclosed pipe or channel. Due to the time lag between grading slopes and installation of permanent stormwater collection systems and slope stabilization measures, temporary provisions to intercept runoff are sometimes necessary. Particularly in steep terrain, slope drains can protect unstabilized areas from erosion.

Installation

The slope drain may be a rigid pipe, such as corrugated metal, a flexible conduit, or a lined terrace drain with the inlet placed on the top of a slope and the outlet at the bottom of the slope. This BMP typically is used in combination with a diversion control, such as an earth dike or drainage swale at the top of the slope.

The following criteria must be considered when siting slope drains.

- Permanent structures included in the project plans can often serve as construction BMPs if implemented early. However, the permanent structure must meet or exceed the criteria for the temporary structure.
- Inlet structures must be securely entrenched and compacted to avoid severe gully erosion.
- Slope drains must be securely anchored to the slope and must be adequately sized to carry the capacity of the design storm and associated forces.
- Outlets must be stabilized with riprap, concrete or other type of energy dissipator, or directed into a stable sediment trap or basin. See EC-10, Velocity Dissipation Devices.
- Debris racks are recommended at the inlet. Debris racks located several feet upstream of the inlet can usually be larger than racks at the inlet, and thus provide enhanced debris protection and less plugging.
- Safety racks are also recommended at the inlet and outlet of pipes where children or animals could become entrapped.
- Secure inlet and surround with dikes to prevent gully erosion and anchor pipe to slope.

- When using slope drains, limit drainage area to 10 acres per pipe. For larger areas, use a rock lined channel or a series of pipes.
- Size to convey at least the peak flow of a 10-year storm. The design storm is conservative due to the potential impact of system failures.
- Maximum slope generally limited to 2:1 (H:V) as energy dissipation below steeper slopes is difficult.
- Direct surface runoff to slope drains with interceptor dikes. See BMP EC-9, Earth Dikes and Drainage Swales. Top of interceptor dikes should be 12 in. higher than the top of the slope drain.
- Slope drains can be placed on or buried underneath the slope surface.
- Recommended materials include both metal and plastic pipe, either corrugated or smooth wall. Concrete pipe can also be used.
- When installing slope drains:
 - Install slope drains perpendicular to slope contours.
 - Compact soil around and under entrance, outlet, and along length of pipe.
 - Securely anchor and stabilize pipe and appurtenances into soil.
 - Check to ensure that pipe connections are watertight.
 - Protect area around inlet with filter cloth. Protect outlet with riprap or other energy dissipation device. For high energy discharges, reinforce riprap with concrete or use reinforced concrete device.
 - Protect outlet of slope drains using a flared end section when outlet discharges to a flexible energy dissipation device.
 - A flared end section installed at the inlet will improve flow into the slope drain and prevent erosion at the pipe entrance. Use a flared end section with a 6 in. minimum toe plate to help prevent undercutting. The flared section should slope towards the pipe inlet.

Design and Layout

The capacity for temporary drains should be sufficient to convey at least the peak runoff from a 10-year rainfall event. The pipe size may be computed using the Rational Method or a method established by the local municipality. Higher flows must be safely stored or routed to prevent any offsite concentration of flow and any erosion of the slope. The design storm is purposely conservative due to the potential impacts associated with system failures.

As a guide, temporary pipe slope drains should not be sized smaller than shown in the following table:

Minimum Pipe Diameter (Inches)	Maximum Drainage Area (Acres)
12	1.0
18	3.0
21	5.0
24	7.0
30	10.0

Larger drainage areas can be treated if the area can be subdivided into areas of 10 acres or less and each area is treated as a separate drainage. Drainage areas exceeding 10 acres must be designed by a Registered Civil Engineer and approved by the agency that issued the grading permit.

Materials:

Soil type, rainfall patterns, construction schedule, local requirements, and available supply are some of the factors to be considered when selecting materials. The following types of slope drains are commonly used:

- **Rigid Pipe:** This type of slope drain is also known as a pipe drop. The pipe usually consists of corrugated metal pipe or rigid plastic pipe. The pipe is placed on undisturbed or compacted soil and secured onto the slope surface or buried in a trench. Concrete thrust blocks must be used when warranted by the calculated thrust forces. Collars should be properly installed and secured with metal strappings or watertight collars.
- **Flexible Pipe:** The flexible pipe slope drain consists of a flexible tube of heavy-duty plastic, rubber, or composite material. The tube material is securely anchored onto the slope surface. The tube should be securely fastened to the metal inlet and outlet conduit sections with metal strappings or watertight collars.
- **Section Downdrains:** The section downdrain consists of pre-fabricated, section conduit of half round or third round material. The sectional downdrain performs similar to a flume or chute. The pipe must be placed on undisturbed or compacted soil and secured into the slope.
- **Concrete-lined Terrace Drain:** This is a concrete channel for draining water from a terrace on a slope to the next level. These drains are typically specified as permanent structures and if installed early, can serve as slope drains during construction, which should be designed according to local drainage design criteria.

Inspection and Maintenance

- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subjected to non-stormwater discharges daily while non-stormwater discharges occur. Minimize areas of standing water by removing sediment blockages and filling scour depressions.

- Inspect outlet for erosion and downstream scour. If eroded, repair damage and install additional energy dissipation measures. If downstream scour is occurring, it may be necessary to reduce flows being discharged into the channel unless other preventative measures are implemented.
- Insert inlet for clogging or undercutting. Remove debris from inlet to maintain flows. Repair undercutting at inlet and if needed, install flared section or rip rap around the inlet to prevent further undercutting.
- Inspect pipes for leakage. Repair leaks and restore damaged slopes.
- Inspect slope drainage for accumulations of debris and sediment.
- Remove built up sediment from entrances and outlets as required. Flush drains if necessary; capture and settle out sediment from discharge.
- Make sure water is not ponding onto inappropriate areas (e.g., active traffic lanes, material storage areas, etc.).
- Pipe anchors must be checked to ensure that the pipe remains anchored to the slope. Install additional anchors if pipe movement is detected.

References and Additional Resources

Construction Site Best Management Practices (BMPs) Manual CTSW-RT-24-425.11.1, California Department of Transportation (Caltrans), March 2024.

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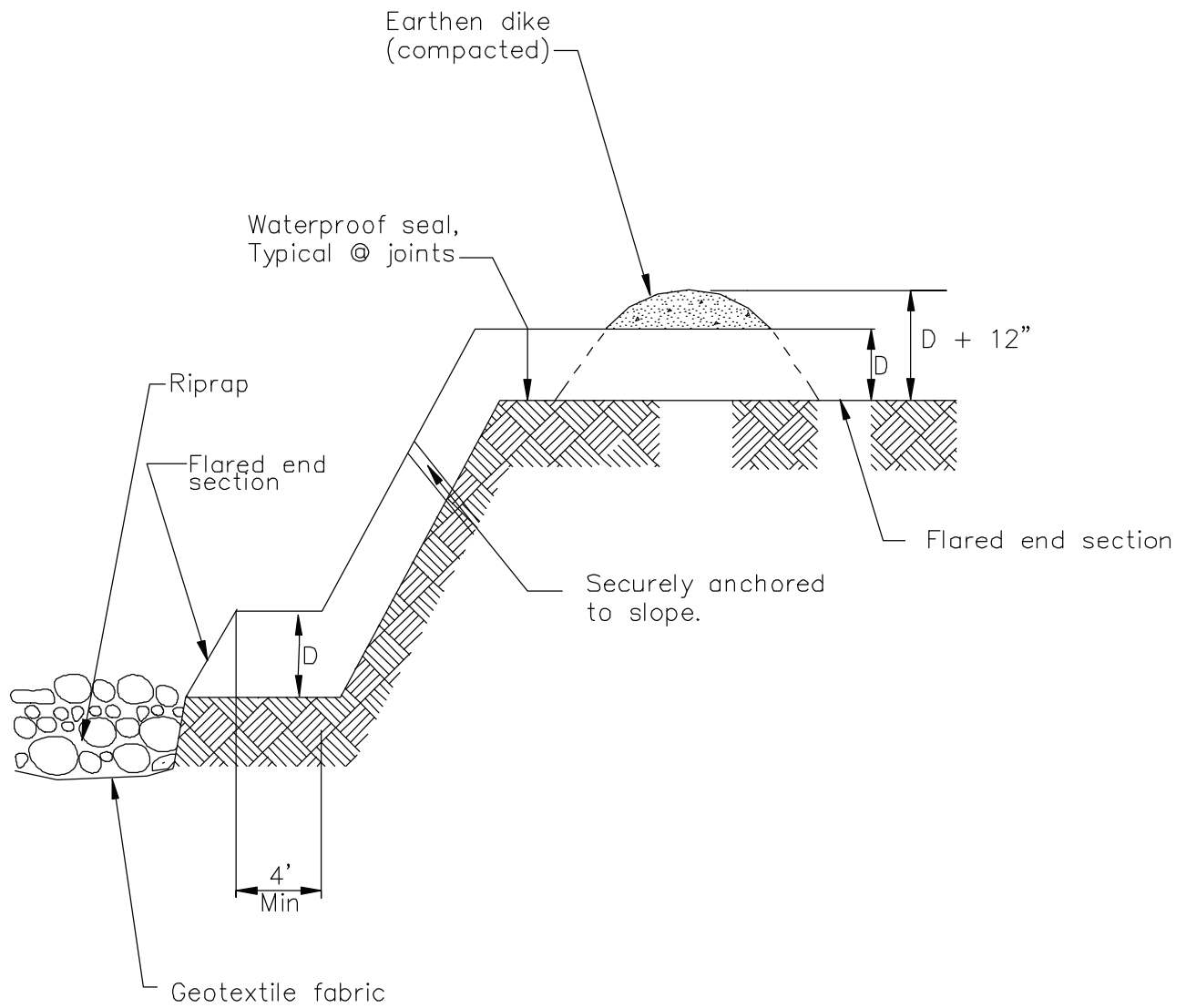
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Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



TYPICAL SLOPE DRAIN
NOT TO SCALE



Description and Purpose

Soil Preparation/Roughening involves assessment and preparation of surface soils for BMP installation. This can include soil testing (for seed base, soil characteristics, or nutrients), as well as roughening surface soils by mechanical methods (including sheepsfoot rolling, track walking, scarifying, stair stepping, and imprinting) to prepare soil for additional BMPs, or to break up sheet flow. Soil Preparation can also involve tilling topsoil to prepare a seed bed and/or incorporation of soil amendments, to enhance vegetative establishment.

Suitable Applications

Soil preparation: Soil preparation is essential to proper vegetative establishment. In particular, soil preparation (i.e. tilling, raking, and amendment) is suitable for use in combination with any soil stabilization method, including Rolled Erosion Control Products (RECPs) or sod. Soil preparation should not be confused with roughening.

Roughening: Soil roughening is generally referred to as track walking (sometimes called imprinting) a slope, where treads from heavy equipment run parallel to the contours of the slope and act as mini terraces. Soil preparation is most effective when used in combination with erosion controls. Soil Roughening is suitable for use as a complementary process for controlling erosion on a site. Roughening is not intended to be used as a stand-alone BMP, and should be used with perimeter controls, additional erosion control measures, grade breaks, and vegetative establishment for maximum effectiveness. Roughening is intended to only affect surface soils and should not compromise slope stability or overall compaction. Suitable applications for soil roughening include:

Categories

EC	Erosion Control	☒
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

- ☒ **Primary Category**
- ☒ **Secondary Category**

Targeted Constituents

Sediment	☒
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

- EC-3 Hydraulic Mulch
- EC-5 Soil Binders
- EC-7 Geotextiles and Mats

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- Along any disturbed slopes, including temporary stockpiles, sediment basins, or compacted soil diversion berms and swales.
- Roughening should be used in combination with hydraulically applied stabilization methods, compost blanket, or straw mulch; but should not be used in combination with RECPs or sod because roughening is intended to leave terraces on the slope.

Limitations

- Preparation and roughening must take place prior to installing other erosion controls (such as hydraulically applied stabilizers) or sediment controls (such as fiber rolls) on the faces of slopes.
- In such cases where slope preparation is minimal, erosion control/revegetation BMPs that do not require extensive soil preparation - such as hydraulic mulching and seeding applications - should be employed.
- Consideration should be given to the type of erosion control BMP that follows surface preparation, as some BMPs are not designed to be installed over various types of tillage/roughening, i.e., RECPs should not be used with soil roughening due to a “bridging” effect, which suspends the blanket above the seed bed.
- Surface roughness has an effect on the amount of mulch material that needs to be applied, which shows up as a general increase in mulch material due to an increase in surface area (Topographic Index -see EC-3 Hydraulic Mulch).

Implementation

- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

General

A roughened surface can significantly reduce erosion. Based on tests done at the San Diego State Erosion Research Laboratory, various roughening techniques on slopes can result in a 12 - 76% reduction in the erosion rate versus smooth slopes.

Materials

Minimal materials are required unless amendments and/or seed are added to the soil. The majority of soil roughening/preparation can be done with equipment that is on hand at a normal construction site, such as bull dozers and compaction equipment.

Installation Guidelines

Soil Preparation

- Where appropriate or feasible, soil should be prepared to receive the seed by disking or otherwise scarifying the surface to eliminate crust, improve air and water infiltration and create a more favorable environment for germination and growth.
- Based upon soil testing conducted, apply additional soil amendments (e.g., fertilizers, additional seed) to the soil to help with germination. Follow EC-4, Hydroseeding, when selecting and applying seed and fertilizers.

Cut Slope Roughening:

- Stair-step grade or groove the cut slopes that are steeper than 3:1.
- Use stair-step grading on any erodible material soft enough to be ripped with a bulldozer. Slopes consisting of soft rock with some subsoil are particularly suited to stair-step grading.
- Make the vertical cut distance less than the horizontal distance, and slightly slope the horizontal position of the "step" in toward the vertical wall.
- Do not make individual vertical cuts more than 2 ft. (0.6 m) high in soft materials or more than 3 ft. (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 in. (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 in. (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 that require mowing activities should not be steeper than 3:1.
- Roughen these areas to shallow grooves by track walking, scarifying, sheepsfoot rolling, or imprinting.
- Make grooves close together (less than 10 in.), and not less than 1 in. 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.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Check the seeded slopes for signs of erosion such as rills and gullies. Fill these areas slightly above the original grade, then reseed and mulch as soon as possible.
- Inspect BMPs weekly during normal operations, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

References and Additional Resources

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Soil Stabilization BMP Research for Erosion and Sediment Controls: Cost Survey Technical Memorandum, State of California Department of Transportation (Caltrans), July 2007.



Description and Purpose

Non-vegetative stabilization methods are used for temporary or permanent stabilization of areas prone to erosion and should be used only where vegetative options are not feasible; examples include:

- Areas of vehicular or pedestrian traffic such as roads or paths;
- Arid environments where vegetation would not provide timely ground coverage, or would require excessive irrigation;
- Rocky substrate, infertile or droughty soils where vegetation would be difficult to establish; and
- Areas where vegetation will not grow adequately within the construction time frame.

There are several non-vegetative stabilization methods and selection should be based on site-specific conditions.

Decomposed Granite (DG) is a permanent erosion protection method that consists of a layer of stabilized decomposed granite placed over an erodible surface.

Degradable Mulches of various types (see EC-3, EC-6, EC-8) can be used for temporary non-vegetative stabilization; examples include straw mulch, compost, wood chips or hydraulic mulch.

Geotextiles and Mats can be used for temporary non-vegetative stabilization (see EC-7). These BMPs are typically manufactured from degradable or synthetic materials and are

Categories

EC	Erosion Control	☒
SE	Sediment Control	☒
TR	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

- ☒ **Primary Category**
- ☒ **Secondary Category**

Targeted Constituents

Sediment	☒
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

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designed and specified based on their functional longevity, i.e., how long they will persist and provide erosion protection. All geotextiles and mats should be replaced when they exceed their functional longevity or when permanent stabilization methods are instituted.

Gravel Mulch is a non-degradable erosion control product that is composed of washed and screened coarse to very coarse gravel, 16 mm to 64 mm (0.6" - 2.5"), similar to an AASHTO No. 3 coarse aggregate.

Rock Slope Protection consists of utilizing large rock or rip-rap (4" - 24") to stabilize slopes with a high erosion potential and those subject to scour along waterways.

Soil Binders can be used for temporary non-vegetative stabilization (see EC-5). The key to their use is functional longevity. In most cases, the soil binder will need to be routinely monitored and re-applied to maintain an erosion-resistant coverage.

Suitable Applications

Non-vegetated stabilization methods are suitable for use on disturbed soil areas and on material stockpiles that need to be temporarily or permanently protected from erosion by water and wind. Non-vegetated stabilization should only be utilized when vegetation cannot be established in the required timeframe, due to soil or climactic conditions, or where vegetation may be a potential fire hazard.

Decomposed Granite (DG) and Gravel Mulch are suitable for use in areas where vegetation establishment is difficult, on flat surfaces, trails and pathways, and when used in conjunction with a stabilizer or tackifier, on shallow slopes (i.e., 10:1 [H:V]). DG and gravel can also be used on shallow rocky slopes where vegetation cannot be established for permanent erosion control.

Degradable Mulches can be used to cover and protect soil surfaces from erosion both in temporary and permanent applications. In many cases, the use of mulches by themselves requires routine inspection and re-application. See EC-3 Hydraulic Mulch, EC-6 Straw Mulch, EC-8 Wood Mulch, or EC-14 Compost Blankets for more information.

Geotextiles and Mats can be used as a temporary stand-alone soil stabilization method. Depending on material selection, geotextiles and mats can be a short-term (3 mos – 1 year) or long-term (1-2 years) temporary stabilization method. For more information on geotextiles and mats see EC-7 Geotextiles and Mats.

Rock Slope Protection can be used when the slopes are subject to scour or have a high erosion potential, such as slopes adjacent to flowing waterways or slopes subject to overflow from detention facilities (spillways).

Soil Binders can be used for temporary stabilization of stockpiles and disturbed areas not subject to heavy traffic. See EC-5 Soil Binders for more information.

Limitations

General

- Refer to EC-3, EC-6, EC-8, and EC-14 for limitations on use of mulches. Refer to EC-7 for limitations on use of geotextiles and mats. Refer to EC-5 for limitations on use of Soil Binders.

Decomposed Granite

- Not available in some geographic regions.
- If not tackified, material may be susceptible to erosion even on slight slopes (e.g., 30:1 [H:V]).
- Installed costs may be more expensive than vegetative stabilization methods.

Gravel Mulch

- Availability is limited in some geographic regions.
- If not properly screened and washed, can contain fine material that can erode and/or create dust problems.
- If inadequately sized, material may be susceptible to erosion on sloped areas.
- Pore spaces fill with dirt and debris over time; may provide a growing medium for weeds.

Rock Slope Protection

- Installation is labor intensive.
- Installed costs can be significantly higher than vegetative stabilization methods.
- Rounded stones may not be used on slopes greater than 2:1 [H:V].

Implementation

General

Non-vegetated stabilization should be used in accordance with the following general guidance:

- Should be used in conjunction with other BMPs, including drainage, erosion controls and sediment controls.
- Refer to EC-3, EC-6, EC-8, and EC-14 for implementation details for mulches. Refer to EC-7 for implementation details for geotextiles and mats. Refer to EC-5 for implementation details for soil binders.
- Non-vegetated stabilization measures should be implemented as soon as the disturbance in the areas they are intended to protect has ceased.
- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

Decomposed Granite Stabilization

- If used for a road or path should be installed on a prepared base.
- Should be mixed with a stabilizer if used for roads or pathways, or on slope applications.
- Though porous it is recommended to prevent standing water on or next to a decomposed granite road or pathway.

Gravel Mulch

- Should be sized based on slope, rainfall, and upgradient run-on conditions. Stone size should be increased as potential for erosion increases (steeper slopes, high intensity rainfall).
- If permanent, a weed control fabric should be placed prior to installation.
- Should be installed at a minimum 2" depth.
- Should completely cover all exposed surfaces.

Rock Slope Protection

- Rock slope protection installation should follow Caltrans Standard Specification 72-2: Rock Slope Protection. Refer to the specification for rock conformity requirements and installation methods.
- When using rock slope protection, rock size and installation method should be specified by an Engineer.
- A geotextile fabric should be placed prior to installation.

Inspection and Maintenance

General

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- For permanent installation, require inspection periodically and after major storm events to look for signs of erosion or damage to the stabilization.
- All damage should be repaired immediately.
- Refer to EC-3, EC-6, EC-8, and EC-14 for inspection and maintenance requirements for mulches. Refer to EC-7 for inspection and maintenance requirements for geotextiles and mats. Refer to EC-5 for inspection and maintenance requirements for soil binders.

Decomposed Granite and Gravel Mulch Stabilization

- Rake out and add decomposed granite or gravel as needed to areas subject to rill erosion. Inspect upgradient drainage controls and repair/modify as necessary.
- Should remain stable under loose surface material. Any significant problem areas should be repaired to restore uniformity to the installation.

References and Additional Resources

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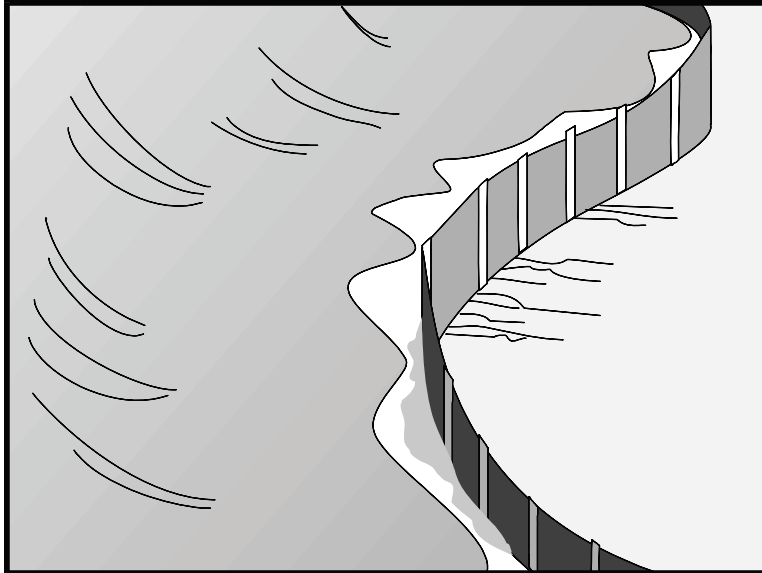
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Standard Specification 72-2: Rock Slope Protection. California Department of Transportation, 2006.



Description and Purpose

A silt fence is made of a woven geotextile that has been entrenched, attached to supporting poles, and sometimes backed by a plastic or wire mesh for support. The silt fence detains water, promoting sedimentation of coarse sediment behind the fence. Silt fence does not retain soil fine particles like clays or silts.

Suitable Applications

Silt fences are suitable for perimeter control, placed below areas where sheet flows discharge from the site. They could also be used as interior controls below disturbed areas where runoff may occur in the form of sheet and rill erosion and around inlets within disturbed areas (Storm Drain Inlet Protection, SE-10). Silt fences should not be used in locations where the flow is concentrated. Silt fences should always be used in combination with erosion controls. Suitable applications include:

- At perimeter of a project (although they should not be installed up and down slopes).
- Below the toe or down slope of exposed and erodible slopes.
- Along streams and channels.
- Around temporary spoil areas and stockpiles.
- Around inlets.
- Below other small cleared areas.

Categories

EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

- ☒ **Primary Category**
- ☒ **Secondary Category**

Targeted Constituents

Sediment (coarse sediment)	☒
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

- SE-5 Fiber Rolls
- SE-6 Gravel Bag Berm
- SE-12 Manufactured Linear Sediment Controls
- SE-13 Compost Socks and Berms
- SE-14 Biofilter Bags

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Limitations

- Do not use in streams, channels, drain inlets, or anywhere flow is concentrated.
- Do not use in locations where ponded water may cause a flooding hazard.
- Do not use silt fence to divert water flows or place across any contour line.
- Improperly installed fences are subject to failure from undercutting, overtopping, or collapsing.
- Must be trenched and keyed in.
- According to the State Water Board's *CGP Review, Issue #2* (2014), silt fences reinforced with metal or plastic mesh should be avoided due to plastic pollution and wildlife concerns.
- Not intended for use as a substitute for Fiber Rolls (SE-5), when fiber rolls are being used as a slope interruption device.
- Do not use on slopes subject to creeping, slumping, or landslides.

Implementation

General

A silt fence is a temporary sediment barrier consisting of woven geotextile stretched across and attached to supporting posts, trenched-in, and, depending upon the strength of fabric used, supported with plastic or wire mesh fence. Silt fences trap coarse sediment by intercepting and detaining sediment-laden runoff from disturbed areas in order to promote sedimentation behind the fence.

The following layout and installation guidance can improve performance and should be followed:

- Silt fence should be used in combination with erosion controls up-slope in order to provide the most effective sediment control.
- Silt fence alone is not effective at reducing turbidity. (Barrett and Malina, 2004)
- Designers should consider diverting sediment laden water to a temporary sediment basin or trap. (EPA, 2012)
- Use principally in areas where sheet flow occurs.
- Install along a level contour, so water does not pond more than 1.5 ft. at any point along the silt fence.
- Provide sufficient room for runoff to pond behind the fence and to allow sediment removal equipment to pass between the silt fence and toes of slopes or other obstructions. About 1200 ft.² of ponding area should be provided for every acre draining to the fence.
- Efficiency of silt fences is primarily dependent on the detention time of the runoff behind the control. (Barrett and Malina, 2004)

- The drainage area above any fence should not exceed a quarter of an acre. (Rule of Thumb-100-feet of silt fence per 10,000 ft.² of disturbed area.) (EPA, 2012)
- The maximum length of slope draining to any point along the silt fence should be 100 ft. per ft of silt fence.
- Turn the ends of the filter fence uphill to prevent stormwater from flowing around the fence.
- Leave an undisturbed or stabilized area immediately down slope from the fence where feasible.
- Silt fences should remain in place until the disturbed area draining to the silt fence is permanently stabilized, after which, the silt fence fabric and posts should be removed and properly disposed.
- J-hooks, which have ends turning up the slope to break up long runs of fence and provide multiple storage areas that work like mini-retention areas, may be used to increase the effectiveness of silt fence.
- Be aware of local regulations regarding the type and installation requirements of silt fence, which may differ from those presented in this fact sheet.

Design and Layout

In areas where high winds are anticipated the fence should be supported by a plastic or wire mesh. The geotextile fabric of the silt fence should contain ultraviolet inhibitors and stabilizers to provide longevity equivalent to the project life or replacement schedule.

- Layout in accordance with the attached figures.
- For slopes that contain a high number of rocks or large dirt clods that tend to dislodge, it may be necessary to protect silt fence from rocks (e.g., rockfall netting) ensure the integrity of the silt fence installation.

Standard vs. Heavy Duty Silt Fence

Standard Silt Fence

- Generally applicable in cases where the area draining to fence produces moderate sediment loads.

Heavy Duty Silt Fence

- Heavy duty silt fence usually has 1 or more of the following characteristics, not possessed by standard silt fence.
 - Fabric is reinforced with wire backing or additional support.
 - Posts are spaced closer than pre-manufactured, standard silt fence products.
- Use is generally limited to areas affected by high winds.
- Area draining to fence produces moderate sediment loads.

Materials

Standard Silt Fence

- Silt fence material should be woven geotextile with a minimum width of 36 in. The fabric should conform to the requirements in ASTM designation D6461.

- Wooden stakes should be commercial quality lumber of the size and shape shown on the plans. Each stake should be free from decay, splits or cracks longer than the thickness of the stake or other defects that would weaken the stakes and cause the stakes to be structurally unsuitable.
- Staples used to fasten the fence fabric to the stakes should be not less than 1.75 in. long and should be fabricated from 15-gauge or heavier wire. The wire used to fasten the tops of the stakes together when joining two sections of fence should be 9 gauge or heavier wire. Galvanizing of the fastening wire will not be required.

Heavy-Duty Silt Fence

- Some silt fence has a wire backing to provide additional support, and there are products that may use prefabricated plastic holders for the silt fence and use metal posts instead of wood stakes.

Installation Guidelines – Traditional Method

Silt fences are to be constructed on a level contour. Sufficient area should exist behind the fence for ponding to occur without flooding or overtopping the fence.

- A trench should be excavated approximately 6 in. wide and 6 in. deep along the line of the proposed silt fence (trenches should not be excavated wider or deeper than necessary for proper silt fence installation).
- Bottom of the silt fence should be keyed-in a minimum of 12 in.
- Posts should be spaced a maximum of 6 ft. apart and driven securely into the ground a minimum of 18 in. or 12 in. below the bottom of the trench.
- When standard strength geotextile is used, a plastic or wire mesh support fence should be fastened securely to the upslope side of posts using heavy-duty wire staples at least 1 in. long. The mesh should extend into the trench.
- When extra-strength geotextile and closer post spacing are used, the mesh support fence may be eliminated.
- Woven geotextile should be purchased in a long roll, then cut to the length of the barrier. When joints are necessary, geotextile should be spliced together only at a support post, with a minimum 6 in. overlap and both ends securely fastened to the post.
- The trench should be backfilled with native material and compacted.
- Construct the length of each reach so that the change in base elevation along the reach does not exceed $\frac{1}{3}$ the height of the barrier; in no case should the reach exceed 500 ft.
- Cross barriers should be a minimum of $\frac{1}{3}$ and a maximum of $\frac{1}{2}$ the height of the linear barrier.
- See typical installation details at the end of this fact sheet.

Installation Guidelines - Static Slicing Method

- Static Slicing is defined as insertion of a narrow blade pulled behind a tractor, similar to a plow blade, at least 10 in. into the soil while at the same time pulling silt geotextile fabric into the ground through the opening created by the blade to the depth of the blade. Once the geotextile is installed, the soil is compacted using tractor tires.
- This method will not work with pre-fabricated, wire backed silt fence.
- Benefits:
 - Ease of installation (most often done with a 2-person crew).
 - Minimal soil disturbance.
 - Better level of compaction along fence, less susceptible to undercutting
 - Uniform installation.
- Limitations:
 - Does not work in shallow or rocky soils.
 - Complete removal of geotextile material after use is difficult.
 - Be cautious when digging near potential underground utilities.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Repair undercut silt fences.
- Repair or replace split, torn, slumping, or weathered fabric. The lifespan of silt fence fabric is generally 5 to 8 months.
- Silt fences that are damaged and become unsuitable for the intended purpose should be removed from the site of work, disposed, and replaced with new silt fence barriers.
- Sediment that accumulates in the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches 1/3 of the barrier height.
- Silt fences should be left in place until the upgradient area is permanently stabilized. Until then, the silt fence should be inspected and maintained regularly.
- Remove silt fence when upgradient areas are stabilized. Fill and compact post holes and anchor trench, remove sediment accumulation, grade fence alignment to blend with adjacent ground, and stabilize disturbed area.

References and Additional Resources

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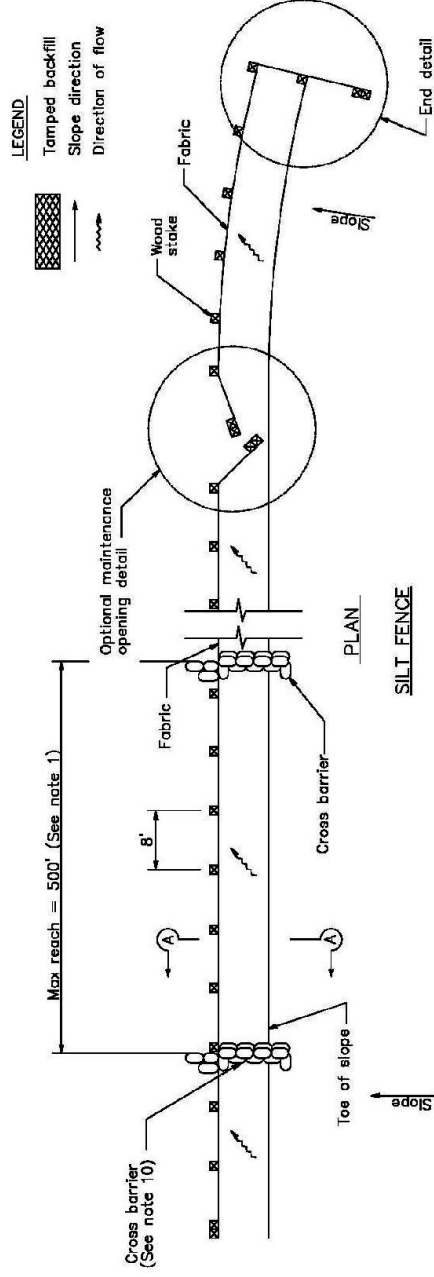
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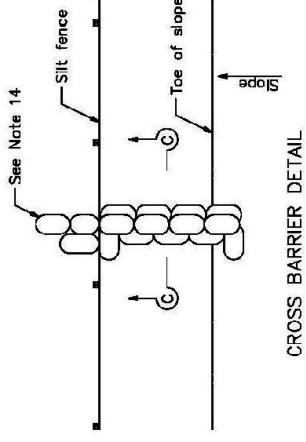
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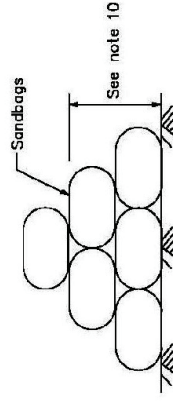
SILT FENCE

NOTES

1. Construct the length of each reach so that the change in base elevation along the reach does not exceed $\frac{1}{3}$ the height of the linear barrier. In no case shall the reach length exceed 500'.
2. The last 8'-0" of fence shall be turned up slope.
3. Stake dimensions are nominal.
4. Dimension may vary to fit field condition.
5. Stakes shall be spaced at 8'-0" maximum and shall be positioned on downstream side of fence.
6. Stakes to overlap and fence fabric to fold around each stake one full turn. Secure fabric to stake with 4 staples.
7. Stakes shall be driven tightly together to prevent potential flow-through of sediment at joint. The tops of the stakes shall be secured with wire.
8. For end stake, fence fabric shall be folded around two stakes one full turn and secured with 4 staples.
9. Minimum 4 staples per stake. Dimensions shown are typical.
10. Cross barriers shall be a minimum of $\frac{1}{3}$ and a maximum of $\frac{1}{2}$ the height of the linear barrier.
11. Maintenance openings shall be constructed in a manner to ensure sediment remains behind silt fence.
12. Joining sections shall not be placed at sump locations.
13. Sandbag rows and layers shall be offset to eliminate gaps.
14. Add 3-4 bags to cross barrier on downstream side of silt fence as needed to prevent bypass or undermining and as allowable based on site limits of disturbance.

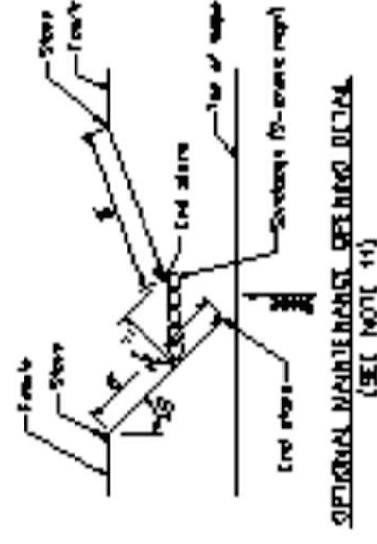


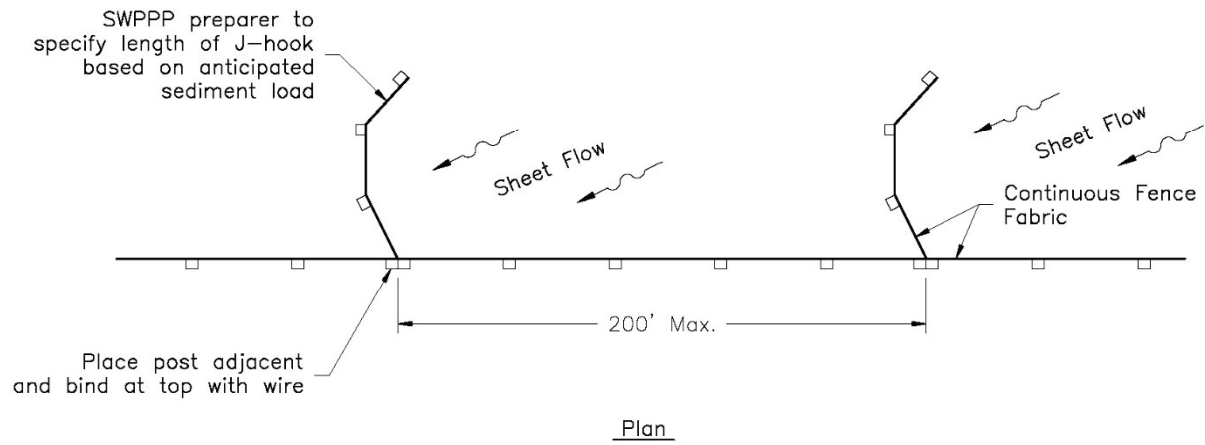
CROSS BARRIER DETAIL



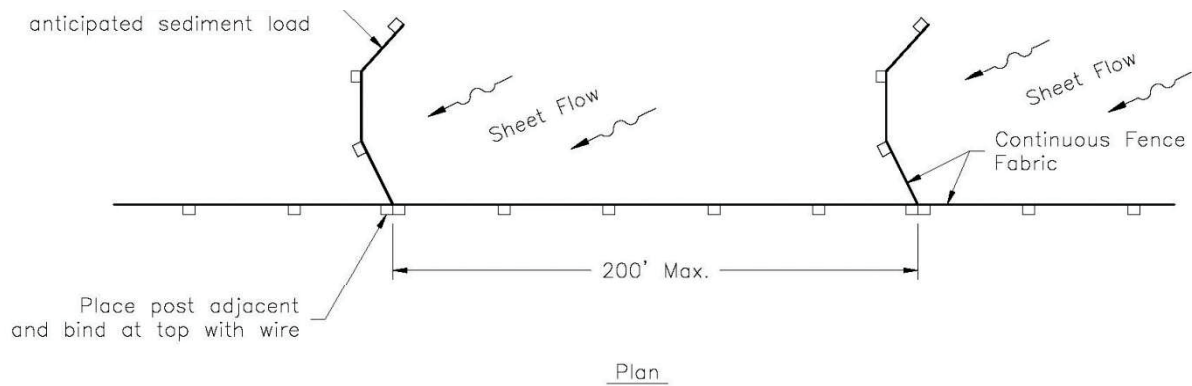
SECTION C-C

T-E-S

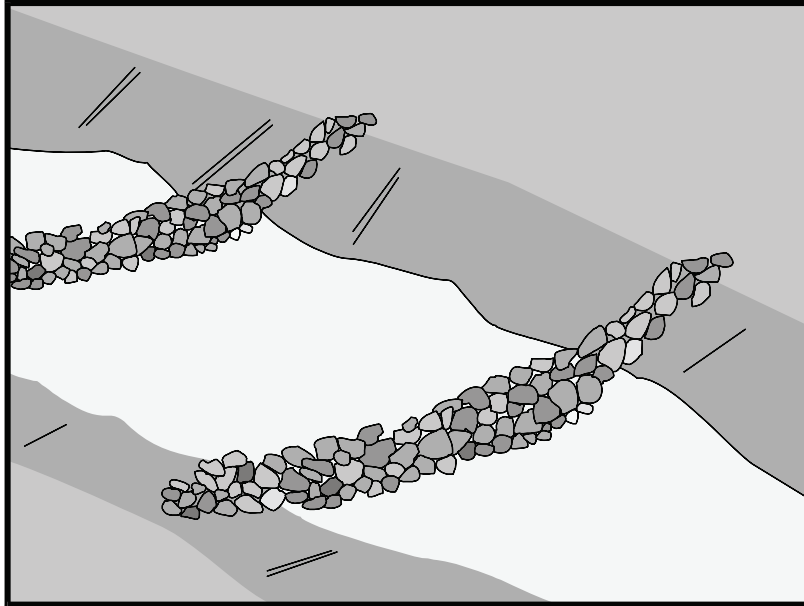




J-HOOK



J-HOOK



Description and Purpose

A check dam is a small barrier constructed of rock, gravel bags, sandbags, fiber rolls, or other proprietary products, placed across a constructed swale or drainage ditch. Check dams reduce the effective slope of the channel, thereby reducing scour and channel erosion by reducing flow velocity and increasing residence time within the channel, allowing sediment to settle.

Suitable Applications

Check dams may be appropriate in the following situations:

- To promote sedimentation behind the dam.
- To prevent erosion by reducing the velocity of channel flow in small intermittent channels and temporary swales.
- In small open channels that drain 10 acres or less.
- In steep channels where stormwater runoff velocities exceed 5 ft/s.
- During the establishment of grass linings in drainage ditches or channels.
- In temporary ditches where the short length of service does not warrant establishment of erosion-resistant linings.
- To act as a grade control structure.

Categories

EC	Erosion Control	☒
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

- ☒ **Primary Category**
- ☒ **Secondary Category**

Targeted Constituents

Sediment	☒
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

- SE-5 Fiber Rolls
- SE-6 Gravel Bag Berm
- SE-8 Sandbag Barrier
- SE-12 Manufactured Linear Sediment Controls
- SE-14 Biofilter Bags

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Limitations

- Not to be used in live streams or in channels with extended base flows.
- Not appropriate in channels that drain areas greater than 10 acres.
- Not appropriate in channels that are already grass-lined unless erosion potential or sediment-laden flow is expected, as installation may damage vegetation.
- Require extensive maintenance following high velocity flows.
- Promotes sediment trapping which can be re-suspended during subsequent storms or removal of the check dam.
- Do not construct check dams with straw bales or silt fence.
- Water suitable for mosquito production may stand behind check dams, particularly if subjected to daily non-stormwater discharges.

Implementation

General

Check dams reduce the effective slope and create small pools in swales and ditches that drain 10 acres or less. Using check dams to reduce channel slope reduces the velocity of stormwater flows, thus reducing erosion of the swale or ditch and promoting sedimentation. Thus, check dams are dual-purpose and serve an important role as erosion controls as well as sediment controls. Note that use of 1-2 isolated check dams for sedimentation will likely result in little net removal of sediment because of the small detention time and probable scour during longer storms. Using a series of check dams will generally increase their effectiveness. A sediment trap (SE-3) may be placed immediately upstream of the check dam to increase sediment removal efficiency.

Design and Layout

Check dams work by decreasing the effective slope in ditches and swales. An important consequence of the reduced slope is a reduction in capacity of the ditch or swale. This reduction in capacity should be considered when using this BMP, as reduced capacity can result in overtopping of the ditch or swale and resultant consequences. In some cases, such as a “permanent” ditch or swale being constructed early and used as a “temporary” conveyance for construction flows, the ditch or swale may have sufficient capacity such that the temporary reduction in capacity due to check dams is acceptable. When check dams reduce capacities beyond acceptable limits, either:

- Don’t use check dams. Consider alternative BMPs, or.
- Increase the size of the ditch or swale to restore capacity.

Maximum slope and velocity reduction is achieved when the toe of the upstream dam is at the same elevation as the top of the downstream dam (see “Spacing Between Check Dams” detail at the end of this fact sheet). The center section of the dam should be lower than the edge sections (at least 6 inches), acting as a spillway, so that the check dam will direct flows to the center of

the ditch or swale (see “Typical Rock Check Dam” detail at the end of this fact sheet). Bypass or side-cutting can occur if a sufficient spillway is not provided in the center of the dam.

Check dams are usually constructed of rock, gravel bags, sandbags, and fiber rolls. A number of products can also be used as check dams (e.g. HDPE check dams, temporary silt dikes (SE-12)), and some of these products can be removed and reused. Check dams can also be constructed of logs or lumber and have the advantage of a longer lifespan when compared to gravel bags, sandbags, and fiber rolls. Check dams should not be constructed from straw bales or silt fences, since concentrated flows quickly wash out these materials.

Rock check dams are usually constructed of 8 to 12 in. rock. The rock is placed either by hand or mechanically, but never just dumped into the channel. The dam should completely span the ditch or swale to prevent washout. The rock used should be large enough to stay in place given the expected design flow through the channel. It is recommended that abutments be extended 18 in. into the channel bank. Rock can be graded such that smaller diameter rock (e.g. 2-4 in) is located on the upstream side of larger rock (holding the smaller rock in place); increasing residence time.

Log check dams are usually constructed of 4 to 6 in. diameter logs, installed vertically. The logs should be embedded into the soil at least 18 in. Logs can be bolted or wired to vertical support logs that have been driven or buried into the soil.

See fiber rolls, SE-5, for installation of fiber roll check dams.

Gravel bag and sand bag check dams are constructed by stacking bags across the ditch or swale, shaped as shown in the drawings at the end of this fact sheet (see “Gravel Bag Check Dam” detail at the end of this fact sheet).

Manufactured products, such as temporary silt dikes (SE-12), should be installed in accordance with the manufacturer’s instructions. Installation typically requires anchoring or trenching of products, as well as regular maintenance to remove accumulated sediment and debris.

If grass is planted to stabilize the ditch or swale, the check dam should be removed when the grass has matured (unless the slope of the swales is greater than 4%).

The following guidance should be followed for the design and layout of check dams:

- Install the first check dam approximately 16 ft from the outfall device and at regular intervals based on slope gradient and soil type.
- Check dams should be placed at a distance and height to allow small pools to form between each check dam.
- For multiple check dam installation, backwater from a downstream check dam should reach the toes of the upstream check dam.
- A sediment trap provided immediately upstream of the check dam will help capture sediment. Due to the potential for this sediment to be resuspended in subsequent storms, the sediment trap should be cleaned following each storm event.

- High flows (typically a 2-year storm or larger) should safely flow over the check dam without an increase in upstream flooding or damage to the check dam.
- Where grass is used to line ditches, check dams should be removed when grass has matured sufficiently to protect the ditch or swale.

Materials

- Rock used for check dams should typically be 8-12 in rock and be sufficiently sized to stay in place given expected design flows in the channel. Smaller diameter rock (e.g. 2 to 4 in) can be placed on the upstream side of larger rock to increase residence time.
- Gravel bags used for check dams should conform to the requirements of SE-6, Gravel Bag Berms.
- Sandbags used for check dams should conform to SE-8, Sandbag Barrier.
- Fiber rolls used for check dams should conform to SE-5, Fiber Rolls.
- Temporary silt dikes used for check dams should conform to SE-12, Temporary Silt Dikes.

Installation

- Rock should be placed individually by hand or by mechanical methods (no dumping of rock) to achieve complete ditch or swale coverage.
- Tightly abut bags and stack according to detail shown in the figure at the end of this section (pyramid approach). Gravel bags and sandbags should not be stacked any higher than 3 ft.
- Upper rows of gravel and sand bags shall overlap joints in lower rows.
- Fiber rolls should be trenched in, backfilled, and firmly staked in place.
- Install along a level contour.
- HDPE check dams, temporary silt dikes, and other manufactured products should be used and installed per manufacturer specifications.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Replace missing rock, bags, rolls, etc. Replace bags or rolls that have degraded or have become damaged.
- If the check dam is used as a sediment capture device, sediment that accumulates behind the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height.

- If the check dam is used as a grade control structure, sediment removal is not required as long as the system continues to control the grade.
- Inspect areas behind check dams for pools of standing water, especially if subjected to daily non-stormwater discharges.
- Remove accumulated sediment prior to permanent seeding or soil stabilization.
- Remove check dam and accumulated sediment when check dams are no longer needed.

References and Additional Resources

Construction Site Best Management Practices (BMPs) Manual CTSW-RT-24-425.11.1, California Department of Transportation (Caltrans), March 2024.

Best Management Practices (BMPs) Manual CTSW-RT-24-425.11.1, California Department of Transportation (Caltrans), March 2024.

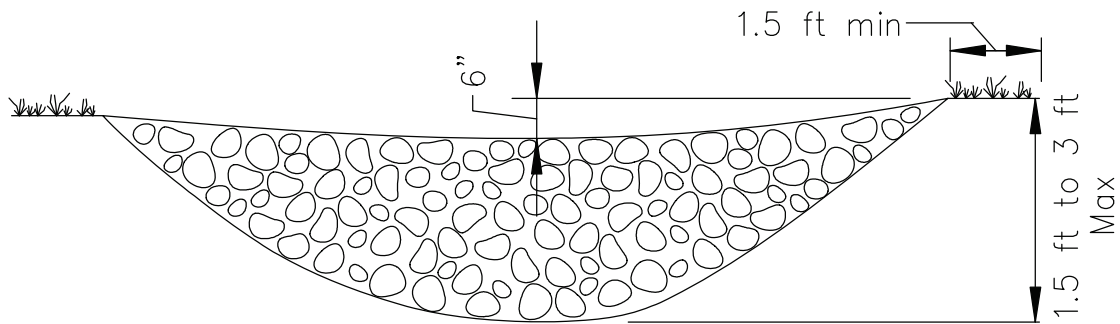
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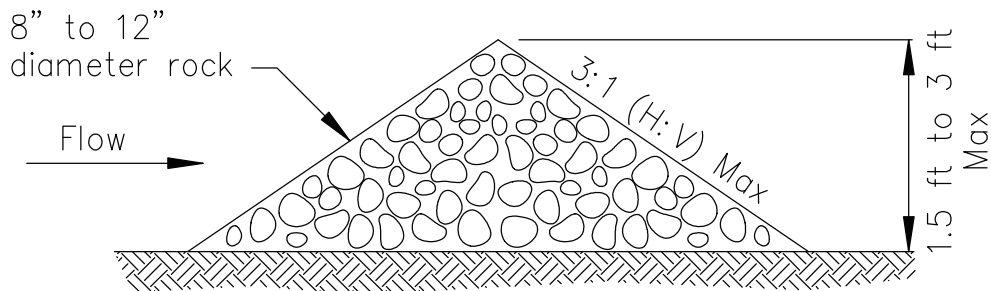
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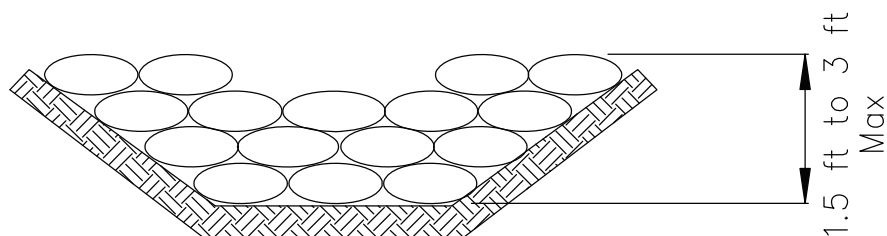


ELEVATION

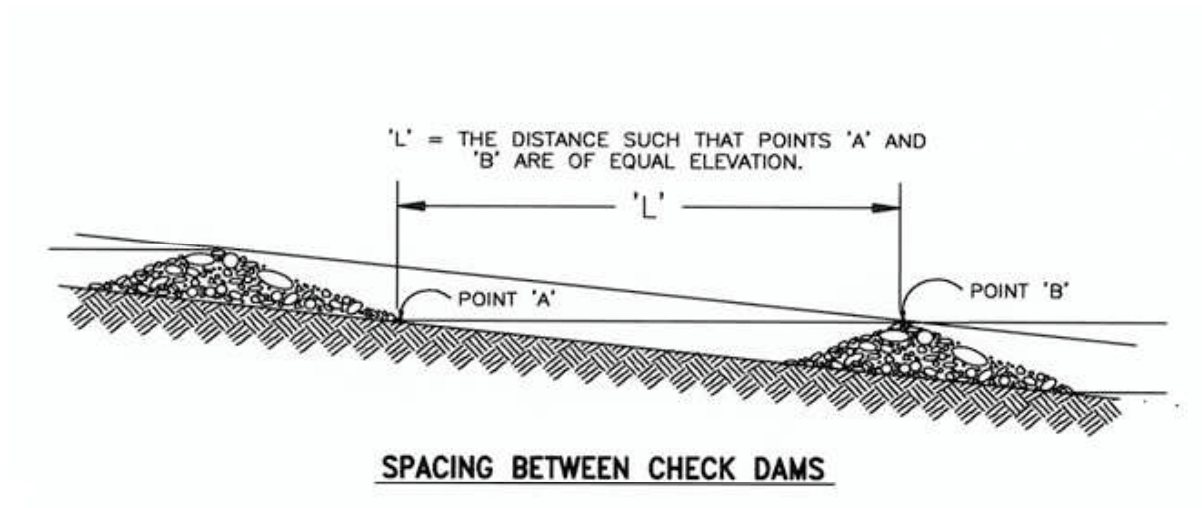


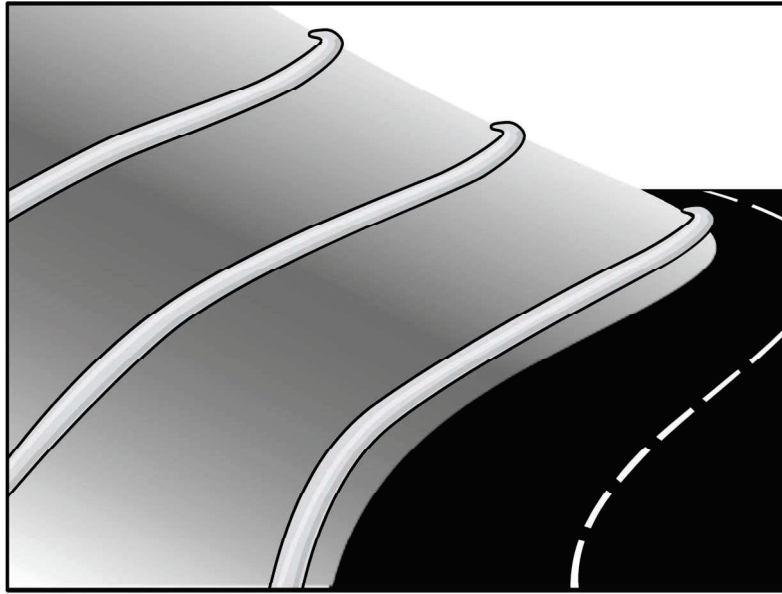
TYPICAL ROCK CHECK DAM SECTION

ROCK CHECK DAM
NOT TO SCALE



GRAVEL BAG CHECK DAM ELEVATION
NOT TO SCALE





Description and Purpose

A fiber roll (also known as a wattle or log) consists of straw, coir, curled wood fiber, or other biodegradable materials bound into a tight tubular roll wrapped by netting. Additionally, gravel core fiber rolls are available, which contain an imbedded ballast material such as gravel or sand for additional weight, when staking the rolls are not feasible (such as use as inlet protection).

When fiber rolls are placed at the top, toe, and on the face of slopes along the contours, fiber rolls intercept runoff, reduce flow velocity, release runoff as sheet flow, and provide sediment removal from the runoff (through sedimentation). By interrupting the length of a slope, fiber rolls can also reduce sheet and rill erosion until vegetation is established.

Suitable Applications

Fiber rolls may be suitable:

- Along the top, toe, face, and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow.
- At the end of a downward slope where it transitions to a steeper slope.
- Along the perimeter of a project.
- As check dams in unlined ditches with minimal grade.
- Down-slope of exposed soil areas.

Categories

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SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

- ☒ **Primary Category**
- ☒ **Secondary Category**

Targeted Constituents

Sediment	☒
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

- SE-1 Silt Fence
- SE-6 Gravel Bag Berm
- SE-8 Sandbag Barrier
- SE-12 Manufactured Linear Sediment Controls
- SE-13 Compost Socks and Berms
- SE-14 Biofilter Bags

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- At operational storm drains as a form of inlet protection.
- Around temporary stockpiles.

Limitations

- Fiber rolls are to be used in conjunction with erosion control, such as hydroseed, mulch, rolled erosion control products (RECPs), etc.
- Only biodegradable fiber rolls containing no plastic can remain on a site when applying for a Notice of Termination (NOT) due to plastic pollution and wildlife concerns. There may be further limitations on the use of plastic wrapped fiber rolls in wildlife sensitive areas. Fiber rolls containing plastic must be removed and disposed of prior to final stabilization.
- Do not install fiber rolls in high traffic areas where vehicles and equipment will displace or damage them.
- Do not use fiber rolls on paved surfaces where they cannot be staked and trenched in. Only gravel core rolls may be effective in this situation. See Gravel Bags (SE-6), Manufactured Linear Sediment Controls (SE-12), Compost Socks and Berms (SE-13), and Biofilter Bags (SE-14) for situations where staking or trenching is not possible.
- Do not use fiber rolls on slopes subject to creep, slumping, or landslides.
- Improper installation of a fiber roll such as not being trenched in, not staked appropriately, or not sufficiently overlapping at the ends, may cause undercutting and increased erosion.
- Fiber rolls installed by the Type 1 method are not effective unless trenched in and staked. If not properly staked and trenched in, fiber rolls will not work as intended and could be transported by high flows.
- Fiber rolls installed by the Type 2 method are not effective unless staked. If not properly staked in, fiber rolls will not work as intended and could be transported by high flows.
- Not intended for use in concentrated flows.
- Not intended to contain stormwater. See Sediment Basin (SE-2) or Sediment Trap (SE-3) for stormwater containment BMPs.
- Difficult to move once saturated.
- Difficult to repair when a small section of the fiber roll is damaged. Replacement of the entire fiber roll or installation of an additional fiber roll adjacent to the damage is often required.
- Fiber rolls are susceptible to damage from wildlife.
- Fiber rolls have a limited sediment capture zone.
- Fiber rolls typically function for 12-24 months, depending upon local conditions, roll material, and installation method. For example, the Type 2 installation method may last longer than the Type 1 installation method because the fiber roll is not penetrated.

- Fiber rolls that come manufactured containing polyacrylamide (PAM), a flocculating agent within the roll, are considered passive treatment technologies and are subject to additional requirements, see Passive Treatment (SE-15).

Implementation

Fiber Roll Materials

- Fiber rolls are to be prefabricated.
- Fiber rolls are made from weed-free rice straw, flax, curled wood fiber, or coir bound into a tight tubular roll by netting or wrap (see Limitations above regarding plastic netting).
- Typical fiber rolls vary in diameter from 6 in. to 20 in. Larger diameter rolls are available as well. The larger the roll diameter, the higher the sediment retention capacity.
- Typical fiber rolls lengths are 4, 10, 20 and 25 ft., although other lengths may be available.

Installation

- Locate fiber rolls on level contours spaced as follows:
 - Slope inclination between 20:1 and 4:1 (H:V): Place fiber rolls at a maximum interval of 35 ft.
 - Slope inclination of 4:1 (H:V): Place fiber rolls at a maximum interval of 20 ft.
 - Slope inclination between 4:1 and 2:1 (H:V): Place fiber rolls at a maximum interval of 15 ft. (a closer spacing is more effective).
 - Slope inclination 2:1 (H:V) or greater: Place fiber rolls at a maximum interval of 10 ft. (a closer spacing is more effective).
- It is critical that fiber rolls are installed perpendicular to water flow and parallel to the slope contour.
- Prepare the slope before beginning installation.
- Dig small trenches across the slope on the contour. The trench depth is to be $\frac{1}{4}$ to $\frac{1}{3}$ of the thickness of the roll, and the width is to be equal to the roll diameter, in order to provide area to backfill the trench.
- Use wood stakes with a nominal classification of 0.75 by 0.75 in. and minimum length of 24 in.
- For Type 1 installations:
 - Place in a trench that is from 2 to 4 inches deep.
 - Fasten with wood stakes every 4 feet along the length of the fiber roll.
 - Fasten the ends of the fiber roll by placing a stake 6 inches from the end of the roll.

- Drive the stakes into the soil so the top of the stake is less than 2 inches above the top of the fiber roll.
- For Type 2 installations (Caltrans, 2024):
 - Trenching in the fiber rolls is optional.
 - J-hook the ends of the fiber roll up-slope to prevent runoff from going around the fiber roll.
 - Drive stakes along alternating sides of each fiber roll, spaced 2 ft. apart. Stakes are to alternate between upslope and downslope of the fiber roll.
 - Lace the rope tightly around the stakes and over the fiber roll. Knot the rope at each stake.
 - Tighten the fiber roll to the surface of the slope by driving the stakes further into the soil.
- If more than one fiber roll is placed in a row, the rolls should overlap, not abut at the ends. Stagger overlapping joints in adjacent rows by 5 to 10 feet.
- See typical fiber roll installation details at the end of this fact sheet.

Removal

- Fiber rolls can be left in place or be removed depending on the type of fiber roll and its application (temporary vs. permanent installation).
- For temporary installations, only remove fiber rolls when upgradient areas are stabilized per General Permit requirements, and/or pollutant sources are no longer present. Remove fiber rolls before vegetation becomes too mature so that the removal process does not disturb more soil and vegetation than is necessary.
- For permanent installations for final stabilization, fiber rolls encased with plastic netting or containing any plastic material are to be removed from the site. If a fiber roll is to be left in place as part of a final stabilization design, the fiber roll must be non-plastic, made of plant-based materials (e.g., burlap-wrapped, coconut jute netting, and any other plant-based netting), and fully biodegradable.
- Fiber rolls can be an effective component of a final stabilization system, if all components of the fiber rolls are plant-based, fully biodegradable, and the fiber rolls are coupled with fully biodegradable effective erosion control measures (hydroseeding, RECPs, etc.) properly applied/installed per manufacturer's specifications and/or per the current CASQA BMP Fact Sheets. Removal of fiber rolls that are used as part of a final stabilization system can result in greater disturbance; therefore, during the BMP planning phase, only specify fiber rolls wrapped in non-plastic fully biodegradable materials for areas where fiber rolls will be used on final slopes.

Inspection and Maintenance

- BMPs are to be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that BMPs be inspected weekly at a minimum and prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Repair/replace split, torn, unraveling, or slumping fiber rolls as needed.
- Replace fiber rolls when they are disintegrated, flattened, and no longer effective.
- If construction activities or access to a work area are impaired by a fiber roll, move the fiber roll to avoid its damage or disintegration. Reinstall the fiber roll once active work is complete.
- If a fiber roll is used as a sediment capture device, or as an erosion control device to maintain sheet flows, periodically remove sediment that accumulates upgradient of the fiber roll to maintain BMP effectiveness. Remove sediment when sediment accumulation reaches one-third of the height of the fiber roll.
- If fiber rolls are used for erosion control, such as in a check dam, sediment removal may not be required as long as the system continues to control the grade. Sediment control BMPs will be implemented in conjunction with this type of application.
- Repair any undercutting, rills, and gullies promptly.

References and Additional Resources

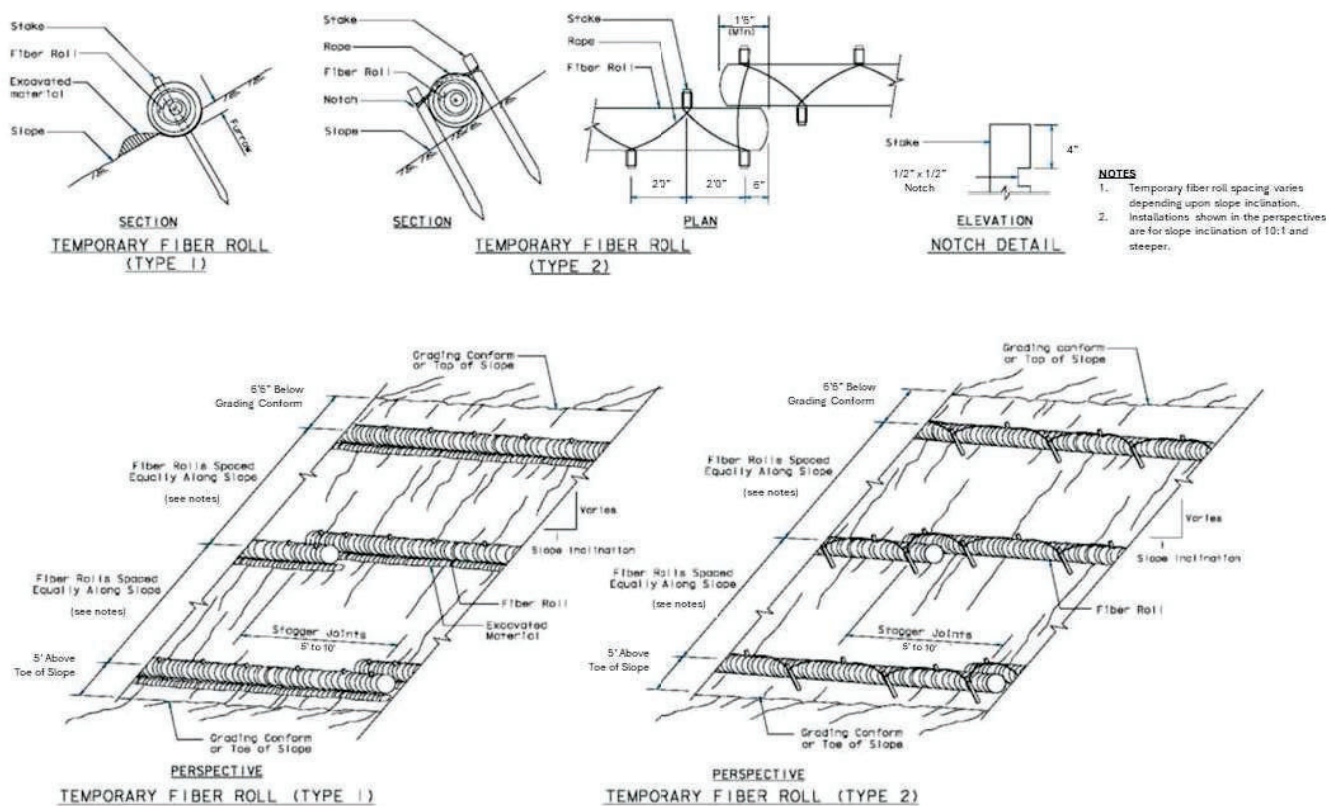
Construction Site Best Management Practices (BMPs) Manual, CTSW-RT-24-425-11.1, Section 4, Fiber Rolls SC-5, California Department of Transportation (Caltrans), March 2024.

Construction Stormwater Program website, State Water Resources Control Board, online at: https://www.waterboards.ca.gov/water_issues/programs/stormwater/construction.html

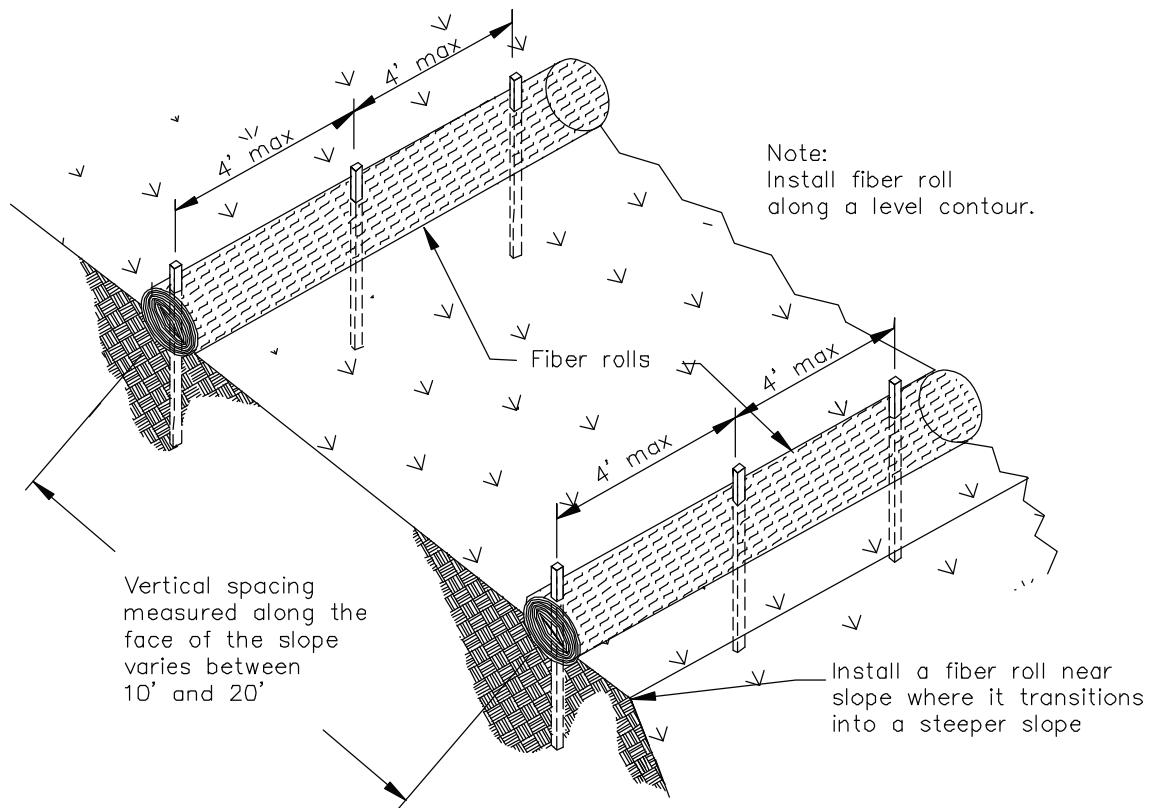
Order 2022-0057-DWQ, NPDES General Permit No. CAS000002: National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities (General Permit), California State Water Resources Control Board (State Water Board), September 2022.

Fiber Rolls

SE-5

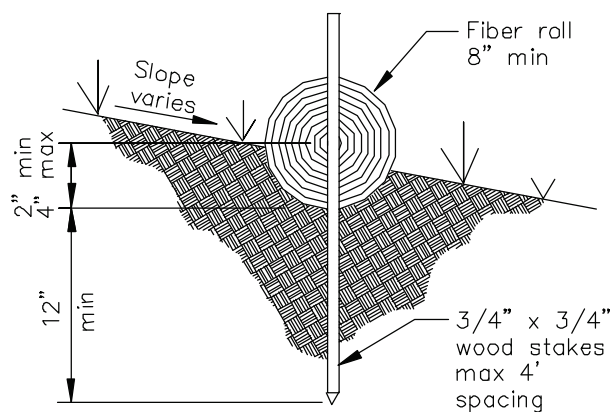


Reference: Construction Site Best Management Practices (BMPs) Manual, CTSW-RT-24-425-11.1, Section 4, Fiber Rolls SC-5, California Department of Transportation (Caltrans), March 2024.



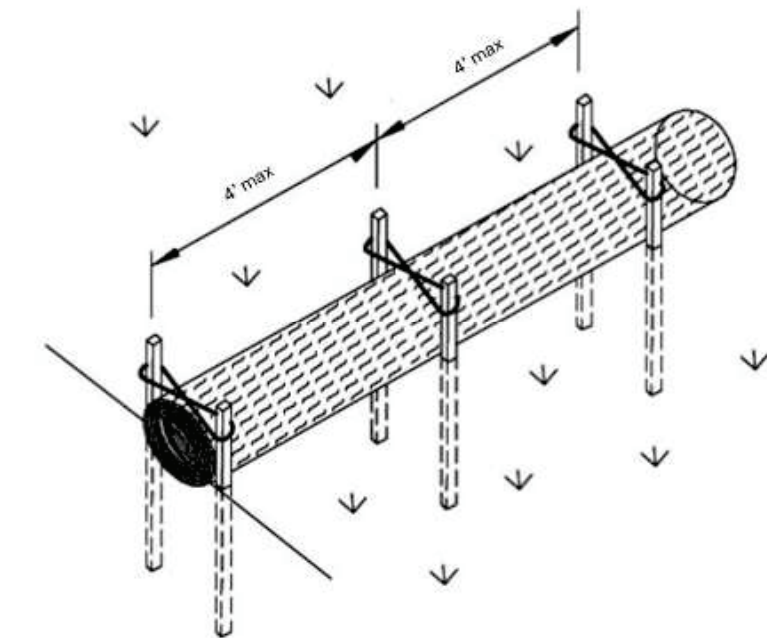
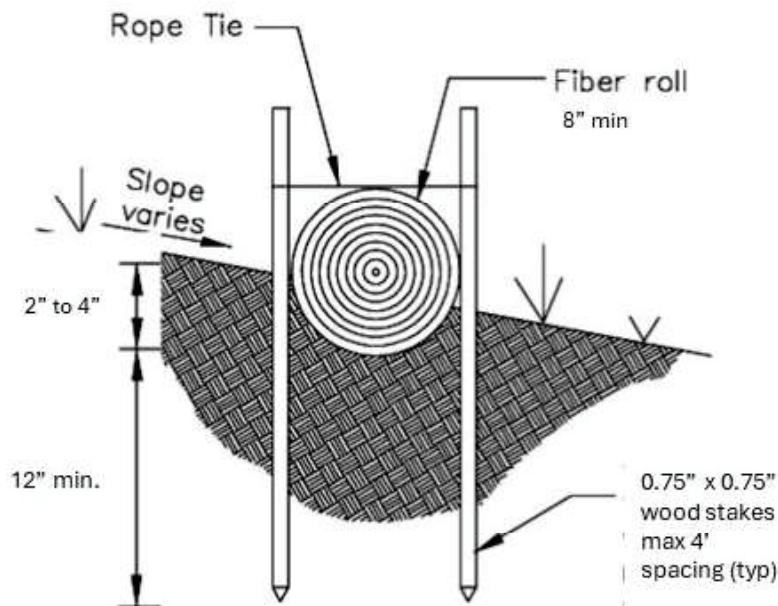
TYPICAL FIBER ROLL INSTALLATION

N.T.S.



ENTRENCHMENT DETAIL

N.T.S.



OPTIONAL ENTRENCHMENT DETAIL

N.T.S.

Reference: Construction Site Best Management Practices (BMPs) Manual, CTSW-RT-24-425-11.1, Section 4, Fiber Rolls SC-5, California Department of Transportation (Caltrans), March 2024.