Eastern Washington Erosion Prevention and Sediment Control Field Guide

Acknowledgements

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The following field guides were consulted during the development of this document:

- **Kentucky Erosion Prevention and Sediment Control Field Guide**
  Contact: Barry Tonning
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- **Idaho Construction Site Erosion and Sediment Control Field Guide**
  Contact: Joan Meitl
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- **Colorado Department of Transportation Erosion Control and Stormwater Quality Field Guide**
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Front cover image sources (clockwise from the top): WSDOT, WSDOT, Asotin County, City of Pullman.

Back cover image source: URS Corporation.

Preface

This Field Guide provides a quick handy guide for individuals involved in land disturbing activities, such as clearing, grading, and/or excavation work. Homebuilders, general contractors, road builders, installers of best management practices (BMPs), planners, designers, plan reviewers, and inspectors will benefit from using this field guide.

The Field Guide is based on the Washington State Department of Ecology (Ecology) Stormwater Management Manual for Eastern Washington (Stormwater Manual), September 2004. The Field Guide covers the most commonly used erosion and sediment control practices at construction sites. Some details were omitted to maintain a small format. Consult the Stormwater Manual for details on planning, design, and construction. Consult the Washington State Department of Transportation (WSDOT) 2008 Highway Runoff Manual (HRM), Standard Plans, and Standard Specifications for details related to highway and road construction. Links to these documents are provided in Section 12.

This Field Guide may be obtained from your local jurisdiction, Asotin County, or the Washington Stormwater Center.

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Introduction

This Field Guide is divided into several sections that take you through the construction erosion and sediment control process. The guide begins with pre-project planning and operational activities. The remainder of the guide discusses erosion prevention and sediment control by starting at the top of the hill, above the project site, and proceeding down the slope through the bare soil area, ditches and channels, traps and basins, and to the waterways below. The figure on Page viii summarizes this approach.

The Field Guide provides general guidance for installing and maintaining erosion and sediment control BMPs commonly used at construction sites. For quick reference:

- Installation schematics are provided based on Ecology and WSDOT standard plans.
- Photos have been included to illustrate good/bad BMP installations and maintenance practices.
- Troubleshooting tips along with common solutions are listed for most BMPs.

Note: Detailed design plan/drawings take precedence over the details in this Field Guide. The Field Guide is not intended for specification use where a design is not available. A professional should always be consulted.

As a companion to the "Top to Bottom" approach used in this guide for presenting erosion and sediment control practices, the following matrix organizes various BMPs based on the following general categories:

- Erosion Control
- Sediment Control
- Runoff Control
- Good Housekeeping/Materials Management

Intended as a quick reference tool, the matrix presents the Field Guide page number and corresponding Stormwater Manual and WSDOT HRM BMP number for each of the BMPs.

Ecology maintains a current list of technologies that have been deemed "functionally equivalent" to specific BMPs listed in the Stormwater Manual. For more details, visit the link provided in Section 12.

BMP Cat.	BMP Name	Guide Page	SWMMEW BMP No.[1]	HRM BMP
Erosion Control	Blankets	4-7, 8-2	C122E	6A-2.3
	Mulching	4-3	C121	6A-2.2
	Seeding	4-1	C120E	6A-2.1
	Sodding	4-7	C124E	6A-2.8
	Soil Binders	4-5	C126E	6A-2.5
	Streambank Stabilization	10-2	[3]	[3]
	Surface Roughening	6-2	C130E	6A-2.16
	Tackifiers	4-3	C126E	6A-2.2
	Vegetated Buffer/ Strip	3-7, 10-1	C10E C234E	6A-2.24
Sediment Control	Compost Sock	5-7	[3]	6A-2.26
	Sediment Trap	9-1	C240E	6A-2.31
	Sediment Pond	9-3	C241E	6A-2.32
	Silt Fence	5-1	C233E	6A-2.27
	Stabilized Const. Entrance/Exit	2-3	C105E	6A-2.12
	Wattles	5-11	C235E	6A-2.25
	Wheel Wash	2-3	C106E	6A-2.13

[1] Washington State Department of Ecology, (2019). Stormwater Manual.

[2] WSDOT, (2008). HRM, M 31-16.01.

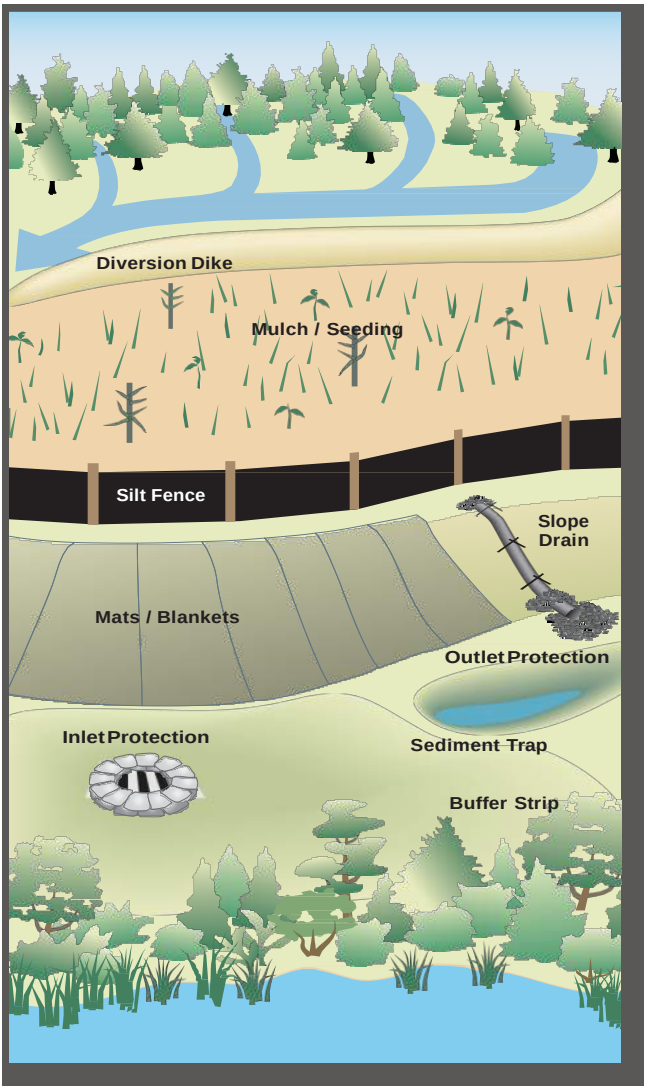
[3] No equivalent BMP is available.

BMP Cat.	BMP Name	Guide Page No.	SWMMEW BMP No.[1]	HRM BMP No.[2]
Runoff Control	Check Dams	8-3	C207E	6A-2.21
	Construction SW Chem. Treatment	11-12	C250E	2A-2.35
	Construction SW Filtration	11-12	C251E	2A-2.36
	Dewatering	11-12	Ch. 7[3]	Ch. 6[3]
	Gradient Terraces	6-4	C131E	Ch. 6[3]
	Interceptor Dike & Swale	3-1	C200E	6A-2.19
	Pipe Slope Drains	3-6	C204E	6A-2.17
	Storm Drain Inlet Protection	7-1	C220E	6A-2.30
	Outlet Protection	7-7	C209E	6A-2.23
Good Housekeeping/ Materials Management	Concrete Washout Area	11-7	C145E	6A-2.33
	Dust Control	11-10	C140E	6A-2.15
	High Visibility Fence	2-2	C103E	6A-2.11
	Material Storage	11-2	Ch. 8[3]	Ch. 6[3]
	Stockpile Management	11-3	Ch. 8[3]	Ch. 6[3]
	Street Cleaning	11-10	Ch. 8[3]	Ch. 6[3]
	Waste Management	11-5	Ch. 8[3]	Ch. 6[3]

[1] Washington State Department of Ecology, (2019). Stormwater Manual.

[2] WSDOT, (2008). HRM, M 31-16.01.

[3] No equivalent BMP is available.



Typical uses and locations for erosion prevention and sediment control BMPs.
(Source: Idaho Construction Site Erosion and Sediment Control Field Guide)

Why Do We Need to Control Erosion and Sediment Losses from Construction Activities?

Remember that stormwater, treated or not, washes into our local waters or conveyance systems leading to those waters, including lakes, rivers, ponds, streams, inland waters, and all other surface waters and water courses within the jurisdiction of the state of Washington.

Sediment laden water can kill or weaken fish and other organisms, and ruin wildlife habitat. When installed correctly, construction site BMPs minimize soil erosion which prevents sediment and the pollution it carries from entering local waters.

How to Keep Our Waters Clean

Six basic rules for preventing common erosion and sediment problems:

1. Minimize disturbance of existing vegetation.
2. Schedule construction activities during dry weather.
3. Protect exposed soil.
4. Avoid concentrating water – if necessary, slow it down and spread it out.
5. Encourage water infiltration, where applicable.
6. Inspect and maintain erosion and sediment controls, as required.

Maintain Your BMPs!

Erosion prevention and sediment control practices must be maintained in effective operating condition at all times. BMPs must be inspected for effectiveness once per week and within 24 hours of a discharge from the site. All BMPs have an expiration date; when BMPs fail, they must be repaired as soon as possible, immediately in most cases, to minimize the discharge of pollutants. Properly maintained BMPs are more economical and effective than measures completed to correct damage.

Section 1—Pre-Construction Planning

Pre-planning your construction project helps minimize project costs associated with controlling erosion and sediment loss to nearby waterways. Follow the steps below before you begin clearing, grading, and/or excavation work.

Apply for Construction Stormwater Permit (File Notice of Intent with Ecology)

Operators of the following construction activities that discharge stormwater to surface waters of the State[1] are required to seek coverage under the ***Construction Stormwater General Permit*** (Construction Permit):

1. Clearing, grading, and/or excavation that disturbs one or more acres of land;
2. Clearing, grading, and/or excavation on sites smaller than one acre that are part of a larger common plan of development or sale that will ultimately disturb one or more acres of land;
3. Forest practices (including, but not limited to, class IV conversions) that are part of a construction activity that disturbs one or more acres; or
4. Any size construction activity that Ecology determines to be a significant contributor of pollutants or reasonably expects to cause a violation of any water quality standard.

A Notice of Intent (NOI) Form must be submitted to Ecology at least 60 days prior to the discharge of stormwater from the construction site. Visit the links provided in Section 12 for more information.

Local stormwater permits may also be required. Check with the local jurisdiction for any additional or specific requirements.

1) Surface waters of the State include lakes, rivers, ponds, streams, inland waters, salt waters, and all other surface waters and water courses within the jurisdiction of the state of Washington.

Construction site operators may qualify for an ***Erosivity Waiver*** from the Construction Permit if allowed by the local jurisdiction and the conditions stated in S2.C of the permit are met. Verify that an Erosivity Waiver is allowed by the local jurisdiction before submitting an Erosivity Waiver Certification Form and commencing any land disturbing activities. See Appendix A (***Erosivity Waiver Criteria***) for further information.

Assess Soils & Slopes on the Construction Site

The need for erosion and sediment controls may vary based on the soils and slopes found throughout your construction site. If your site has highly erodible soils and steep slopes, you need maximum erosion and sediment control protection. Soil type and slope data for your site can be accessed using the interactive map tools provided through the USDA Natural Resources Conservation Service (NRCS) Web Soil Survey (WSS). To access the interactive map, see the link provided in Section 12.

Identify Nearby Streams and Drainage Control Points

Walk over the site and find where ditches or other concentrated flows leave the site, or enter on-site wetlands or other surface waters of the State. These are the final sediment ***control points***. Sediment traps or ponds should be installed just above these control points. Low spots—where rainwater collects—are good places for sediment traps (see Section 9).

Your site may drain to an underground stormwater system. In this case, the storm drain inlets that drain runoff from your site are the control points and must be protected (see Section 7). These are also the compliance points for any permits issued for the site.

In addition to walking the site, aerial photographs and topographic data can be used to identify upland areas that may contribute runoff to your project site as well as any downstream risks that may impact how erosion and sediment control is addressed on or below the project site.

Preserve Existing Vegetation Wherever Possible

Only dig or grade where necessary. Existing trees, bushes, and grass help keep erosion to a minimum. Protect large trees by marking off a no-dig root protection zone that is twice as large as the outer perimeter of the branches. Plan your project to limit the amount of bare soil area exposed to the weather, and limit the amount of exposure time. ***Do not clear vegetation or excavate areas near streams, rivers, lakes, or wetlands without getting the required federal, state, and/or local permits!***

Design Projects to Fit the Lay of the Land

Identify natural landscape features you want to keep, mature vegetation, wildflower areas, grasslands, streams, and wetlands. Plan ways to fit your project around these features, so they remain in place after construction is completed. ***Be sure to mark off these areas with colored ribbon or high visibility fencing and warn equipment operators of their location!***

Minimize Impervious Surfaces and Promote Infiltration in Project Design

Keep the amount of roof area, parking lots, driveways, and roads to a minimum. Design these hard surfaces so that stormwater runoff is directed onto pervious surfaces such as landscaped or yard areas and not into ditches or streams. For example, roads can be designed with curb inlets that direct runoff to adjacent infiltration swales or with porous pavement to promote groundwater recharge.

Develop a Stormwater Site Plan

A Stormwater Site Plan contains all of the technical information and analysis necessary for regulatory agencies to evaluate a proposed new development or redevelopment project for compliance with stormwater requirements. Contents of the Stormwater Site Plan will vary with the type and size of the project, individual site characteristics, and special requirements of the local jurisdiction. Guidance for preparing a Stormwater Site Plan is provided in Chapter 3 of the Stormwater Manual.

Develop a Stormwater Pollution Prevention Plan (SWPPP)

Projects meeting the regulatory threshold and not qualifying for an Erosivity Waiver shall prepare an adequate SWPPP for construction activities. The SWPPP shall be implemented beginning with initial soil disturbance and continuing until final site stabilization. A Certified Erosion and Sediment Control Lead (CESCL) must be identified in the SWPPP and shall be on site or on-call at all times. A SWPPP shall include a narrative and map explaining the pollution prevention decisions made for the project site and where and when the various BMPs will be installed. Each of the 13 Elements listed below shall be included in the SWPPP and must be implemented unless site conditions render the element unnecessary and the exemption is clearly justified in the SWPPP:

1. Preserve Vegetation/Mark Clearing Limits
2. Establish Construction Access
3. Control Flow Rates
4. Install Sediment Controls
5. Stabilize Soils
6. Protect Slopes
7. Protect Drain Inlets
8. Stabilize Channels and Outlets
9. Control Pollutants
10. Control De-Watering
11. Maintain BMPs
12. Manage the Project
13. Protect LID BMPs

More information regarding SWPPP content, as well as a SWPPP template, is available on Ecology's website, see Section 12.

Projects that qualify for an Erosivity Waiver from the Construction Permit may still be required to develop and implement a SWPPP for construction activities if an Erosivity Waiver is not allowed by the local jurisdiction. Check with the local jurisdiction for additional information.

Section 2—Construction Phase Operations

Construction sites may be divided into natural drainage areas, allowing each to be handled individually. Control erosion on bare soil areas by re-establishing vegetation and minimizing the time bare soil is exposed to the weather. Control sediment by installing sediment traps and slowing the flow of sediment laden water. Control points for sediment in runoff will be where concentrated flow leaves the site or enters on-site wetlands or other surface waters of the State.

Install Erosion and Sediment Controls

Install the following erosion and sediment control BMPs before clearing, grading, or excavation work begins (if applicable to the project site):

- Establish clearing limits/high visibility fence
- Stabilized construction entrance
- Clean water interceptor dikes, swales, and pipe slope drains
- Sediment control barriers
- Stormwater inlet and outlet protection devices
- Stabilize drainage channels with liners and check dams
- Sediment traps/ponds

Phase Your Construction Work to Minimize Exposed Soil Areas

Excavate or place fill material at the site in stages, to avoid exposing large areas of bare soil to the elements. Establish final grade quickly, then seed, mulch, or cover bare soil. Require utilities and subcontractors to grade their work sites and seed, mulch, or cover excavated areas promptly. Require subcontractors to sign a form assuring compliance with your SWPPP (or other plans required by the local jurisdiction) if their work is covered under your permit.

If work will proceed over several weeks or months, apply temporary seeding, mulch, or other effective BMPs to prevent erosion until final site stabilization is completed. Depending on the geographic location of the project, no

soils are to remain exposed and unworked for more than the time periods below:

East of the Cascades Crest, Excluding the Central Basin*

During the dry season (July 1 – Sept. 30): 10 days
During the wet season (Oct. 1 – June 30): 5 days

The Central Basin*

During the dry season (July 1 – Sept. 30): 30 days
During the wet season (Oct. 1 – June 30): 15 days

*Note: The Central Basin is defined as those portions of Eastern Washington with mean annual precipitation of less than 12 inches (see Figure 4.1 in the SWMMEW).

Excavation and grading work should be conducted during dry weather if possible. Prepare for rainy weather forecasts by making sure sediment controls are in place and that seed and mulch or grass is established on bare areas that are at final grade.

Access to Plans and Records

Operators are required to retain permit documentation (plans and records) on-site, or within reasonable access to the site, for use by the operator or on-site review by Ecology or the local jurisdiction.

Required on-site documentation includes: (1) permit coverage letter; (2) Construction Permit; (3) Site Log Book; and (4) SWPPP. Construction site operators are encouraged to post a sign near the main entrance of the site with a copy of the permit coverage letter; on-site location of the SWPPP, Site Log Book, and Construction Permit; and contact information for the project CESCL.

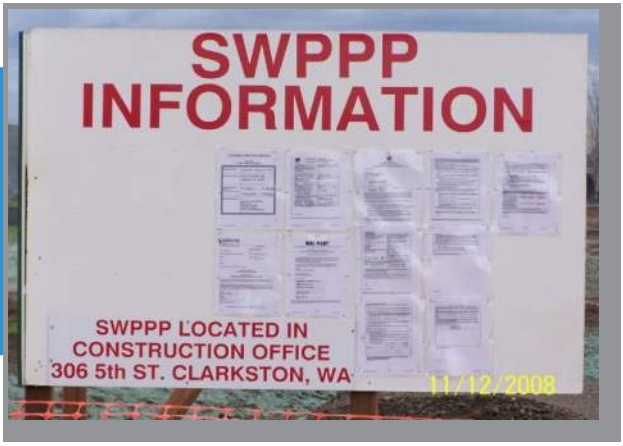
High Visibility Fencing

High visibility orange fencing shall be used throughout the construction site to:

- Restrict clearing to approved limits;
- Prevent disturbance of sensitive areas, their buffers, and other areas required to be left undisturbed;
- Limit construction traffic to designated construction entrances or roads; and
- Protect areas where marking with survey tape may not provide adequate protection.

Installation:

- Fence shall be at least four feet high.
- Wood or steel posts shall be placed every 6 feet on center (maximum).
- High-density polyethylene orange fence shall be fastened to the post every six inches.



Example of on-site posting of SWPPP information.
(Source: Asotin County)

Construction Entrances/Exits

A rock construction exit can reduce the amount of sediment transported onto paved roads by vehicles by dislodging mud from vehicle tires.

Installation:

- Limit construction site access to one route, if possible.
- Pads should be a minimum of 15 feet wide and at least 100 feet long and composed of 4- to 8-inch quarry spalls at a thickness of at least 12 inches (see schematic on page 2-6).
- Do not use crushed concrete for construction entrances. Runoff passing through crushed concrete will have high pH and cannot be discharged.
- Install a 6 to 8 oz. nonwoven construction geotextile under the quarry spalls to separate the rock from the underlying soil.
- Install a wheel wash if the stabilized entrance is not effective in preventing track out.

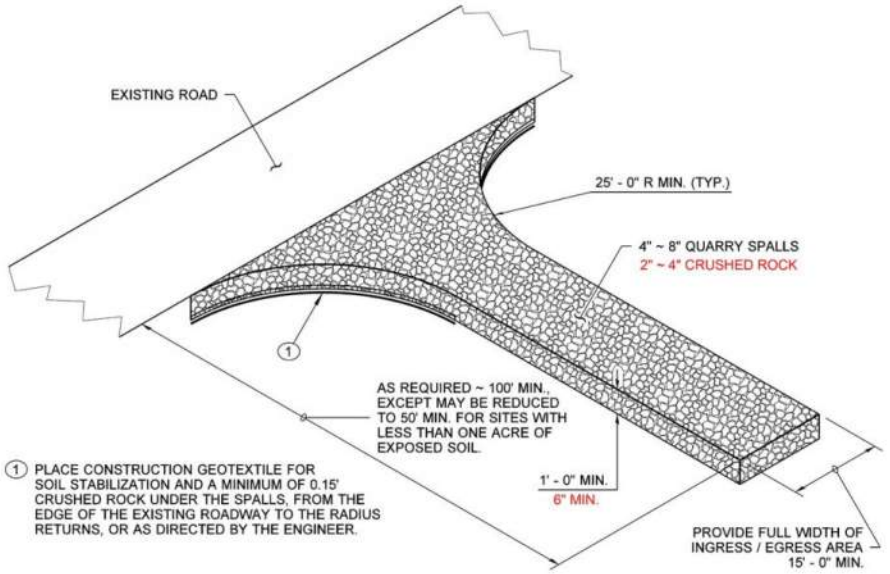
Inspect construction exits daily and after storm events for evidence of track out. Remove tracked dirt from all off-site paved surfaces at the end of each day, or more frequently as necessary (for example, during wet weather). Pavement should not be washed down using water.

An excellent example of a properly installed construction entrance.
(Source: Asotin County)

Good installation of a construction entrance, but sediment is still being tracked off-site. Add more rock or make entrance longer.
(Source: Douglas County)

Troubleshooting Tips

Condition	Common Solution
Dirt tracking from the site.	Increase length of stabilized exit or install a wheel wash. Conduct street sweeping.
Vehicles are leaving the site from other locations and not using the designated construction exit.	Designate access points and require all employees, subcontractors, and others to use them. Fence or barricade other access points.
Aggregate needs to be replaced or replenished.	Rake rock with a grubbing attachment or replace material if the pad fills with sediment.
Aggregate material is being incorporated into soil.	Install geotextile under base material.
Runoff leaving the site.	Grade construction entrance/ exit points to prevent runoff from leaving the construction site.



Stabilized construction entrance.
(Source: WSDOT Standard Plan I-80.10-01, Revised)
Redtext denotes guidance for BMP C105 as stated in Ecology's Stormwater Manual.

Section 3—Diverting Upland Runoff Around Exposed Soils

Keep clean upland runoff from flowing through your construction site. Clean water diversions, such as interceptor dikes, swales, or pipe slope drains, are designed to intercept and divert upland runoff around bare soil areas in order to reduce erosion and sedimentation problems.

Interceptor Dikes

An interceptor dike is a long, mounded "collar" of compacted soil located uphill from the excavated areas. The dike is designed to intercept overland runoff and direct it around the construction site. This prevents "clean" water from becoming muddied with soil from the construction site. Dikes can be temporary or permanent landscape features of the site. See Section 8 for stabilization approaches.

Installation:

- Dikes should be sized to convey the peak flow from a 6-month, 3-hour storm event.
- Sub-basin tributary area should be 1 acre or less.
- Dikes should be a minimum of 1.5 feet tall, with 2H:1V side slopes or flatter, and a 2-foot minimum top width.
- Compact dikes to 90% American Society for Testing and Materials (ASTM) D698 standard proctor.
- Dike channels with slopes of < 5% should have seed and mulch applied within 5 days of construction.
- Dike channels with slopes of 5% to 40% should be stabilized immediately using sod, erosion control blankets, quarry spalls, or other measures.
- If slopes are greater than 40% use pipe slope drains to convey runoff.
- Check dams may be installed to reduce the velocity of concentrated runoff.
- Extend the downhill end of the dike so it directs runoff to areas of thick vegetation or flat surfaces to promote dispersal and infiltration.
- Install outlet protection as needed (see Section 7).

Interceptor dike illustration.
(Source: Kentucky Erosion Prevention and Sediment Control Field Guide)

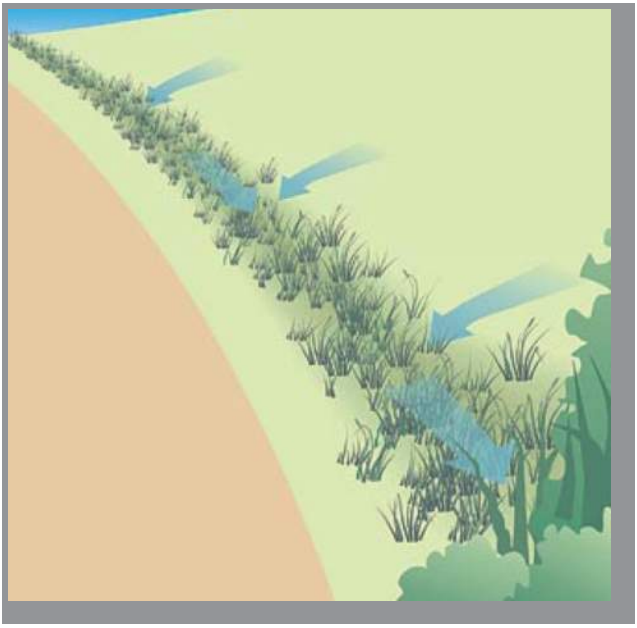
Interceptor Swales

Interceptor swales are similar to dikes—they are designed to intercept and divert upland runoff around bare soil areas. Swales are cut above cleared or fill areas and designed with a gentle slope to carry water away from work areas. Stabilized, lined swales can also be used to route clean upland water through the site. These "pass through" swales should be constructed and lined before general clearing or grading work begins. See Section 8 for stabilization approaches.

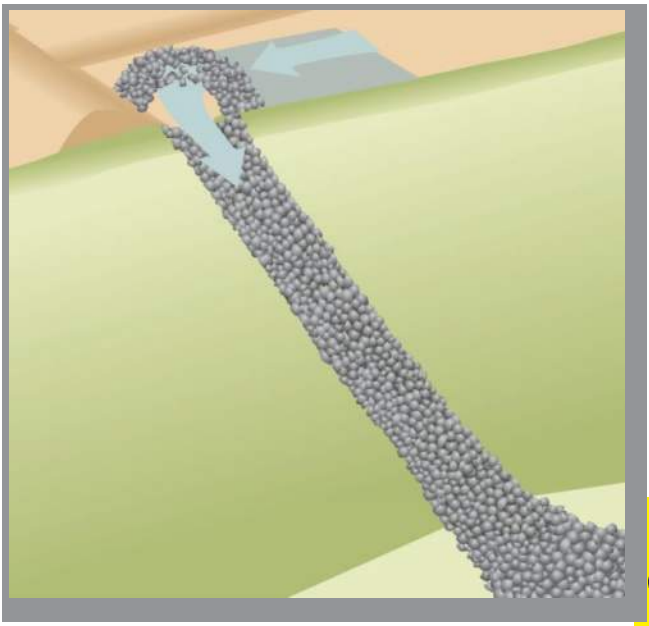
Installation:

- Swales should be sized to convey the peak flow from a 6-month, 3-hour storm event.
- Sub-basin tributary area should be 1 acre or less.
- Swales should have a 2-foot minimum bottom width, with 2H:1V side slopes or flatter, and a 1-foot minimum depth.
- Swales with slopes of < 5% should have seed and mulch applied within 5 days of construction.
- Swales with slopes of 5% to 40% should be stabilized immediately using sod, erosion control blankets, quarry spalls, or other measures.

- If slopes are greater than 40% use pipe slope drains to convey runoff.
- Check dams may be installed to reduce the velocity of concentrated runoff.
- Extend the downhill end of the swale so it directs runoff to areas of thick vegetation or flat surfaces to promote dispersal and infiltration.
- Install outlet protection as needed (see Section 7).



Vegetated interceptor swale.
(Source: Kentucky Erosion Prevention and Sediment Control Field Guide)



Rock lined interceptor swale. *Be sure to install a non-woven geotextile between the rock and ground surface.*
(Source: Idaho Construction Site Erosion and Sediment Control Field Guide)

Good example of a rock lined interceptor swale.
(Source: Peter Vaughn, A3E Consultants)

Interceptor Dike and Swale
Troubleshooting Tips

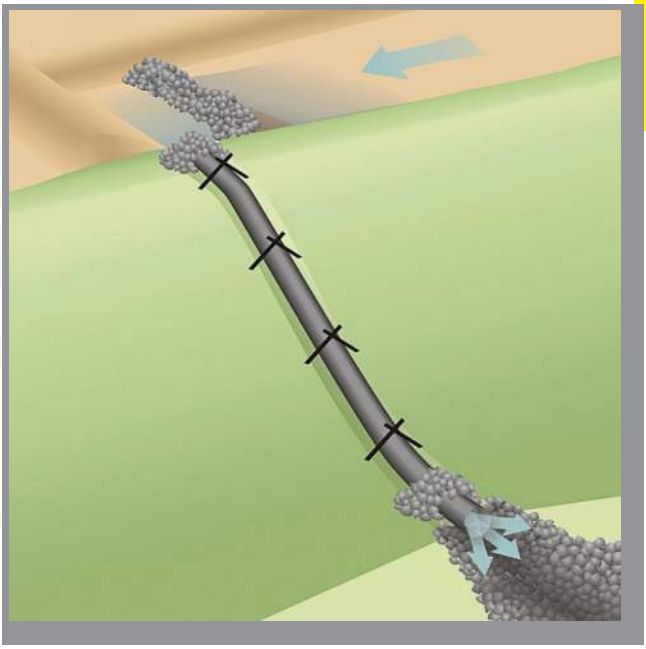
Condition	Common Solution
Dike washes out after rain event.	Make sure soil is properly compacted. Provide proper soil stabilization depending on slope.
Outlet area eroded.	Stabilize outlet according to Section 7.
Swales eroded due to high velocity flows.	Line swales with more suitable stabilization materials. Place riprap or line swale with blankets or plastics. Add check dams upstream.
Swales filled up with sediment.	Remove sediment. Stabilize upstream contributing areas.
Swales are overtaken by flows.	Re-evaluate design parameters or consider installing additional swales or dikes to breakup contributing areas.
Ponding within swale. Poor vegetative cover.	Verify design slope and regrade. Re-establish grass. Spot seeding can be done on small areas to fill in bare spots where grass did not grow properly. If the seeded area is damaged due to runoff, additional stormwater measures such as check dams or matting may be needed.
Accumulated debris.	Remove and dispose of properly.
Scour and erosion occurring.	Immediately make repairs and revegetate.

Pipe Slope Drains

Pipe slope drains should be used when a temporary or permanent stormwater conveyance is needed to move water down a steep slope in order to avoid erosion. Use interceptor dikes or swales to collect upland runoff and pipe slope drains to convey the water downhill.

Installation:

- Temporary drains should be sized to convey the peak flow from a 6-month, 3-hour storm event.
- Permanent drains should be sized to convey the peak flow from a 25-year, 24-hour storm event.
- The inlet should have a standard flared end section with watertight connecting bands.
- Slope drain sections should be securely fastened together, fused, or have gasketed watertight fittings, and should be securely anchored into the soil using "t" posts or equivalent. Anchors should be fitted with orange safety caps.
- Both the inlet and outlet should be properly stabilized to prevent erosion (see Section 7).



Pipe slope drain.
(Source: Idaho Construction Site Erosion and Sediment Control Field Guide)

Pipe Slope Drains
Troubleshooting Tips

Condition	Common Solution
The piping does not stay in place.	Secure the pipe every 10 to 20 feet with steel "t" posts and wire. Use thrust blocks anytime 90 degree bends are utilized.
Erosion occurs around inlet and outlet.	Regrade soil and thoroughly compact. Prevent source material movement with additional BMPs such as, flared end sections or lining with geotextile and rock.
Pipe becomes clogged.	Flush out pipe. Place a screen or grate at inlet to capture large materials. Identify source of material and consider additional BMPs.
Excessive sediment accumulates around inlet/ outlet.	Remove accumulated sediment and stabilize upstream area.
Pipe slope drain overtops.	Limit drainage area and flow velocity. Check pipe diameter to ensure that it is sized properly to accept flow. Add additional pipes as necessary.

Vegetated Buffers

Grass, shrubs, trees, and other vegetation located above or below excavated areas should be preserved if possible. Vegetation above construction sites prevents high volume sheet runoff flows from moving across cut or fill areas. Vegetation below the construction site helps filter and trap sediment before it can move into ditches, channels, and streams. All vegetated areas help to promote infiltration of stormwater, which is a key objective in preventing erosion and controlling sediment movement off the construction site.

Section 4—Protecting Soils with Seed, Mulch, or Other Products

Covering bare soil with seed and mulch, sod, blankets, or other products as soon as possible is the most cost effective way to prevent erosion. Established vegetation can reduce erosion by more than 90 percent (see table below).

Soil Cover Requirements

Bare soil in excavated or fill areas must be seeded, mulched, or covered immediately after final grading work is completed. If work will proceed over several weeks or months, apply temporary seeding and mulch, or other effective BMPs to prevent erosion until final grade work is completed. Seed, mulch, or cover bare soil areas within the time periods specified in Section 2.

Soil Cover vs. Erosion Reduction

Soil Covering	Immediate Erosion Reduction	Long-Term Erosion Reduction
Erosion control blankets	95% – 99%	
Grass (seed or sod)	(From Sod)	(From Seed)
Bushes and shrubs 25% cover 75% cover		 60% 72%
Trees 25% cover 75% cover		 58% 64%

(Source: Kentucky Erosion Prevention and Sediment Control Field Guide, Revised)

Seeding

A well-established vegetative cover is one of the most effective methods of reducing erosion. Seeding is not an immediate stabilization method; seeding must always be accompanied with mulch, blankets, or other products until vegetation is established.

Eastern Washington Seeding Window

Recommendation	Date [1]
Optimum	October 1 – November 15
Acceptable	September 1 – April 30
Not Recommended	May 1 – August 31 (unless irrigated)

[1] Consult with the local County Extension Service for the optimal seeding windows in your area.

Temporary and permanent seed mixes and application rates can be found in Section 7.3.2 of the Stormwater Manual (see BMP C120). Tables for permanent seed mixes are presented based on mean annual precipitation for a particular site. Check with the local jurisdiction for approved, alternative seed mixes. In addition, local suppliers or your local County Extension Service may be consulted.

Installation:

- Stockpile topsoil and spread over site prior to seeding.
- Prepare bare soil for planting by disking across slopes, scarifying, or tilling if soil has been sealed or crusted over by rain. Seedbed should be dry with loose soil to a depth of 4 to 6 inches.
- Fertilize or amend poor soils as needed.
- For slopes steeper than 4H:1V (or if compaction is required for engineering purposes), walk bulldozer or other tracked vehicle up and down slopes before seeding to create tread-track depressions for catching and holding seeds.
- Apply seed by hand, seed spreader, drill, or hydroseed.
- Hydroseed applications shall include a minimum of 1,500 lbs. per acre of mulch with 3% tackifier.
- Apply mulch, erosion control blankets, or other products to protect seed from heat, moisture loss, and transport due to runoff.
- On slopes less than 2H:1V, apply mulch on top of the seed or simultaneously by hydroseeding. For slopes steeper than 2H:1V, cover seed with blankets or other products.
- Water seeded areas during dry conditions to ensure seed germination and early growth. Re-seed areas that do not show growth within 14 days after rain or watering.

- Protect bare areas during the cold season by sowing winter rye, winter wheat, and mulching. Sow permanent seed when the weather permits.

Mulch Types and Application

Mulching is an erosion control practice required for all seeded areas. Mulch provides temporary stabilization of slopes and exposed areas.

Installation:

- Bring site to final grade and clear rocks, wood, trash, and other debris.
- Refer to the table on page 4-4 for common mulch products and application rates.
- Apply mulch uniformly across surface so that at least 80% to 90% of the ground is covered.
- Tackifier is recommended to hold the mulch in place, preventing material loss due to wind and runoff.

Bonded fiber matrices are hydraulically applied products containing a mix of tackifiers, mulch fibers, and seed, which provides a stable crust that cements soil particles and prevents erosion. Apply seed prior to bonded fiber matrices, if seed is not included in the mix. Consult the manufacturer's installation instructions for product applicability and installation details.

Mulch Tackifier

Applying tackifier over recently installed mulch will hold mulch in place and minimize mulch loss due to erosion from runoff and wind.

Installation:

- Mulch tackifier should be applied within 4 hours of mulch applications.
- Tackifier should be plant-based (such as guar or alpha plantago) or chemical-based (such as polyacrylamide or polymers) and applied according to manufacturer's instructions.
- Tackifiers are water-soluble and must be reapplied 6 to 12 months after initial application if plants have not germinated and stabilized the soil.
- Do not apply during rain events, high winds, or over snow.

Mulch Types and Application

Mulch Product	Application Rate	Benefits	Limitations
Wood chips, bark, and sawdust	2-inch minimum thickness	Very low cost in some locations; can use chips produced from removed vegetation; chips effective on slopes up to 35%.	High nitrogen demand when decomposing; may float away or blow away during rain storms.
Hydraulic mulches and tackifiers	Approx. 25 to 30 lbs per 1,000 sf or 1,500 to 2,000 lbs per acre	Easily and rapidly applied with sprayer equipment; can include seed, fertilizer, and tackifiers; many new products available.	May be too expensive for small or very remote sites; must dry for at least 24 hours before rainfall.
Compost	2-inch minimum thickness; approx. 100 tons per acre	Adds nutrients to the soil; readily available and inexpensive in some locations; can be applied by blower or hand/mechanical spreading.	Limited erosion control effectiveness; not suitable for steep slopes; may be expensive in some areas.

(Source: Stormwater Manual and Kentucky Erosion Prevention and Sediment Control Field Guide, revised)

Soil Binders

Soil binders, also known as chemical stabilizers, provide temporary soil stabilization. Soil binders are sprayed onto the surface of exposed soils to hold the soil in place and minimize erosion from runoff and wind. Soil binders are used to temporarily stabilize soils in stockpiles, berms, or when slopes cannot be seeded due to seasonal constraints. These materials can stabilize areas where vegetation cannot be established and provide immediate protection.

Installation:

- Prepare soil before applying the binder so that the binder adheres to and penetrates the soil surface. The untreated surface must be roughened (see Section 6) and must contain sufficient moisture for the binder to achieve uniform penetration. See manufacturer soil moisture recommendations for soil types and product mixtures.
- Binding agents can be sprayed over the slope with water or mixed with hydromulch or hydroseed. Follow manufacturer recommendations regarding mixing and application.
- Do not allow these products to enter a water body.
- Soil binders require a minimum curing time before becoming fully effective; therefore, binders should not be applied during or immediately before rainfall.
- Do not use in areas with equipment or vehicular traffic. Once the surface is broken, the soil binder must be reapplied.

Polyacrylamide (PAM) is a type of soil binder used on construction sites to prevent soil erosion. More information about PAM varieties, application rates, and maintenance can be found in Section 7.3.2 of the Stormwater Manual (BMP C126).

Seed, Mulch, and Soil Binder Troubleshooting Tips

Condition	Common Solution
Slope was improperly dressed before application.	Roughen areas first by rolling with crimping or punching type roller or by track walking. Reapply soil stabilization BMPs.
Coverage is inadequate.	Fill in or remove rills and re-apply where necessary following recommended application rates.
Soil binder allowed inadequate drying time or washed off slope.	Re-apply where necessary. Allow at least 24 hours for the material to dry before a rain event.
Portions of the mulch have been disturbed.	Keep workers and equipment off mulched areas and repair damaged areas. Use fencing if needed.
Seeds fail to germinate.	Verify that seed is appropriate for your area and reapply. Apply mulch to keep seeds in place and to moderate soil moisture and temperature. Temporary irrigation may be necessary.
Seeded slope fails.	Fill in rills and re-seed. Combine with erosion control blankets or mats.
Seeding is washed off slope.	Re-apply where necessary and mulch.
Excessive water flows across stabilized surface.	Utilize additional BMPs to disperse/minimize flow on stabilized areas and/or reduce slope lengths.
Sprayed areas degrade or become ineffective.	Reapply binder or consider alternate BMPs such as seed and mulch.
Sprayed slope has spot failures.	Repair slopes and re-spray damaged areas.

Condition	Common Solution
Binder fails to penetrate soil.	Roughen soil and pre-wet to manufacturer's recommendations. Re-apply to areas where necessary.
Mulch blows away.	Anchor straw mulch in place by applying a tackifier, crimping, punching, or track walking. May need to use a different BMP.

Sod Application

Sod provides immediate erosion protection and can remove sediment and pollutants by filtering runoff. To install, bring soil to final grade and clear of trash, wood, rock, and other debris. Amend soil as needed by incorporating 4 inches of compost (minimum) into the top 8 inches of soil. Fertilize according to the supplier's recommendations.

Install sod within 36 hours of cutting. Lay sod in straight lines. Butt joints tightly, but do not overlap joints or stretch sod. Stagger joints in adjacent rows in a brickwork type pattern. Use torn or uneven pieces on the end of the row. Notch sod into existing grass.

Anchor sod with pins or stakes if placed on slopes greater than 3H:1V. Roll or tamp sod after installation and water immediately. Soak to a depth of 4 to 6 inches. Replace sod that grows poorly. Do not cut or lay sod in extremely wet or cold weather. Do not mow regularly until sod is well established. Sodded areas may need to be irrigated to prevent the sod from dying out.

Erosion Control Blankets

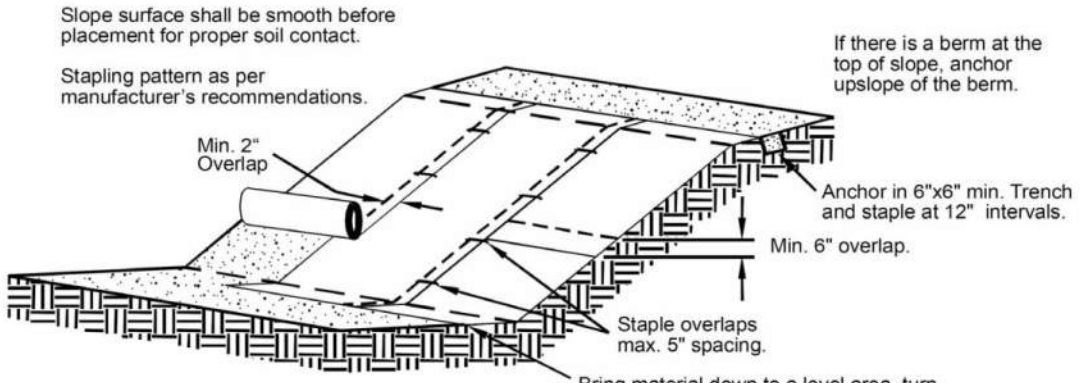
Erosion control blankets protect disturbed soil from raindrop and sheet erosion until permanent vegetation is established. Organic blankets made of jute, straw, wood shavings, or coconut fiber may last 6 months to 5 years, depending on the composition of the blanket and environmental conditions. Blankets are commonly used on slopes, but synthetic blankets (commonly referred to as turf reinforcement mats) may be used in ditches with considerable flow volumes/velocities.

Installation:

- Grade, disk, and prepare seedbed. Seed the area before blanket installation.
- For long slopes, install blankets up and down the slope face.
- For channels, install blankets parallel to flow of the channel, as per manufacturer's directions.
- Install the product starting from the top of the slope, anchored in a 6" x 6" trench that is backfilled and tamped firmly.
- Anchors/staples are "U" shaped and a minimum of 6 inches long. Longer staples are used in sandy soils.
- Walk blankets down slope to ensure good contact with the soil. Staple blankets every 12 inches on tops and 18 to 36 inches down the sides and in the middle or according to manufacturer's directions, whichever is more protective.
- Do not stretch blankets.
- Do not exceed manufacturer's directions on maximum slope angle for the product.
- Additional staking or stapling is needed for applications in channels that carry flowing water and on steep slopes. Inspect before and after each rain event and twice monthly until the tributary drainage area has been stabilized.

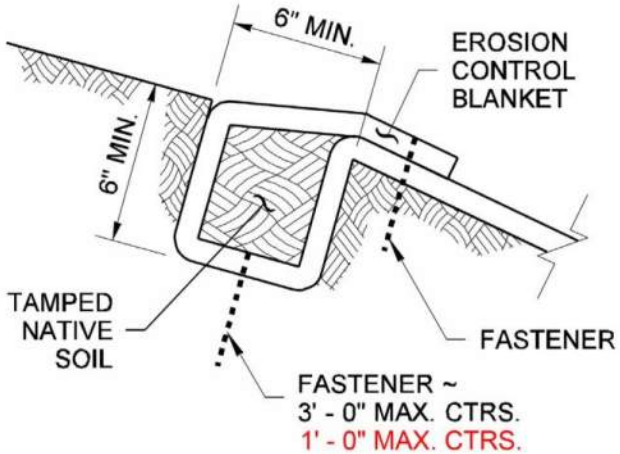
Erosion Control Blanket Troubleshooting Tips

Condition	Common Solution
Anchoring is failing. Undercutting occurring.	Dig trench along the top and bury the blankets. Use staples to anchor according to manufacturer's recommendations.
Undercutting due to inadequate preparation.	Repair the soil surface. Remove rocks, clods and other obstructions. Fill in rills in uneven areas to promote good contact between blanket and soil.
Excessive water flow across stabilized surface.	Use other BMPs to limit flow onto stabilized area or reduce slope length. See Berms, Dikes and Swales, Slope Tracking.
Undercutting occurs along the top of the slope.	Dig a trench along the top of the slope (6" x 6") and anchor blanket into trench by back filling and tamping the soil.
Blankets separate along the seams.	Overlap edges of blanket by 6 inches and staple every 3 feet, or according to manufacturer's directions.
Blankets separate where the rolls are attached end to end.	Shingle the blanket so that the top blanket overlaps the bottom blanket by 6 inches and staple through the overlapped areas every 12 inches.
Blanket does not make complete contact with the soil surface.	Prepare the soil surface by removing rocks, clods, sticks and vegetation; fill in uneven areas.

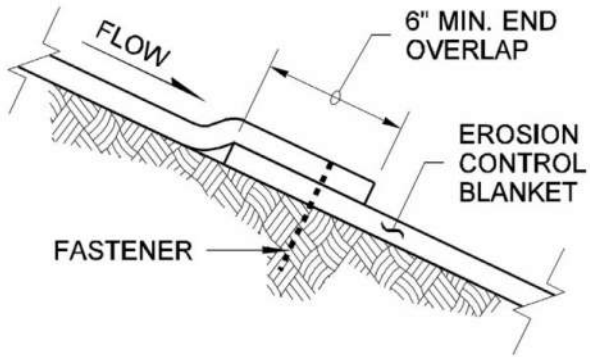


NOTE: For WSDOT projects, utilize WSDOT Standard Plan I-60.10-00

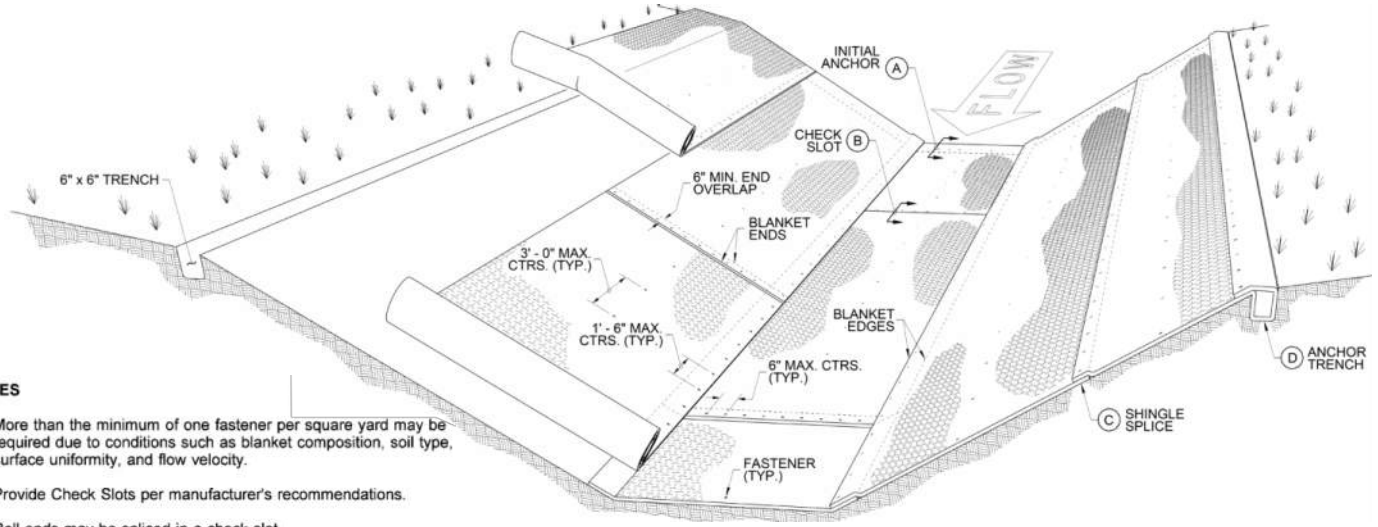
Slope installation—erosion control blanket.
(Source: Ecology 2004 Stormwater Manual)



Slope and channel installation—erosion control blanket anchor trench.
(Source: WSDOT Standard Plan I-60.10-00 and I-60.20-00, Revised)
Redtextdenotes guidancefor BMP C122as statedinEcology'sStormwaterManual.



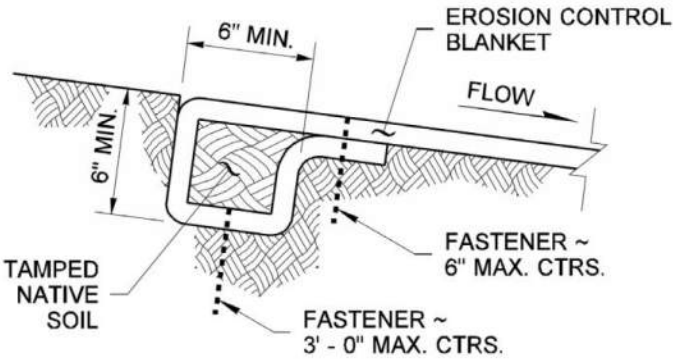
Slope and channel installation—erosion control blanket shingle splice.
(Source: WSDOT Standard Plan I-60.10-00 and I-60.20-00)



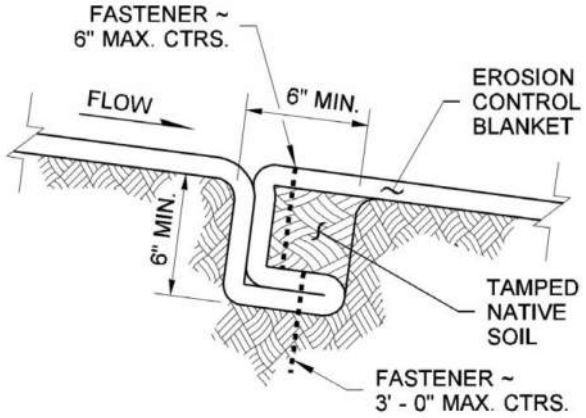
NOTES

1. More than the minimum of one fastener per square yard may be required due to conditions such as blanket composition, soil type, surface uniformity, and flow velocity.
2. Provide Check Slots per manufacturer's recommendations.
3. Roll ends may be spliced in a check slot.
4. See Standard Specification 8-01.3(3).
5. Stapling pattern should follow manufacturers recommendations.

Channel installation—erosion control blanket.
(Source: WSDOT Standard Plan I-60.20-00, Revised)
Red text denotes guidance for BMP C122 as stated in Ecology's Stormwater Manual.



Channel installation—erosion control blanket initial anchor.
(Source: WSDOT Standard Plan I-60.20-00)



Channel installation—erosion control blanket check slot.
(Source: WSDOT Standard Plan I-60.20-00)

Cellular Confinement Systems

Cellular confinement systems are strips of high density polyethylene arranged in a honeycomb configuration used to hold native or fill materials in place. Common uses are soil retention, slope erosion control, channel wall protection, and load support. They are typically used for ground stabilization on slopes, channels, stream crossings, construction entrance/exit/roadways, or vegetated retaining walls. Unless identified in the construction drawings as a permanent feature, use of cellular confinement systems as a temporary construction site BMP is not recommended due to high cost and installation and removal effort.

Example installation of cellular confinement system.
(Source: TerraGraphics Environmental Engineering, Inc., via Peter Vaughn, A3E Consultants)

Section 5—Installing Silt Fence and Other Sediment Barriers

Use sediment barriers along the face and at grade breaks of exposed and erodible slopes. They can also be used as controls along the property boundary and to protect storm drains, drywells, and water bodies. Maintenance of sediment barriers is critical to their success. Inspect them regularly for evidence of bypassing water or damage and remove captured sediment when the depth reaches 1/3 the height of the barrier.

Local jurisdiction specifications and installation requirements may differ from those provided in this section.

Sediment Barrier Placement

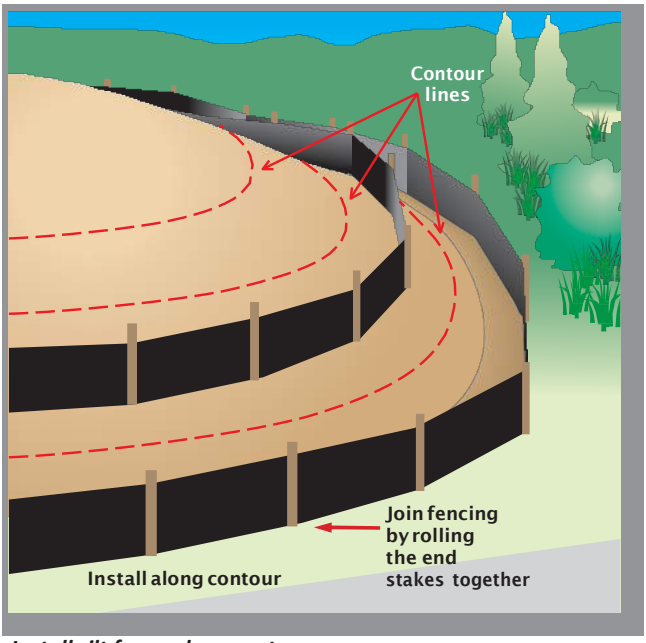
Sediment barriers—silt fences, compost socks, etc.—are recommended below (downhill from) areas of bare soil. ***Hay or straw bales should not be used as sediment barriers due to their inherent weakness and tendency to fall apart.*** There are several factors to consider in placing silt fences, compost socks, or other commercially available sediment barriers:

- Place filters on downhill edge of bare soil areas.
- Make sure the barrier catches all the muddy runoff.
- The goal is to pond runoff, allowing sediment to settle out.
- Place barriers across slopes, on the contour (level).
- Install multiple sediment barriers on long slopes.

Silt Fence Installation

A silt fence is a temporary linear barrier that captures sediment by ponding stormwater runoff, allowing sediment to settle out. Silt fence can be used along slopes, below exposed soil areas, and around temporary stockpiles. In general, each 100-foot section of silt fence treats runoff from approximately 1/4 acre (about 100 feet uphill). To install a silt fence, follow these basic steps:

- Note the location and extent of the bare soil area.
- Mark silt fence location just below bare soil area.
- Make sure fence will catch all flows from area.
- Dig trench a minimum of 4 inches wide and deep across slope.



Install silt fence along contours.
(Source:IdahoConstructionSiteErosionandSedimentControlFieldGuide)

- Unroll silt fence along trench.
- Push geotextile into trench; spread along bottom and sides (see installation detail on page 5-4).
- Drive posts on downhill side a maximum of 6 feet apart.
- Secure silt fence to posts with staples, wire, or as recommended by manufacturer.
- If needed, join fencing by rolling the end posts together (see splice detail on page 5-4).
- Do not place joined sections in low spots or sump locations.
- Fill trench with soil and tamp down.

Additional installation tips:

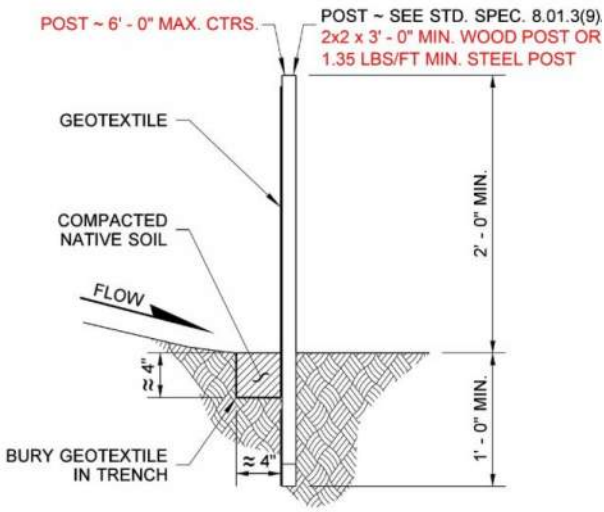
- The geotextile used for the silt fence should comply with Ecology and WSDOT specifications (see the table on page 5-3).
- Silt fences should be installed on the contour below bare soil area. Use multiple fences on long slopes. The maximum flow path length to the fence shall be 100 feet.

- Fence should be installed with at least a 3-foot setback from the toe of slope where possible.
- For silt fences treating high flows from steep slopes, reinforce the silt fence with woven wire and metal fence posts. Install wire fencing between the posts and the geotextile, so pressure on the geotextile from uphill flows is distributed across the wire fencing, then to the posts.
- Turn ends of fence uphill one full panel (~ 6 feet) to prevent runoff from flowing around fence.
- Install J-hooks (or check dams) where runoff flows along silt fence to pond muddy water (see figure on page 5-5).
- Silt fencing should not be installed in ditches, channels, or streams.
- Inspect prior to and after rain events, and at least daily during prolonged rainfall.

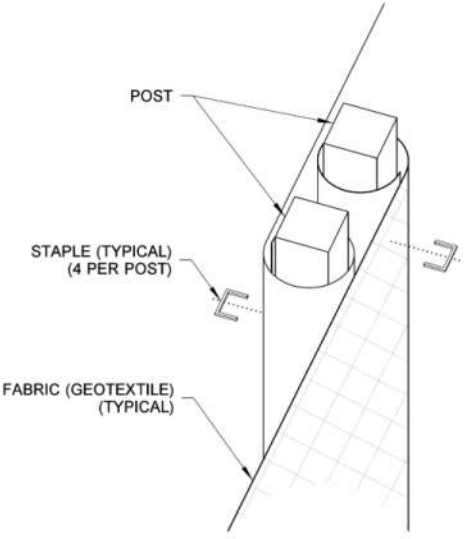
Silt Fence Geotextile Property Requirements

Geotextile Property	Requirements
Apparent Opening Size (AOS)	0.60 mm (No. 30) max. for silt wovens 0.30 mm (No. 50) max. for all other geotextile types 0.15 mm (No. 100) min. for all geotextile types
Water Permittivity	0.02 sec^{-1} min.
Grab Tensile Strength	180 lbs. min. for extra strength geotextile 100 lbs. min. for standard strength geotextile
Grab Failure Strain	30% max.
Ultraviolet Resistance	70% min.

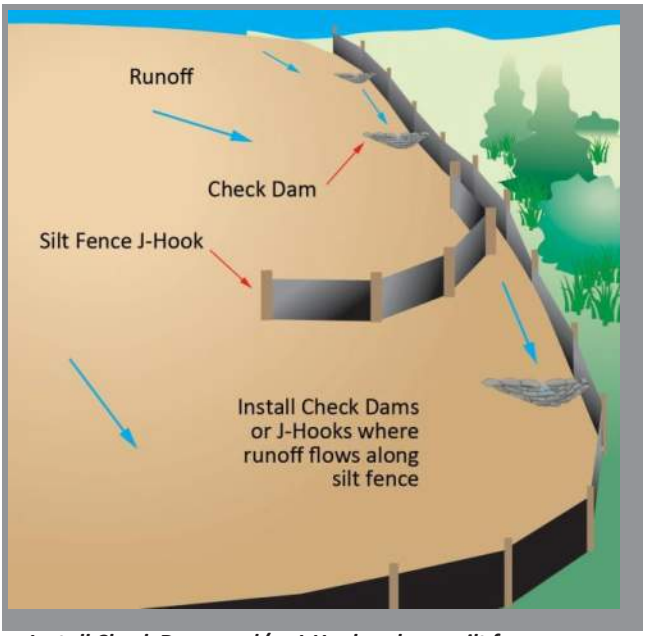
(Source: 2019 SWMMEW and 2008 WSDOT HRM)



Cross-section of a properly installed silt fence.
(Source: WSDOT Standard Plan I-30.15-00, Revised)
Red text denotes guidance for BMP C233 as stated in Ecology's Stormwater Manual.



Spliced fence sections should be close enough together to prevent silt laden water from escaping through the fence at the overlap. *Joined sections should not be placed in low spots.*
(Source: WSDOT, Standard Plan I-30.15-00)



Install Check Dams and/or J-Hooks when a silt fence crosses contours and runoff flows along the fence. *See Section 8 for check dam installation procedures.*
(Source: Idaho Construction Site Erosion and Sediment Control Field Guide, Revised)

Properly installed silt fence using steel posts and wire mesh backing.
(Source: URS Corporation)

Silt fence is installed backwards; posts should be on downhill side.
(Source: City of Wenatchee)

Silt Fence
Troubleshooting Tips

Condition	Common Solution
Excessive sediment accumulation.	Remove accumulated sediment before it reaches 1/3 of the distance up the fence. Apply erosion controls upslope to reduce sediment in runoff.
Flow undermining fence.	Trench, place geotextile, and backfill.
Lack of sufficient ponding area.	Fence should be installed with at least a 3-foot setback from the toe of slope where possible.
Erosion occurs around barrier ends or runoff escaping around end.	Extend fence and turn ends up-slope.
Slope draining to fence is too steep.	Increase setback of silt fence away from the toe of slope. Shorten slope length using wattles or equivalent.
Fence is installed in concentrated flow area.	Replace fence with check dams.

Condition	Common Solution
Posts are too far apart and geotextile is sagging.	Posts should be a maximum of 6 feet apart. Install additional posts as needed.
Posts broken or bent over. Potential damage to silt fence.	Replace fence stakes. If required, repair/replace fencing material and re-stake fences that are damaged.

Silt Fence Slicing Devices

Tractor-mounted equipment that "slices" silt fence into the ground can provide a better installation than the open trench method. The equipment uses a chisel-point or vibratory plow to create a narrow slit in the ground. Rolled silt fencing is pushed into the slit, creating a very tight seal that prevents water from blowing out the bottom of the fence. Posts are driven and attached to the fence after the fencing is sliced in. Besides better performance, the slicing method is typically faster than open trenching.

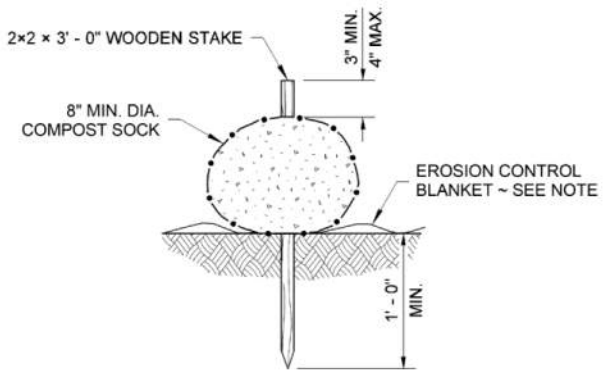
Compost Sock Installation

Compost socks can be used as an alternative to silt fencing and also work well to protect storm drain inlets (see Section 7). They function by intercepting runoff, reducing runoff flow velocity, ponding runoff, allowing sediment to settle out, and releasing the runoff as sheet flow. An advantage to using compost socks is that they have a minimal disposal cost; at the end of the project the compost can be incorporated into the surrounding soil.

Installation:

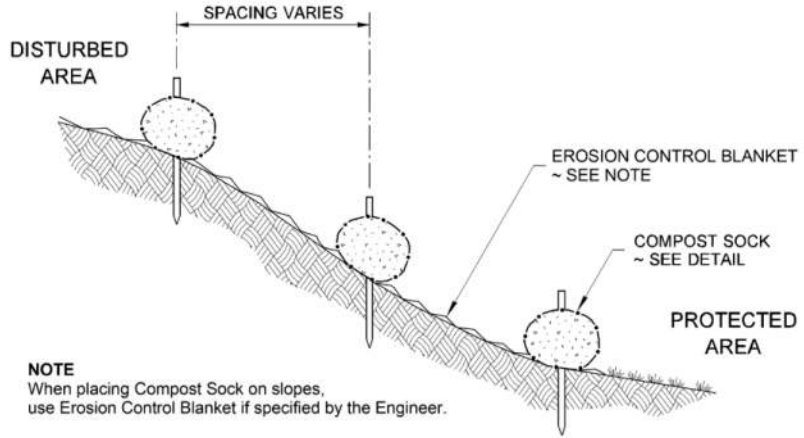
- Install along contours starting at the toe of the slope, or slightly away from the toe, and every 3 to 30 feet along the slope depending on the steepness of the slope, soil type, and rainfall. The steeper the slope the closer together the compost socks should be.
- Compost socks shall ***not*** be used on slopes greater than 2H:1V.
- ***Use only cured or finished compost.***

- Compost socks shall be filled so they are firmly packed yet flexible. Once placed on the ground, apply temporary weight to the sock to improve contact with the underlying surface. This may cause the sock to assume an oval shape.
- Install stakes at each end of a compost sock, and at 3-foot centers along the entire length. If required, install pilot holes through the compost sock and into the soil prior to installing stakes. Stakes should be installed perpendicular to the ground surface and on a slight angle alternating left to right. The stakes at angle prevent the sock from lifting or floating during the first rain event.
- Wooden stakes should be 2" x 2" x 36" minimum. Willow cuttings or 3/4 inch rebar can also be used as stakes.
- If more than one compost sock is installed in a row, tightly abut end to end the two adjoining socks.
- Turn ends of compost socks uphill to prevent water from flowing around the barrier.

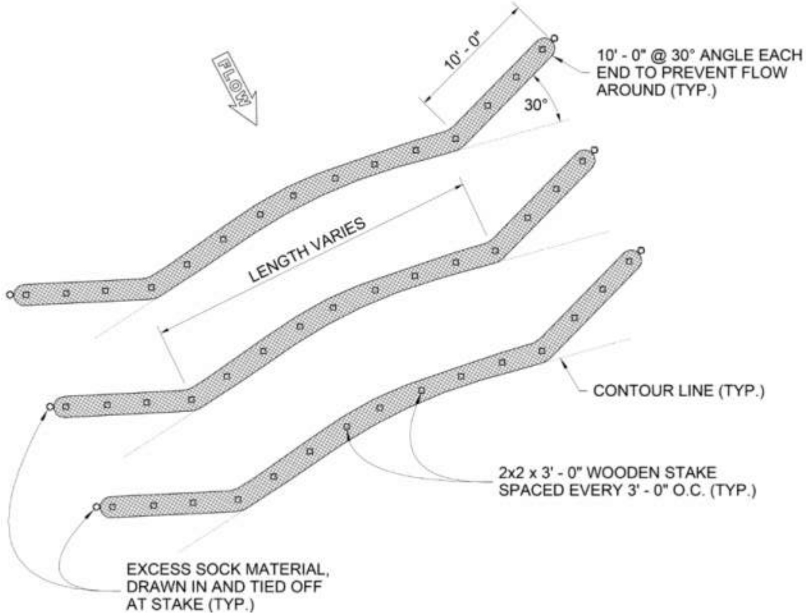


NOTE
When placing Compost Sock on slopes, use Erosion Control Blanket if specified by the Engineer.

Typical compost sock detail.
(Source: WSDOT, Standard Plan I-30.40-00, Revised)



Extended compost sock detail.
(Source: WSDOT, Standard Plan I-30.40-00, Revised)



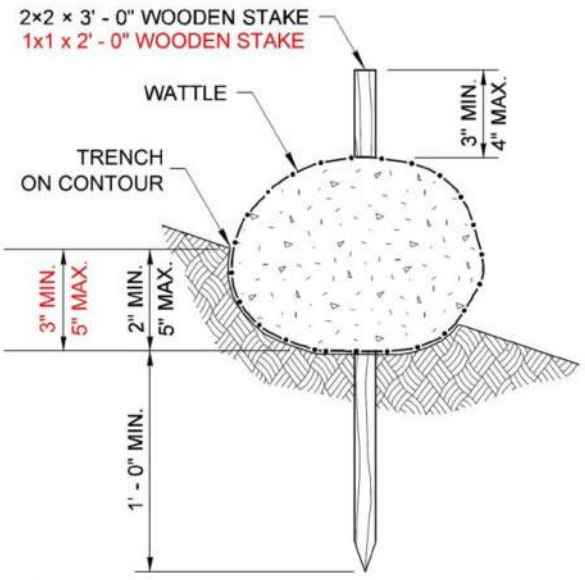
Compost sock plan view.
(Source: WSDOT, Standard Plan I-30.40-00)

Wattles

Wattles are another alternative to silt fencing and consist of straw, coconut husk, rice straw, or a similar material packed and placed into rolls. They are typically 8 to 10 inches in diameter and 25 to 30 feet in length. They function by intercepting runoff, reducing runoff flow velocity, removing sediment from runoff, and releasing the runoff as sheet flow.

Installation:

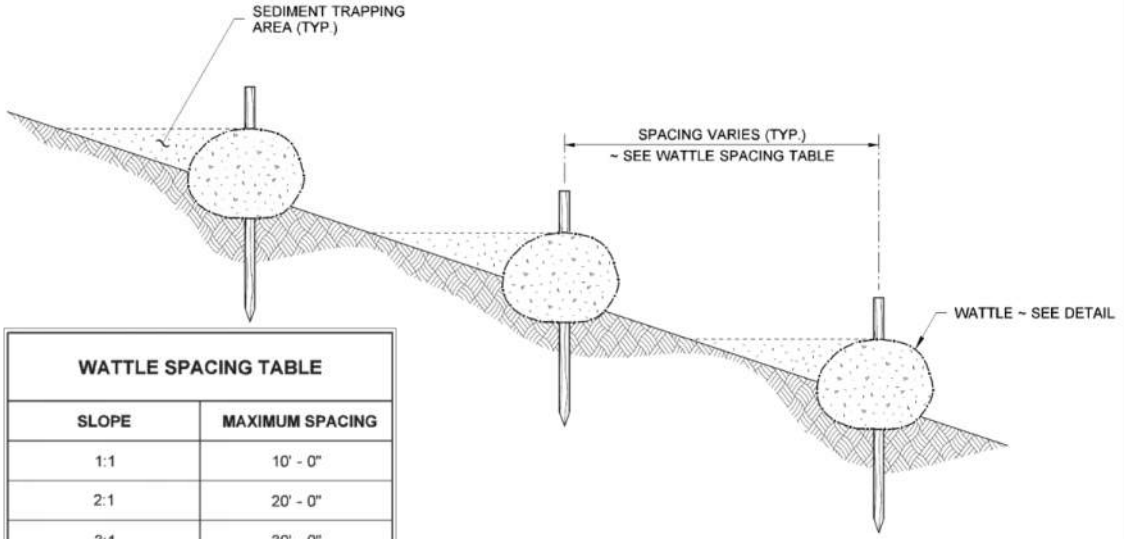
- Install along contours starting at the toe of the slope, or slightly away from the toe, and every 10 to 40 feet along the slope depending on the steepness of the slope, soil type, and rainfall. The steeper the slope, the closer together the wattles should be.
- Install the wattles snugly into a 3- to 5-inch deep trench, or 1/2 to 2/3 of the thickness of the wattle.
- If more than one wattle is installed in a row, tightly abut end to end the two adjoining wattles.
- Install stakes at each end of a wattle, and at 4-foot centers along the entire length. If required, install pilot holes through the wattle and into the soil prior to installing stakes. Stakes should be installed perpendicular to the ground surface and on a slight angle alternating left to right. The stakes at angle prevent the wattle from lifting or floating during the first rain event.
- Wooden stakes should be 1” x 1” x 24” minimum. Willow cuttings or 3/8 inch rebar can also be used as stakes.
- Turn ends of wattles uphill to prevent water from flowing around the barrier.



NOTE
Stakes should be installed perpendicular to the ground surface and on a slight angle alternating left to right. The stakes at angle prevent the wattle from lifting or floating during the first rain event.

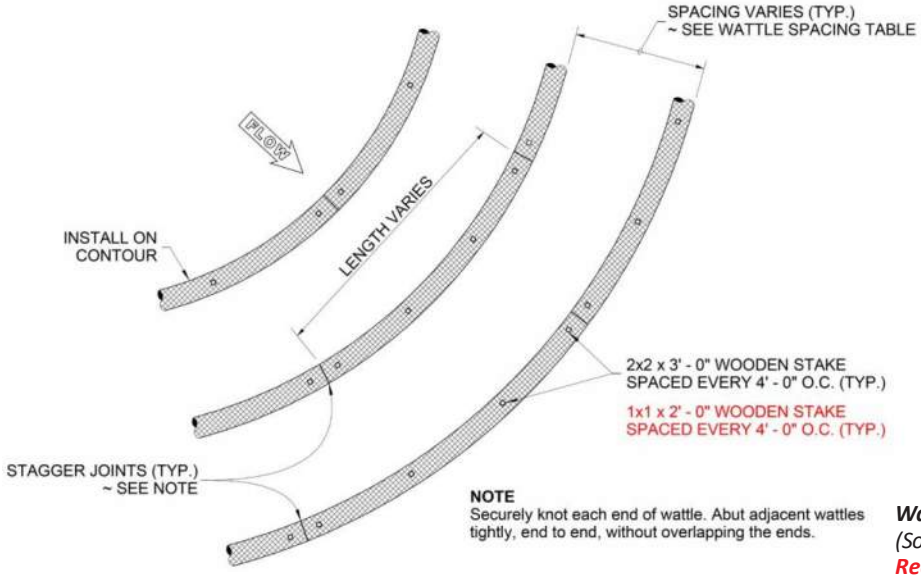
Typical wattle detail.
(Source: WSDOT, Standard Plan I-30.30-00, Revised)
Red text denotes guidance for BMP C235 as stated in Ecology's Stormwater Manual.

Good example of properly installed wattles.
(Source: WSDOT)



WATTLE SPACING TABLE	
SLOPE	MAXIMUM SPACING
1:1	10' - 0"
2:1	20' - 0"
3:1	30' - 0"
4:1	40' - 0"

Extended wattle detail.
(Source: WSDOT, Standard Plan I-30.30-00)



Wattle plan view.
(Source: WSDOT, Standard Plan I-30.30-00, Revised)
Red text denotes guidance for BMP C235 as stated in Ecology's Stormwater Manual.

Compost Sock and Wattle

Troubleshooting Tips

Condition	Common Solution
Excessive sediment accumulation on upslope side of compost sock/wattle.	Remove accumulated sediment before it reaches 1/3 of the distance up the sock/wattle. Apply erosion controls upstream to reduce sediment in runoff.
Compost sock/wattle split, tear, unravel, or become ineffective.	Replace immediately.
Runoff flows along compost sock/wattle and discharges around end.	Make sure socks/wattles are placed on a contour and turn ends up-slope.
Runoff flows between compost socks/wattles.	Socks/wattles should be butted tightly together and staked.

Section 6—Protecting Slopes to Prevent Gullies

Slopes—especially steep and long slopes—must be protected to prevent sheet, rill, and gully erosion. Slopes must be stabilized immediately after grading work is completed. Seeding and mulching provide the best and least expensive protection. Erosion control blankets are needed on most slopes greater than 3H:1V (see Section 4).

Approximate Slope Conversions

Percent	Slope Ratio (H:V)	Degrees from Horizontal
100%	1:1	45°
50%	2:1	27°
33%	3:1	18°
25%	4:1	14°
10%	10:1	6°

Assessing Slopes and Soils

Steeper slopes (3H:1V or steeper) require more protection than flatter slopes. Slopes with highly erodible soils (silty soils) need more protection than those with less erodible soils (sands and gravels). Also, long slopes (greater than 50 feet) are at greater risk for erosion than short slopes.

Slope Protection Basics

Protecting slopes from erosion requires several actions that must be taken together. No single approach will be successful, especially if the slope is long, steep, or has highly erodible soils. Use one or more of the following actions to reduce erosion on slopes:

Divert Upland Runoff

Interceptor dikes, swales, and pipe slope drains are designed to intercept and divert clean upland runoff around bare soil areas in order to reduce erosion and sedimentation problems. See Section 3 for additional information.

Control Slope Runoff

Surface roughening or dozer tracks up and down slopes help hold soil in place and reduce runoff velocity. Breaking slopes into terraces also reduces slope lengths and erosion potential.

Seed and Mulch

Seed and mulch is the best and least expensive protection by far. See Section 4 for details on seeding, mulching types, and application.

Silt Fence or Other Barrier

Multiple silt fences can be used on long slopes to break up overland flow and protect the slope from erosion. However, compost socks and wattles are a less expensive alternative. See Section 5 for additional information.

Retaining Wall

Extremely steep slopes can be leveled out and shortened into two or more steps or benches by installing retaining walls of rock, brick, blocks, wood, logs, or other material. If rock layers are present along the slope, use these to establish firm benches in a stair-step pattern. Consult with a professional engineer or landscape architect for selection of appropriate materials and installation methods. Check with the local jurisdiction for specific requirements.

Blankets, Mats, or Armoring

Slopes exceeding 3H:1V with highly erodible soils must be protected with erosion control blankets or other products such as soil binders or bonded fiber matrices. Rock-lined, slope drain channels might be needed on steep slopes to control gullying. See Section 8 for additional information.

Surface Roughening

Surface roughening is used as a temporary BMP to reduce the speed of runoff, increase infiltration, reduce erosion, trap sediment, and prepare the soil for seeding and planting by capturing moisture for seed. This can be done using a serrated wing blade attached to the side of a bulldozer or by other agricultural equipment such as spike-toothed harrows. Surface roughening should be used in conjunction with BMPs such as mulching, seeding, or soil binders and should be done along the contour of slopes.

Excellent example of surface roughening along the contour of the slope.
(Source: Colorado DOT Erosion Control and Stormwater Quality Field Guide)

Slope Tracking

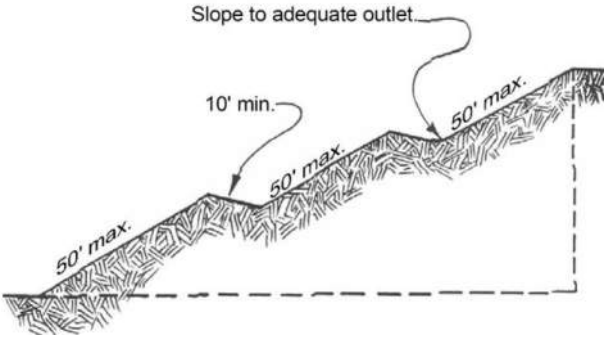
Slope tracking is an alternative to surface roughening when slopes are to remain compacted for engineering purposes. It is also suitable on areas that would otherwise be unfavorable for plant establishment. Slope tracking helps hold the soil in place, traps seed, and reduces runoff velocity. This can be done by operating tracked equipment up and down the face of the slope. Do not operate tracked equipment across the slope as this can increase erosion on slopes.

Tread-track slopes up and down hill to improve stability and reduce erosion.
(Source: WSDOT)

Slope tracking was performed laterally; tracking should run up and downhill.
(Source: City of Pullman)

Gradient Terraces

Gradient terraces reduce erosion damage by intercepting surface runoff and conducting it to a stable outlet at a non-erosive velocity. Terrace spacing is determined by slope, soil type, and soil cover. Each terrace channel should have enough capacity to handle the peak runoff expected from a 6-month, 3-hour storm event.



Gradient terracing. *Actual spacing to be determined by engineer.*
(Source: Ecology's Stormwater Manual)

Section 7—Protecting Inlets and Outlets

Culverts, ditches, and storm drains are designed to carry moderate to large amounts of stormwater. They also carry a lot of sediment to streams, rivers, wetlands, lakes, and sensitive areas if they are not properly protected. Culvert, ditches, and storm drain outlets can become severely eroded if fast concentrated stormwater flows are not controlled.

PondingMethods

Muddy runoff that flows toward a culvert, ditch, or storm drain inlet must be slowed down and pooled or filtered to settle out and remove sediment. This can be accomplished by placing rock, reinforced silt fencing, silt dikes, or other barriers in front of the inlet. The goal is to cause ponding of the inflow so sediment can settle out, and allow ponded water to enter the inlet only after sediment has been removed.

The next section describes several inlet protection devices. For all inlet protection approaches, seeding and mulching upland areas promptly will greatly reduce incoming runoff volumes and sediment loads.

Inlet Protection Devices

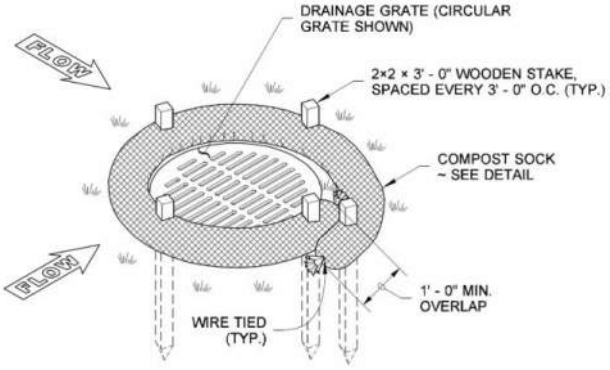
Storm drain inlet protection measures prevent soil and debris from entering storm drain inlets. Inlet protection is implemented at existing inlets prior to construction, and new inlets are protected as they are installed and brought on-line. Inlets can be protected with compost socks, concrete blocks with a gravel filter, reinforced silt fences, manufactured catch basin insert products, or other sediment control devices. Additional inlet protection devices and schematics are provided in the Stormwater Manual. ***Straw bales should not be used for inlet protection.***

Installation:

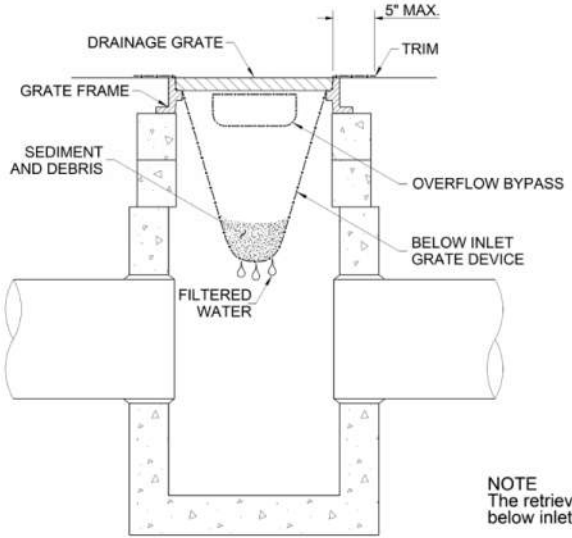
- Place materials to form a small dam around the inlet; countersink, if possible, to prevent undercutting.
- Build larger dams farther away from inlets with heavy incoming flows.

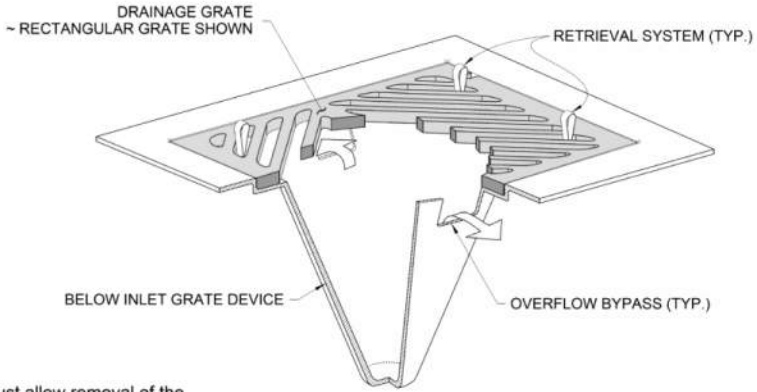
- When using rock, mix rock of various sizes so flows can seep through the dam slowly. If spaces between rocks are too large, runoff will move through the dam without adequate settling time.
- Ensure that inlet protection devices do not cause a safety hazard for pedestrians or vehicle traffic.
- Place removed sediment in areas where it will not wash into inlets or waterways.

Geotextile under inlets should not be used. *They can cause flooding and are difficult to remove when filled with sediment.*
(Source: Douglas County)



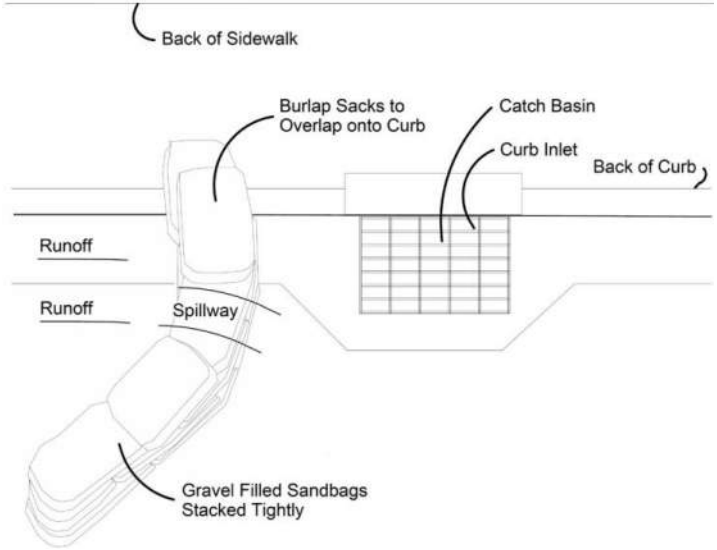
Compost sock installation.
(Source: WSDOT Standard Plan I-30.40-00)



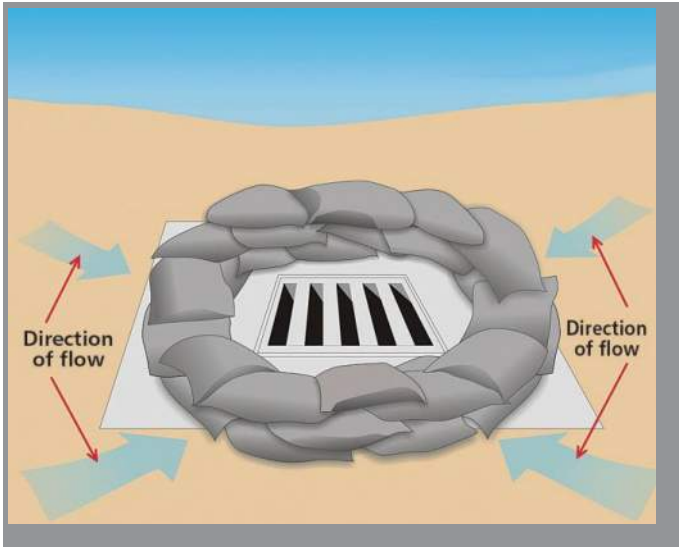


NOTE
The retrieval system must allow removal of the
below inlet grate device without spilling the collected material.

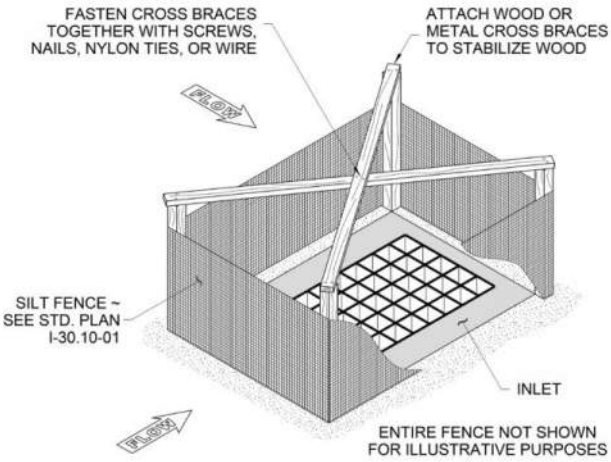
Below inlet grate device.
(Source: WSDOT, Standard Plan I-40.20-00)



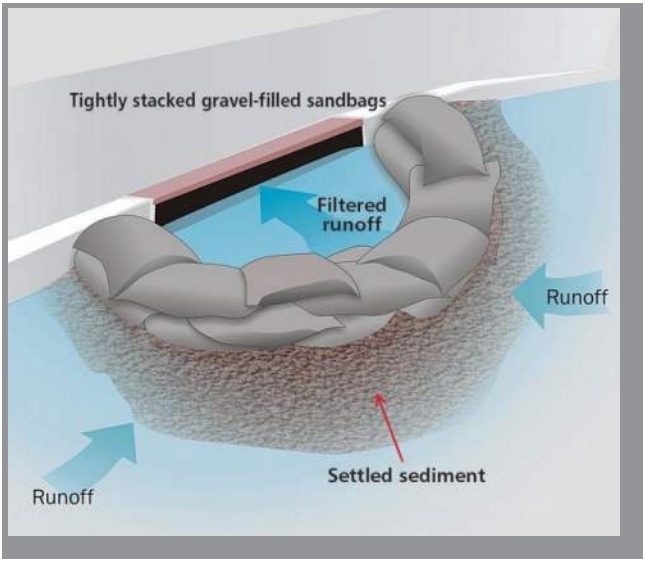
Use of gravel bags to protect acatch basin.
(Source: Stormwater Manual)



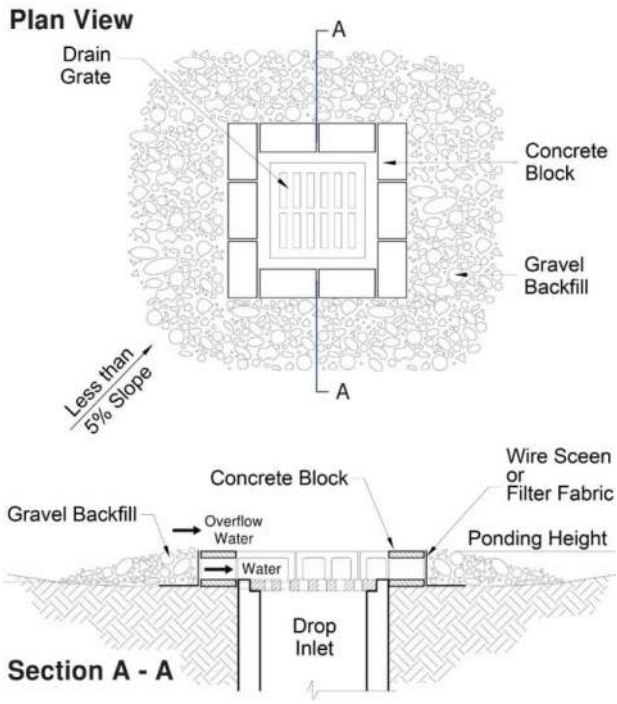
Use of gravel bags to protect a drop inlet.
(Source: Idaho Construction Site Erosion and Sediment Control Field Guide)



The use of a temporary silt fence can be an effective inlet protection option in unpaved areas. *Create an enclosure out of silt fence materials that surrounds the inlet. Use diagonal bracing on sides and/or top to protect against incoming flow pressures. Trench in the geotextile and securely fasten to posts.*
(Source: WSDOT Standard Plan I-40.10-00)



Stone-filled bag barriers are constructed by placing the bags around the inlet to create a holding area that allows suspended sediment to settle. Ensure bags are tightly abutted.
(Source: Idaho Construction Site Erosion and Sediment Control Field Guide)



Block and gravel filter installation.
(Source: Stormwater Manual)

Inlet Protection
Troubleshooting Tips

Condition	Common Solution
Excessive sediment accumulation behind protection device.	Remove accumulated sediment when it reaches 1/3 the barrier height or 1/3 the holding capacity. Repair bypasses and undercuts promptly.
Excessive sediment is entering the inlet.	Ensure that soil stabilization and sediment control devices are installed upstream of inlets. Ensure that the barriers around the inlet are installed correctly.
Sediment is bypassing silt fence used for inlet protection.	Repair/replace fencing material and re-stake fences that are damaged. Silt fence needs to be keyed in so that water goes through the geotextile and not under it.
Material from broken bags is entering inlet.	Clean out inlet. Remove broken bags and replace as necessary.
Ponded water causes a traffic concern.	Use alternative BMPs upstream. Try installing a manufactured catch basin insert.

Outlet Protection Methods

Outlet protection prevents scour and erosion at outlets by reducing the speed of stormwater flow. Outlet protection should be installed at the outlets of culverts, ditches, storm drains, piped slope drains, and any temporary channels that discharge into natural waterways or constructed channels. Quarry spall or riprap splash pads underlain by construction geotextile are the most common form of outlet protection. Permanent outlet protection splash pads should be designed by a Professional Engineer.

Installation:

- The rock-lined splash pad should be shaped like a long rectangle, with the width and length determined by the expected water velocity and pipe diameter.
- The type of rock material and thickness is also -determined by the water velocity. The table on page 7-10 provides information for sizing rock protection (splash pads) at outfalls.
- The splash pad must be straight (lined up with the discharging pipe or channel).
- Protect the slope around and above the pipe.

If the culvert outlet and receiving channel do not line up straight, the channel bank receiving the brunt of the outlet flow must be protected or it will quickly erode. Gabion baskets – galvanized wire mesh boxes filled with rock – are often used in this situation, and can be stacked to form a wall if necessary.

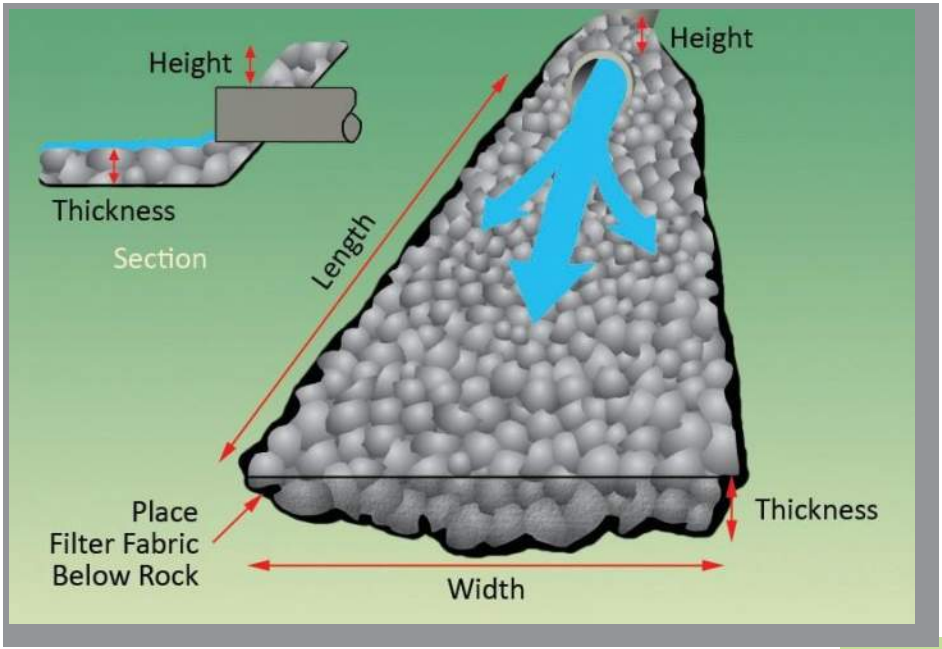
Outlet Protection
Troubleshooting Tips

Condition	Common Solution
Rock protection washes away.	Replace rock protection with larger diameter rock based on the discharge velocity. Consult an engineer for proper rock sizing.
Scour occurs at the end of the rock protection splash pad.	Increase length of rock protection splash pad or stabilize downstream channel with vegetation or synthetic blankets (turf reinforcement mats).

Rock Protection at Outfalls

Discharge Velocity (fps)		Required Protection (Minimum Dimensions)				
Greater than	Less than or equal to	Type	Thickness	Width	Length	Height above outlet
0	5	Quarry Spalls	1 foot	Pipe diameter + 6 feet	8 feet or 4 x pipe diameter, whichever is greater	Crown + 1 foot
5	10	Riprap	2 foot	Pipe diameter + 6 feet or 3 x pipe diameter, whichever is greater	12 feet or 4 x pipe diameter, whichever is greater	Crown + 1 foot
Greater than 10 fps: Consult a Professional Engineer						
Quarry Spalls shall have the following gradation: Passing 8-inch square sieve: 100% Passing 3-inch square sieve: 40% to 60% max. Passing ¾-inch square sieve: 0% to 10% max.						
Riprap shall be reasonably well graded with the following gradation: Maximum stone size: 24 inches (nominal diameter) Median stone size: 16 inches Minimum stone size: 4 inches						

(Source: Table 4.2.2.A of the King County 2009 Surface Water Design Manual, Revised)



Outlet protection.
(Idaho Construction Site Erosion and Sediment Control Field Guide, Revised)

Section 8—Stabilizing Drainage Ditches

Man-made drainage ditches with gently sloping bottoms (less than 5%) can be stabilized with thick grass seeding and erosion control blankets (see Section 4). Moderately sloping ditches (5% to 10% slopes) will likely require turf reinforcement mats and perhaps some riprap if soils are silty. Steeply sloping ditches (greater than 10%) need heavier armoring with concrete, riprap, gabion baskets, geogrid, retaining walls, or other approved products.

Natural (i.e., not "man-made") drainage channels and creeks or streams cannot be cleared, re-routed, or otherwise altered without one or more federal, state, and/or local permits (see Section 10).

Drainage Ditch Slopes and Soils

Steep ditches and those with highly erodible soils need more protection. Drainage ditch bank slopes must not exceed 2H:1V. If tractor mowers or other equipment will cross channels in the future, bank slopes must be 3H:1V or flatter. The outlet must be installed, seeded, stabilized, and protected before the ditch receives incoming flows.

Stabilization Methods for Drainage Ditches

Drainage ditch stabilization techniques are used when natural soils or vegetated stabilized soils in a channel are not adequate to prevent channel erosion. Protect erodible channels using channel liners such as blankets, turf reinforced mats, riprap, or concrete. Stabilization methods should be selected based on the ditch slope to be protected (see the following table).

Drainage Ditch Stabilization Methods

Ditch Slope	Stabilization Method
Steep (> 10%)	Concrete or riprap
Moderate (5% – 10%)	Riprap or seeding & turf reinforcement mats
Slight (<5%)	Seeding & blankets or turf reinforcement mats

This is general guidance; refer to a professional engineer for site specific stabilization methods.

(Source: Kentucky Erosion Prevention and Sediment Control Field Guide)

Installation:

- Blankets and turf reinforced mats are more effective than riprap at protecting channels from erosion.
- In many areas of Eastern Washington, rock is not easily obtainable or is very expensive to haul to a site; consider using turf reinforcement mat linings instead.
- Blanketed channels can be designed to handle any expected flow and longevity requirement. Some synthetic blankets have a predicted life span of 5 years or more, even in sunlight.
- Blankets, mats, and other flexible liners are not recommended when the channel slope exceeds 10% or the shear stress exceeds 8 lbs/ft^2.
- Place engineered geotextile between riprap and the underlying soil surface to prevent soil movement into the riprap. Ensure that the geotextile is keyed in at the top of the bank.

Erosion Control Blanket and Turf Reinforcement Mat Linings

Ditches of 10% or less can be stabilized with seeding and erosion control blankets or turf reinforcement mats. See Section 4 for installation and other useful information on erosion control blankets, turf reinforcement mats, and seeding/mulching applications.

Rock Linings

All ditches steeper than 10% require rock, concrete, or other armored liners and/or grade control structures. Consult the plans or project engineer for specific installation details.

Riprap is commonly used to line sides and bottoms of moderate or steep ditches. Line the bare ditch bottom and sides with non-woven geotextile to prevent undercutting and washouts. Rock should be mixed sizes so the spaces between large rocks are filled with smaller rock. See table on page 8-3 for rock sizing.

As ditch depth and steepness increase, rock size must also increase. Rock must be placed along ditch bottom first, then up the sides. Riprap can be placed by hand or machine, but should be placed intentionally (as opposed to randomly or haphazardly). Replace dislodged rock after storm events as needed.

Rock Sizing for Ditch Liners

Flow Velocity	Average Rock Diameter
6 ft. per second	5 inches
8 ft. per second	10 inches
10 ft. per second	14 inches
12 ft. per second	20 inches

This is general guidance; refer to a professional engineer for site specific stabilization methods.
(Source: Kentucky Erosion Prevention and Sediment Control Field Guide)

Check Dams

Drainage ditches may need check dams to reduce the speed of runoff water, prevent erosion of the ditch, and allow suspended sediment to settle out through ponding.

- Dams can be made of rock, stone-filled bags, or triangular silt dikes and should be sized according to site-specific characteristics.
- Compost socks and some types of wattles may be used in situations with minimal slope and flow.
- ***Silt fencing and straw bales should not be used as check dams and must not be used in drainage ditches that carry flowing water.***

Installation:

- Install check dams before uphill excavation or fill activities begin.
- The maximum spacing between the dams shall be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam spillway.
- Check dams should form a triangle when viewed from the side. Side slopes should be 2H:1V or flatter.
- Extend the ends of the check dam to the top of the bank to prevent bypassing and side cutting. Key the check dam material into the ditch banks to prevent washouts.
- Keep the center of the check dam at least 12" lower than the outer edges.
- The height at the center of the dam should not be greater than 2 feet above the downstream toe.
- Placing a geotextile under the dam during installation will make removal much easier.

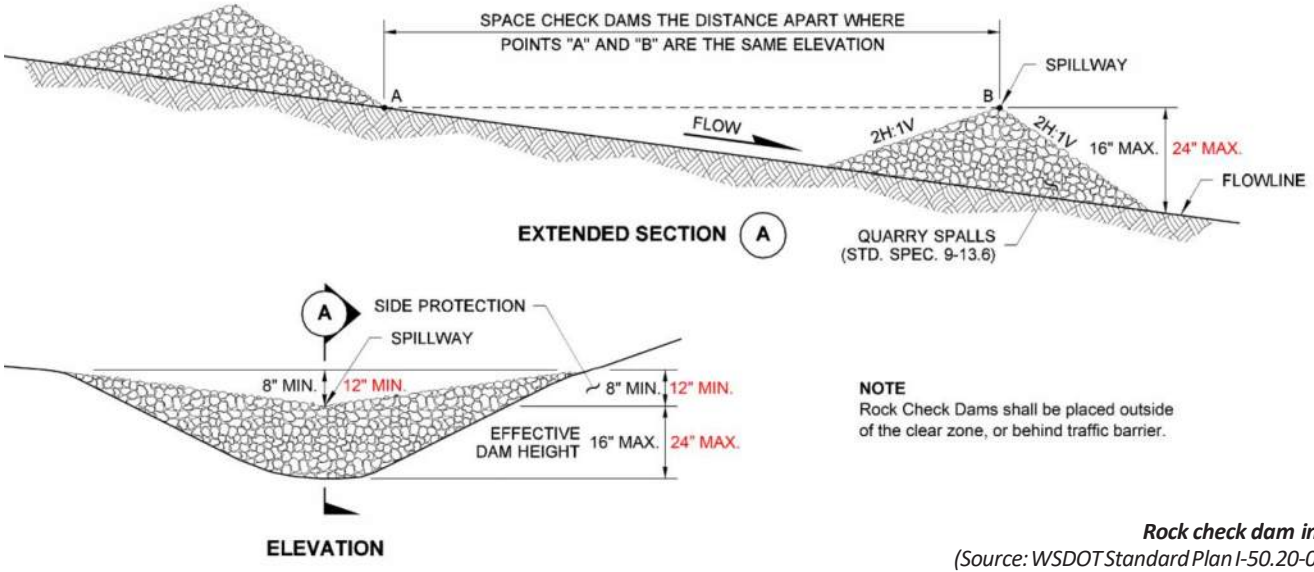
- Stone bag check dams are easiest to remove and can be reused.
- Check dams may require maintenance after storm events or high velocity flows to repair damage and remove sediment.
- Remove temporary dams after the site is stabilized and vegetation is established.

Good example of a properly installed check dam.
(Source: WSDOT)

Silt fence is not an approved BMP for use as a check dam.
(Source: Peter Vaughn, A3E Consultants)

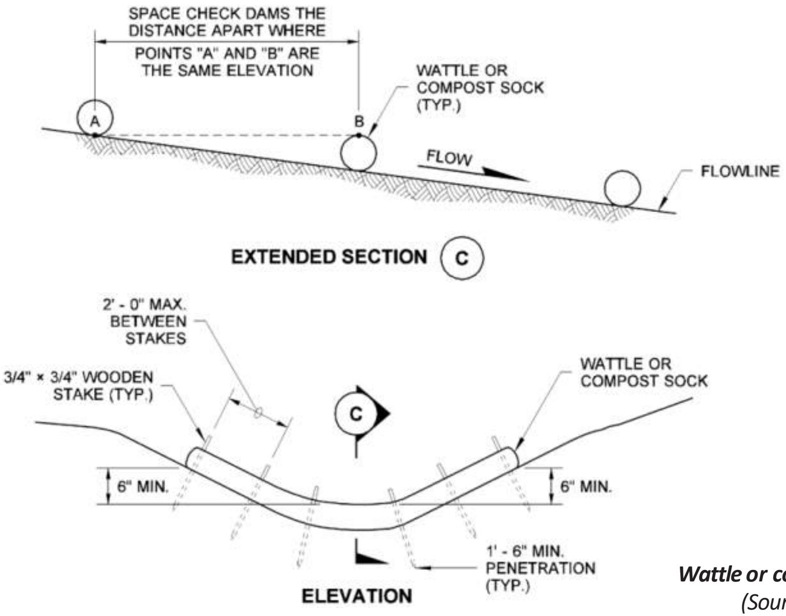
Check Dam
Troubleshooting Tips

Condition	Common Solution
There is too much sediment.	Remove accumulated sediment to recover holding capacity. Remove sediment when it reaches 1/3 the check dam height.
There is insufficient ponding area.	Space check dams farther apart and increase height of dams.
Flow travels around check dam.	Lower center of check dam so that it is 12 inches lower than the channel side.
Check dams wash away.	Replace check dams. Consider adding more dams upstream.
Wrong type of materials is used to construct barrier.	Use heavier materials such as larger rocks. Do not use straw bales or silt fence.
Check dams undercut.	Stabilize ditch with erosion control blanket, vegetation, or other controls.
Rills and gullies form in channels between check dams.	Check dams are too far apart. Add more dams and stabilize bottom of ditch.

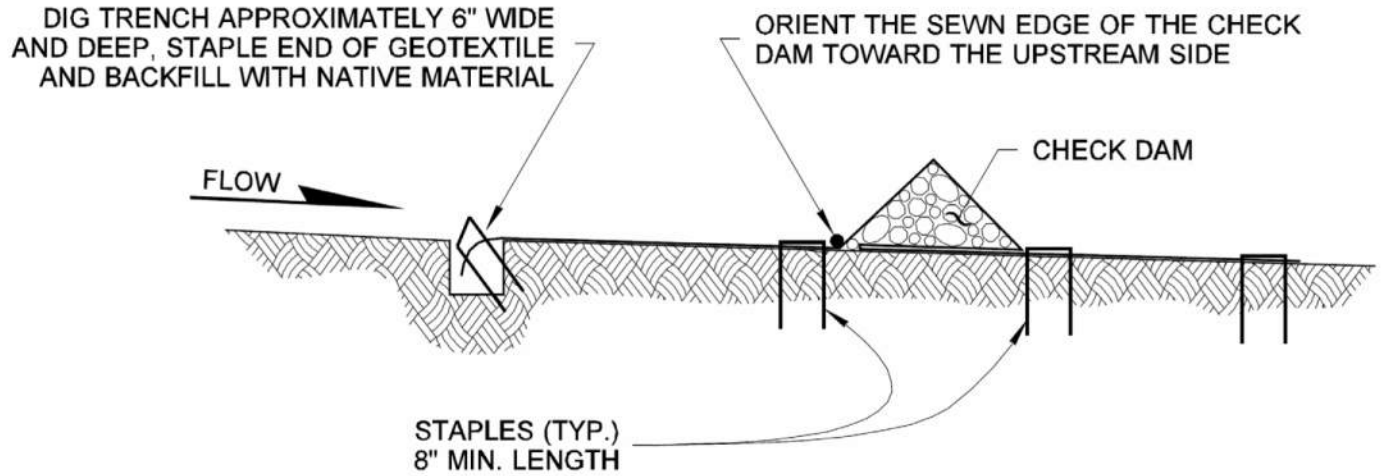


Rock check dam installation.
(Source: WSDOT Standard Plan I-50.20-00, Revised)

Redtext denotes guidance for BMP C207E as stated in Ecology's Stormwater Manual.



Wattle or compost sock check dam installation.
(Source: WSDOT Standard Plan I-50.20-00)



Triangular silt dike check dam installation.
(Source: WSDOT Standard Plan I-50.10-00)

Section 9—Installing Sediment Traps and Ponds

The purpose of a trap or pond is to provide an area where muddy runoff is allowed to pool, so sediment will settle out. Sediment traps and ponds, along with other perimeter controls, should be installed before any land disturbance takes place in the drainage area. They are only effective in removing sediment down to about the medium silt size fraction. For this reason, do not depend on sediment traps and ponds alone to control sediment loss from your construction site. Other upslope erosion and sediment controls are needed on bare areas, slopes, and ditches to prevent overloading of traps and ponds.

Containment for the pooling area can be an excavated hole or a berm made of earth or stone. ***Straw bales and silt fencing should not be used as containment structures for concentrated runoff flows.***

Locations for Traps and Ponds

Natural drainage areas or low-lying areas where flows converge are ideal places to install temporary sediment traps or ponds on construction sites. In general, sediment traps are designed to treat runoff from up to 3 acres. Sediment ponds are larger, and serve areas of about 3 to 10 acres. Temporary sediment traps and/or ponds that will serve as permanent stormwater facilities after construction should be designed by a professional engineer and cleaned at the end of construction activity to restore design capacity.

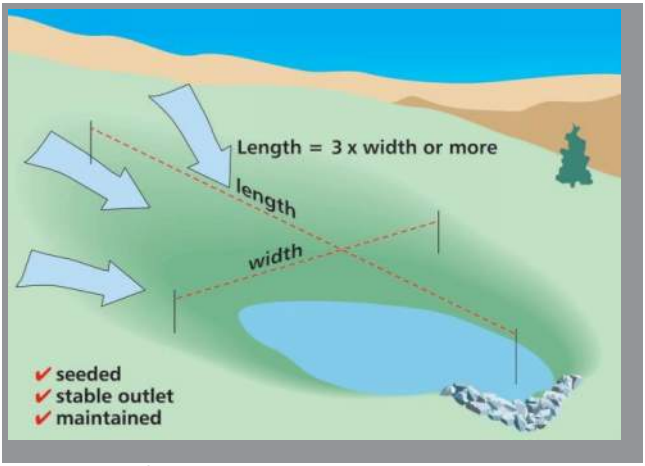
Do not put sediment traps or ponds in or next to flowing streams or other waterways. Make sure pooled water does not flood buildings, roadways, or other structures.

Sediment Traps

Installation:

- The simplest approach is to excavate a hole or build a berm of earth or stone where concentrated flows are present. This will help to detain runoff so sediment can settle out.
- Side slopes for the excavation or earthen containment berms are 3H:1V or flatter.

- The trap length shall be 3 to 6 times the trap width to provide a longer flow path and enhance particle settling.
- Berms are made of well-compacted clayey soil, with a height of 5 feet or less.
- Place soil fill for the berm or dam in 6 inch layers and compact.
- Seed and mulch the entire trap including the ponding area, berms, outlet, and discharge area immediately after construction.
- The overflow outlet should be at an elevation so dam will not overtop. Allow at least 1 foot of freeboard.
- An overflow outlet can be made by making a notch in the containment berm and lining it with rock over geotextile. Rock in the notch must be large enough to handle overflows. Stabilize downhill outlet with rock or other flow dissipaters as described in Section 7.
- Outlets must be designed to promote sheet flow of discharges onto vegetated areas if possible. If the discharge will enter a ditch or channel, stabilize according to Section 8.
- ***Do not allow sediment to be discharged offsite.*** To aid in determining sediment depth, all traps should have a staff gage with a prominent mark 1 foot above the bottom of the trap. Remove sediment from the trap when it has reached 1 foot in depth, and dispose of properly.
- Inspect inlets, berms, spillway, and outlet area for erosion after each storm event exceeding 1/2 inch.
- For additional design criteria refer to the Stormwater Manual.



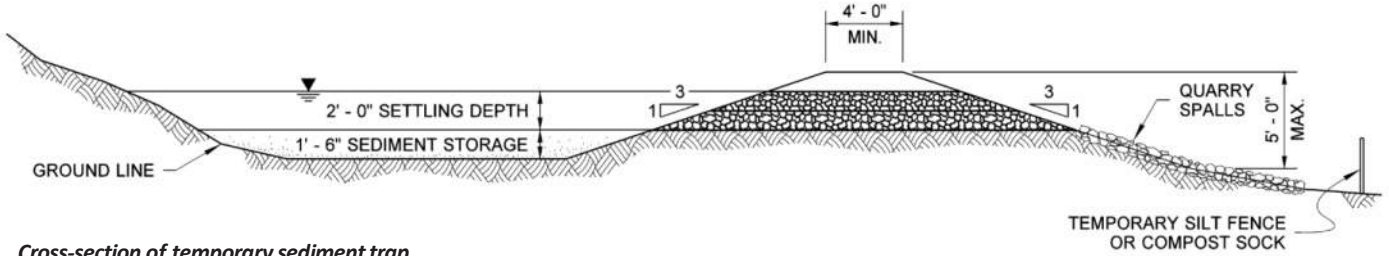
Temporary sediment trap.
(Source: Idaho Construction Site Erosion and Sediment Control Field Guide, Revised)

Sediment Trap
Troubleshooting Tips

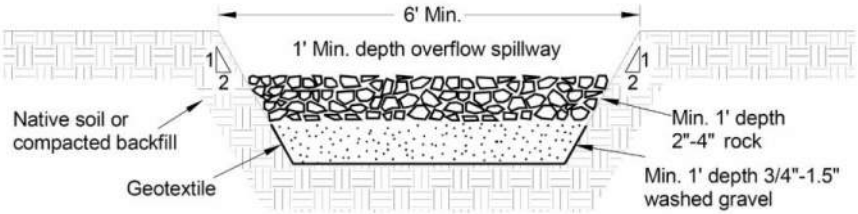
Condition	Common Solution
Spillway erodes due to high velocity flows.	Widen the spillway and stabilize with geotextile and rock, mats, or blankets.
Trap side slopes erode.	Stabilize slopes with vegetation, blankets, mats, or geotextile and rock.
Accumulated sediment has built up.	Remove sediment before it reaches 1 foot in depth. Inspect and repair upslope erosion and sediment controls; install additional BMPs as necessary.
Pond frequently overflows.	Ensure that the trap is designed to accommodate the inflow for the design storm event. Limit drainage contributing area. Consider additional traps or other controls.

Sediment Ponds

Sediment ponds are to be designed by a professional engineer. Refer to the Stormwater Manual for design and installation procedures.



Cross-section of temporary sediment trap.
(Source: WSDOT Standard Plan I-80.10-01)



Temporary sediment trap outlet.
(Source: Stormwater Manual, Revised)

Section 10—Protecting Stream Channels, Wetlands, and Lakes

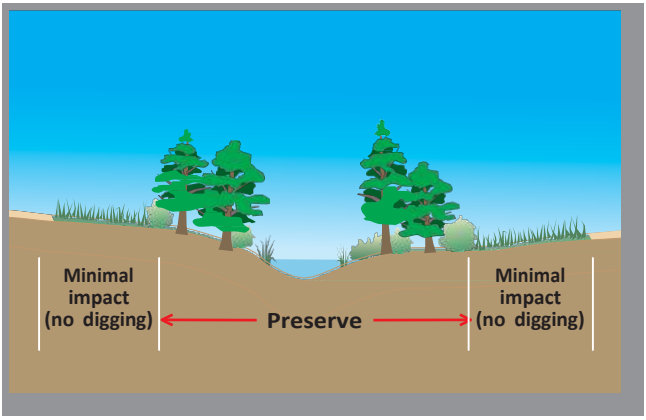
Work in and around streams, wetlands, and lakes will likely require one or more federal, state, and/or local permits or approvals. ***Consult with the local jurisdiction in advance of planned activities to determine specific requirements that may apply at your site.***

Streambank and channel disturbances resulting from construction activities can increase the stream's sediment load, which can cause channel erosion or sedimentation and have adverse effects on the biotic system. Erosion and sediment control BMPs can reduce the discharge of sediment and other pollutants to minimize the impact of construction activities on watercourses.

Buffer Zones

Buffers include undisturbed areas or strips of natural vegetation or recently established plantings of suitable material that provide a living filter to reduce erosion and runoff velocities. This vegetation is the last chance barrier to capture sediment runoff before it enters a lake, river, stream, or wetland.

Setback requirements for vegetative buffer zones along streams, lakes, or other waterways are established by the local jurisdiction or other federal/state regulations. ***Check with the local jurisdiction before working near waterways.***



Buffer zone.
(Source: Idaho Construction Site Erosion and Sediment Control Field Guide)

Considerations:

- Preserve natural vegetation near waterways wherever possible, preferably in clumps, blocks, or strips.
- Leave all unstable steep slopes in natural vegetation.
- Mark clearing limits and keep all equipment and construction debris out of natural areas.
- Keep all excavations outside the dripline of trees and shrubs.
- Use high visibility fencing to mark clearing and excavation limits.
- Avoid pushing debris or extra soil into the buffer zone area to minimize plant damage by smothering and burying.
- Where vegetation has been removed from buffer zones, or where it is absent, plant native species of trees, shrubs, and grasses.

Streambank Stabilization

Construction activities such as clearing and grubbing, new road or parking lot construction, and other alterations to the natural landscape increases flow rates in local receiving waters which can lead to streambank erosion and habitat degradation. Streambank erosion is addressed by preserving vegetated buffer zones and installing upslope erosion and sediment control BMPs. Removal of vegetation should be avoided if at all possible.

Temporary streambank stabilization methods include:

- Interceptor dikes, swales, or pipe slope drains to keep upland runoff from eroding streambanks.
- Stabilize conveyance outfalls.
- Seeding or hydro-seeding with mulch or hydro-mulch applied above the mean high water level. Do not apply mulch or tackifiers below the mean high water level as these materials could be washed into the channel.
- Soil binders – do not apply below the high water level.
- Wattles, socks, and blankets – do not apply below the high water level.

Unstable or bare streambanks should be permanently stabilized with native plant materials including cottonwood or willow cuttings, shrubs, or grasses. Bank slopes can be cut back and replanted if severe erosion is occurring. Outside channel curves might need protection with large rock, imbedded root wads, logs, gabions, or other material if banks are collapsing. Consult with your local conservation district, nursery supplier, or revegetation specialist for more information on how to obtain, install, and maintain native plant materials. Consult a professional engineer for assistance in stabilizing streambanks below the mean high water level.

Stream stabilization with rock and coconut fiber erosion control blankets.
(Source: Peter Vaughn, A3E Consultants)

Section 11—Maintaining and Closing Out Your Construction Project

All temporary and permanent erosion and sediment controls need to be inspected and maintained. Good housekeeping BMPs should be implemented for other construction activities such as waste management, material storage, concrete washout areas, street cleaning, dust control, and dewatering. All temporary controls must be removed and the site permanently stabilized before a Notice of Termination form can be filed with Ecology.

Inspections and Maintenance of Erosion and Sediment Controls

Inspections:

- All inspections must be conducted by a CESCL.
- Conduct inspections on active construction sites at least once every calendar week and within 24 hours of any discharge from the site.
- Inspect temporarily stabilized, inactive sites once every calendar month.
- Inspect all areas of the site disturbed by construction activity, all BMPs, and all stormwater discharge points.
- Visually examine stormwater discharges for the presence of suspended sediment, turbidity, discoloration, and oil sheen.
- Evaluate the effectiveness of BMPs and determine if it is necessary to install, maintain, or repair BMPs.
- See Section 12 for a link to a sample Site Inspection Checklist.
- Perform Turbidity and pH testing weekly, as required.

Maintenance:

- Maintain all temporary and permanent erosion and sediment control BMPs as needed to assure continued performance.
- Eliminate non-stormwater discharges from the construction site to storm drains and other water bodies. Non-stormwater discharges may result from

a variety of sources, including dumping, leaking storage and maintenance areas, spillage of chemicals or waste materials, and concrete washout.

- Remove brush and other debris from culvert and channel inlets.
- Remove accumulated sediment from silt fences or other sediment barriers regularly.
- Repair all BMPs that have become dislodged or damaged (such as silt fences, check dams, etc.) as soon as possible and prior to next storm event.

Record Keeping:

- Keep stormwater permit documentation on-site or within reasonable access to the site (i.e., General Permit, Permit Coverage Letter, SWPPP, and Site Log Book).
- Maintain a Site Log Book that includes installation and maintenance of BMPs, site inspection checklists/ reports, and stormwater monitoring results.
- Amend the SWPPP whenever there is a change in design, construction, operation, or maintenance that has a potential for discharge of pollutants.
- Amend the SWPPP if it is ineffective in eliminating or significantly reducing pollutants.
- Amend the SWPPP if a new contractor and/or subcontractor will implement any measure of the SWPPP. Sign, date, and keep all amendments as attachments to the original SWPPP.
- Fill out electronic Monthly Discharge Monitoring Report and submit to Ecology.

Material Storage

Construction Materials

Store materials delivered in bags and boxes on pallets. Cover bagged/boxed materials on non-working days and prior to rain events to protect materials from wind and precipitation.

Use tarps or plastic covering to protect unused materials from precipitation. Note that materials are stored on pallets to prevent contact with stormwater runoff.
(Source: Colorado DOT Erosion Control and Stormwater Quality Field Guide)

Hazardous Materials

Store oil, gasoline, paint, and any other hazardous substances under cover to prevent contact with stormwater.
Liquid hazardous materials must be stored so that if a spill or leak does occur, the material remains contained and does not contaminate the environment. The best way to ensure this is to provide secondary containment for all containers of liquid hazardous materials. Inspect storage areas frequently.

Stockpile Management

Stockpiles of soil and other erodible materials must be managed so that stormwater does not come in contact with the pile and potentially wash pollutants into water bodies. Protect all active stockpiles prior to rain events using the following techniques:

- Cover with temporary plastic sheeting or tarps. Secured correctly, plastic covering provides immediate, short-term erosion protection.
- Soil stockpiles can be sprayed with soil binder or have mulch/mulch tackifier applied.
- Install temporary barriers around stockpile perimeters to prevent contact with stormwater runoff when necessary. Temporary barriers can be dikes, swales, or sandbag barriers.
- Install a sediment barrier, such as a silt fence, near the base of erodible stockpiles to capture sediment.

Stockpiles should not be stored in the street or on impervious surfaces that drain to street. Locate stockpiles away from drainage paths and storm drain inlets and protect against erosion.
(Source: Douglas County)

Material Storage & Stockpile Management Troubleshooting Tips

Condition	Common Solution
Stockpile eroded.	Cover stockpile with plastic sheeting or spray with a soil binder. Protect with a temporary sediment barrier around the perimeter of the stockpile.
Stockpile located in drainage path.	Remove stockpile from the drainage path or protect with a dike, swale, or temporary diversion device.
Stormwater run-on erodes stockpile.	Protect the stockpile by using temporary sediment barriers such as berms, ditches, or silt fencing.
Wind causes erosion and/or blowing dust.	Cover stockpile or spray with a soil binder. Use a water application to suppress dust. Install wind barrier.
Plastic sheeting separates along the seams.	Overlap edges by 12 to 24 inches, tape the entire length or anchor with sandbags along seam.
Plastic sheeting tears and separates.	Replace damaged sections.
Plastic sheet is blown or displaced by winds.	Anchor with sandbags or other suitable tethered anchoring system, space on 10 foot grids.

Waste Management

Solid and Liquid Waste

Properly dispose of non-hazardous solid and liquid wastes (e.g., collected sediment, paper, plastic, construction and demolition debris, catch basin debris, and other wastes). Store non-hazardous solid and liquid wastes in containers appropriate for their intended use. Solid waste receptacles (e.g., dumpsters, trash cans, etc.) should be non-leaking with either a solid or screened cover/lid. If lids are screened, store containers under cover.

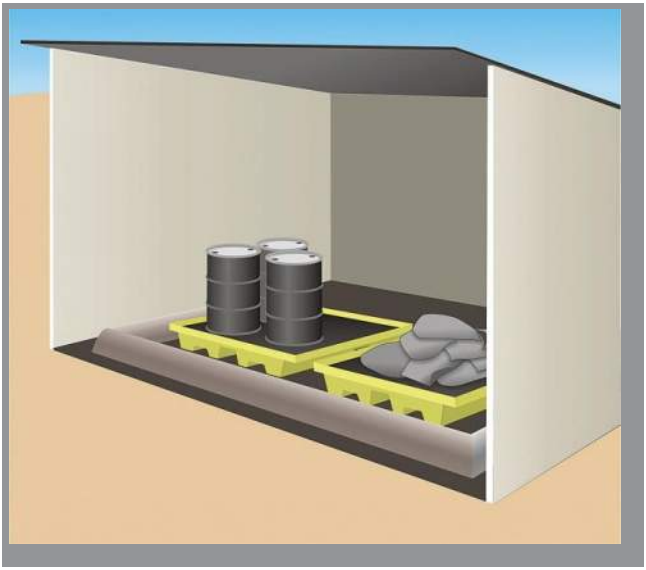
Hazardous Waste

Similar to the storage of hazardous materials, wastes must also be kept under cover and in secondary containment prior to proper transport and disposal. In addition:

- Label containers with their contents;
- Keep containers closed, except when adding or removing waste;
- Keep volumes of waste low by properly recycling and disposing wastes; and
- Inspect storage areas frequently.

Portable Toilets

Do not locate portable toilets near drainage facilities, water bodies, or in areas that will collect water. Ensure that the toilets are maintained in good working order and wastes are transported off-site by a licensed service. Stake toilets or otherwise secure to ground.



Store hazardous materials/wastes inside secondary containment structures under cover and protected from rainfall.
(Source:IdahoConstructionSiteErosionandSedimentControlFieldGuide)

Trash receptacles should have solid lid or should be stored under cover.
(Source: Asotin County)

Waste Management Troubleshooting Tips

Condition	Common Solution
Materials located throughout construction site.	Designate storage area away from water bodies and storm drains. When practical do not stockpile materials on site. Bring to the site only what will be used within a reasonable timeframe.
Litter and trash found on construction site or in the storm drain system.	Provide dumpsters or other containers. Collect trash and dispose of properly.
Overflowing dumpsters.	Arrange for waste collection before containers overflow.
Leaking dumpsters.	Contact dumpster provider and request new dumpster. Close lid or provide cover.
Hazardous chemicals, drums, or bagged materials are stored directly on the ground.	Place material on a pallet and when possible, under cover and in secondary containment.
Hazardous waste containers are not labeled.	Re-label items with an original label or remove substances from the site.
Leaking hazardous material containers.	Contain spill immediately. Damaged or leaking containers should be placed in overpack drums or secondary containment. Properly dispose of waste and any contaminated soil as hazardous waste.
Portable toilet tipped over.	Place toilet on level surface and out of drainage paths or traffic areas. Stake down.
Portable toilet leaks.	Repair or replace.

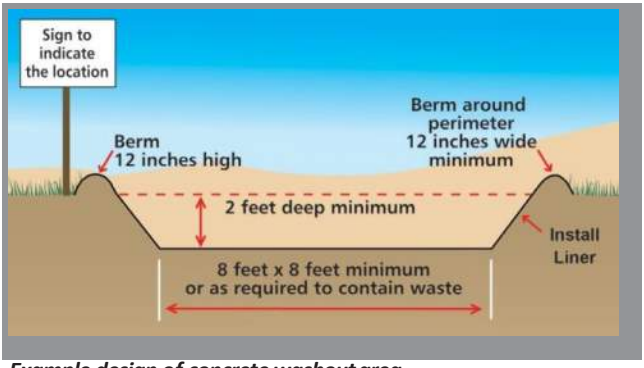
Concrete Washout Area

Concrete washout structures are used to contain concrete and liquids when the chutes of concrete mixers and hoppers of concrete pumps are rinsed out after delivery. The washout facilities can be constructed or ready-made. All washout facilities consolidate solids for easier disposal

and prevent runoff of liquids. The wash water is alkaline and contains high levels of chromium, which can leach into the ground and contaminate groundwater. It can also migrate to a storm drain, which can increase the pH of nearby waterways and harm aquatic life. Concrete washout areas should be located away from existing or planned stormwater management facilities, particularly infiltration based BMPs. Washout area can also be used for sheet rock mud, stucco, masonry, tool cleaning, etc.

Installation:

- The pit (or ready-made structure) should be large enough to contain the anticipated waste from operations.
- Washout pits should be lined with a minimum of 10-mil polyethylene sheeting, free of holes or other defects.
- Washout areas should be located a minimum of 50 feet from storm drains or receiving waters.
- Inspect daily when in use.
- Maintain washouts to provide a minimum of 1 foot freeboard. Clean existing facilities or construct additional facilities when the washout is 50% full.
- Allow waste to dry and then dispose of as solid waste.
- Permanent disposal of concrete waste on the construction site is prohibited



Example design of concrete washout area.
(Source: Idaho Construction Site Erosion and Sediment Control Field Guide, Revised)

Good example of properly designed concrete washout area.
(Source: City of Pullman)

Concrete Washout Area
Troubleshooting Tips

Condition	Common Solution
Washout overflows.	Pump or siphon off excess liquids and properly dispose in a manner that does not violate groundwater or surface water quality standards. If necessary, discontinue using washout and construct new facility to contain anticipated washout operations.
Drivers not using washout area.	Place sign at washouts and instruct drivers of the washout locations. Educate drivers and other concrete company personnel.

Street Cleaning

Streets surrounding construction entrances/exits should be checked daily for evidence of sediment track out. Any sediment should be removed immediately by shoveling, street sweeping, or vacuuming. Collected sediment can be mixed with other on-site soils. Pavement should not be washed down using water.

Stabilize or maintain construction exits to prevent track out.
(Source: City of Moses Lake)

Dust Control

Some Eastern Washington jurisdictions and/or local clean air agencies may require that a dust control plan be submitted; check with the local agencies for specific requirements.

In general, owners or operators shall take reasonable precautions to prevent fugitive dust from becoming airborne and shall maintain and operate the source to minimize emissions.

Considerations:

- Monitor weather forecasts and prepare appropriately for dust control on your site.
- Provide stabilized roadways (haul roads, construction entrances, etc.) to minimize amount of dust generated by construction vehicles.

- Maintain a low speed limit for construction vehicles throughout the site.
- Restrict access only to authorized vehicles and areas.
- Limit the number of vehicles on site; use a dedicated vehicle to shuttle personnel and others on and off the site.
- Keep haul roads, detours, and other bare areas moist by sprinkling them with water or other dust control methods. Care should be taken when applying water or liquid substances to prevent non-stormwater discharges and sediment from entering storm drains or water bodies.
- Cover small stockpiles as an alternative to applying water or other substances.
- Establish vegetation at the earliest possible opportunity.
- Apply protective materials such as stone, mulch, or binders to exposed areas.
- Install barriers to prevent dust from blowing off-site. A board fence, wind fence, silt fence, or similar barrier can control air currents and blowing soil.

Inspect site during windy conditions to monitor dust control measure effectiveness. Reapply dust control measures as needed to maintain level of control required.

Dust Control
Troubleshooting Tips

Condition	Common Solution
Excessive dust leaves the site.	Increase frequency of water application or other controls.
Vehicles kick up dust.	Water more frequently. Limit vehicle speeds. Stabilize the roadway.
Watering for dust control causes erosion.	Reduce water pressure on the water truck. Check watering equipment to ensure that it has a positive shutoff. Water less frequently.
Sprayed areas are ineffective at limiting dust.	Re-spray areas and ensure that the application rate is proper or stabilize site using other practices.

Dewatering Operations and Discharges Muddy water pumped from collection basins or other areas must not be pumped into storm drains, streams, lakes, or wetlands unless sediment is removed prior to discharge.

Filter or settle water to remove sediment before discharge. Polluted water should not be discharged. Options include the following:

- Containment in a pond for a minimum of 4 hours or until water is clear. Settling times will vary depending on soil type.
- Pumping to a settling tank with sampling ports.
- Filtering through a sieve or other filter media (swimming pool filter). Simple on-site filter systems can be constructed by wrapping the ends of the suction and discharge pipes with geotextile; discharging through a series of drums filled with successively finer gravel and sand; and other filtering techniques like those described under inlet protection (see Section 7).
- Manufactured sediment bags lie on the ground and water is pumped into an opening in the bag filter. The water is filtered through the sediment bag cloth and out onto the ground. These systems do not always work with fine clay soils.
- Advanced chemical treatment technologies, such as chitosan enhanced sand filtration, provide exceptional reductions of turbidity and associated pollutants. Formal written approval from Ecology is required for the use of chemical treatment regardless of site size.

Prior to discharge, protect flow paths to prevent erosion and sedimentation. Dry and reuse filtered material in a mixture with other on-site soils or dispose of appropriately if contaminants are present.

Consider managing dewatering without discharge to a storm drain or receiving water. Options include:

- Retaining the water on site for construction use or allowing water to evaporate/infiltrate.
- Discharging to adjacent land or drainage facility with permission of the owner.

- Discharging to a stabilized vegetated slope through sprinkler or perforated pipe.
- Having the water transported and disposed of off-site in a manner that does not pollute waters of the state, including surface water and groundwater.

Dewatering
Troubleshooting Tips

Condition	Common Solution
Sediment laden discharge is escaping around the hose insert of sediment bag.	Cease pumping and insert discharge hose further into bag. Re-tie bag around the discharge hose to create a tight seal. Periodically check this connection.
Flow rate from sediment bag decreases.	Sediment bag may be clogged with sediment. Remove and replace bag. Properly dispose of used bag.
Discharge of treated water causes erosion.	Install outlet protection.
Filter is clogged.	Check filtering devices frequently to make sure they are unclogged and operating correctly. Adjustments may be needed depending on the amount of sediment in the water being pumped.
Treatment units such as ponds or tanks fill with sediment.	Remove sediment when unit reaches 1/3 its capacity to maintain settling efficiency.
Dewatering discharge flow is higher than expected.	Alter the treatment unit to handle increased flow.
Water spread on the construction site is not infiltrating fast enough and is entering the storm drain system or receiving water.	Stop dewatering. Install a sediment treatment system and test discharge as necessary.

Sediment bag used to clean sediment laden water.
(Source: WSDOT)

Six inch pipe draining a sediment pond. *The six inch pipe drains into four inch perforated pipe which allow the sediment laden water to percolate through the duff and soil.*
(Source: WSDOT)

Vegetated Cover Considerations for Project Close-Out

The project site may not be closed out until vegetation is established on all bare soil areas and ditches are stable. Check seeded areas, and reseed areas where vegetation is thin or absent. This is especially important for slopes, ditches, and channels.

Removing Temporary Sediment Controls

All temporary erosion and sediment control BMPs must be removed within 30 days after final site stabilization is achieved or when they are no longer needed.

When final site stabilization is completed:

- Remove all silt fencing and stakes. Accumulated sediment can be graded out, seeded and mulched, broadcast over grassed areas, or removed and properly disposed of off-site.
- Check ditches and channels to make sure banks and ditch bottoms are well vegetated. Reseed bare areas and replace rock that has become dislodged.
- Culvert inlets and outlets should be stabilized and show no visible gullies. Rock or soil that has been washed away by runoff or upstream flows should be replaced. Brush or other debris that could clog inlets should be removed.
- Check areas where erosion control blankets were installed. Cut away and remove all loose, exposed material, especially in areas where walking or mowing will occur. Reseed all bare soil areas.
- Fill in, grade, and seed all temporary sediment traps and ponds that have been removed. Double the seeding rate where runoff flows might converge or high velocity flows are expected.
- Remove temporary stream crossings and grade, seed, or re-plant vegetation removed during crossing installation.
- Clean and return to design capacity all permanent facilities that were used as temporary facilities during construction.

Notice of Termination

If the site is covered under a Construction Permit the project site is eligible for termination of coverage when it has met any of the following conditions:

1. Final Stabilization

   The site has undergone final stabilization when:

   a. All disturbed areas have established permanent vegetative cover, or equivalent permanent stabilization measures which prevent erosion;

   b. All temporary erosion and sediment control BMPs have been removed; and

   c. All stormwater discharges associated with construction activity have been eliminated.

2. Transfer of Permit Coverage

   Permit coverage on all or portions of the site that have not undergone final stabilization have been transferred and the permittee no longer has operational control of the construction activity. The current permittee and new permittee must complete and submit a Transfer of Coverage Form to Ecology.

3. Transfer of Property Ownership

   All or portions of the site that have not undergone final stabilization have been sold and the permittee no longer has operational control of the construction activity. Includes residential construction where the permittee has completed temporary stabilization and the homeowners have taken possession of the residences.

When the site is eligible for termination, submit a Notice of Termination (NOT) form to Ecology. Termination is effective on the date Ecology receives the NOT form, unless Ecology notifies the permittee within 30 days that the termination request is denied.

Local stormwater construction close-out requirements may also be required. Check with the local jurisdiction for specific requirements.

Section 12—Additional Resources

Eastern Washington NPDES Phase II Communities

Always contact the local jurisdiction for any additional stormwater requirements!

Jurisdiction	Website	Phone
Cities		
Asotin	www.cityofasotin.org	(509)243-2071
Clarkston	www.clarkston-wa.com	(509)243-2071
East Wenatchee	www.east-wenatchee.com	(509)884-1829
Ellensburg	www.ci.ellensburg.wa.us	(509)962-7230
Kennewick	www.go2kennewick.com	(509)585-4200
Moses Lake	www.ci.moses-lake.wa.us	(509)764-3792
Pasco	www.pasco-wa.gov	(509)545-3444
Pullman	www.pullman-wa.gov	(509)338-3314
Richland	www.ci.richland.wa.us	(509)942-7480
Selah	www.ci.selah.wa.us	(509)698-7365
Spokane	www.spokanecity.org	(509)625-7900
SpokaneValley	www.spokanevalley.org	(509)688-0321
Sunnyside	www.ci.sunnyside.wa.us	(509)837-5206
Union Gap	www.ci.union-gap.wa.us	(509)225-3524
Walla Walla	www.ci.walla-walla.wa.us	(509)527-4363
Wenatchee	www.wenatcheewa.gov	(509)888-3235
West Richland	www.westrichland.org	(509)967-5434
Yakima	www.ci.yakima.wa.us	(509)575-6005
Counties		
Asotin	www.asotincountystormwater.com	(509)243-2071
Chelan	www.co.chelan.wa.us	(509)667-6415
Douglas	www.douglascountywa.net	(509)8884-7173
Spokane	www.spokanecounty.org	(509)477-3600
Walla Walla	www.co.walla-walla.wa.us	(509)524-2710
Yakima	www.yakimacounty.us	(509)574-2300

Washington State Department of Ecology

Construction Stormwater General Permit

Main Web Page

www.ecy.wa.gov/programs/wq/stormwater/construction/index.html

Construction Stormwater General Permit Application Form (Notice of Intent)

www.ecy.wa.gov/biblio/ecy02085.html

Erosivity Waiver Form

https://fortress.wa.gov/ecy/publications/documents/ecy070202.pdf

Stormwater Pollution Prevention Plan (SWPPP) Template

SWPPP Template

https://ecology.wa.gov/Asset-Collections/Doc-Assets/Water-quality/Water-Quality-Permits/Stormwater-General-Permits/Construction-Stormwater-General-Permit/NEW-SWPPP

Construction Stormwater Site Inspection Checklist

Word Document

https://ecology.wa.gov/Asset-Collections/Doc-Assets/Water-quality/Water-Quality-Permits/Stormwater-General-Permits/Construction-Stormwater-General-Permit/InspectionForm

Water Quality Permitting Portal (WQWebPortal)

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Water-quality-permits-guidance/WQWebPortal-guidance

Transfer of Permit Coverage Form

https://fortress.wa.gov/ecy/publications/documents/ecy02087a.pdf

Construction Stormwater General Permit Termination Form (Notice of Termination)

https://fortress.wa.gov/ecy/publications/documents/ecy02087.pdf

Certified Erosion and Sediment Control Lead (CESCL) Training and Certification Programs

https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Certified-erosion-sediment-control

Local Clean Air Agencies

https://ecology.wa.gov/About-us/Our-role-in-the-community/Partnerships-committees/Clean-air-agencies

Stormwater Management Manual for Eastern Washington

https://fortress.wa.gov/ecy/ezshare/wq/Permits/Flare/2019SWMMEW/2019SWMMEW.htm

Washington Stormwater Center

www.wastormwatercenter.org

USDA NRCS Web Soil Survey

Interactive Soil Map

websoilsurvey.nrcs.usda.gov

Washington State Department of Transportation

Highway Runoff Manual

https://www.wsdot.wa.gov/Publications/Manuals/M31-16.htm

Standard Specifications for Road, Bridge, and Municipal Construction

www.wsdot.wa.gov/Publications/Manuals/M41-10.htm

Washington State University

WSU Extension Programs Listed by County

ext.wsu.edu/locations

Western Regional Climate Center

Historical Climate Information for Select Stations in Washington

www.wrcc.dri.edu/summary/Climsmwa.html

Appendix A—Erosivity Waiver Criteria

Construction site operators may qualify for an Erosivity Waiver from the Construction Permit if allowed by the local jurisdiction and the conditions stated in S2.C of the permit are met. Verify that an Erosivity Waiver is allowed by the local jurisdiction before submitting an Erosivity Waiver Certification Form and commencing any land disturbing activities.

Erosivity Waiver Criteria for Ecology Construction Stormwater General Permit

Construction site operators may qualify for a waiver from Ecology's Construction Stormwater General Permit if the following conditions are met:

1. The site will result in the disturbance of fewer than 5 acres and the site is not a portion of a common plan of development or sale that will disturb 5 acres or greater.
2. Calculation of Erosivity Factor and Regional Timeframe:
    a. The project's rainfall erosivity factor ("R" Factor) must be less than 5 during the period of construction activity, as calculated using either the Texas A&M University online rainfall erosivity calculator at: **http://ei.tamu.edu/** or EPA's calculator at **http://cfpub.epa.gov/npdes/stormwater/lew/lewcalculator.cfm**. The period of construction activity starts when the land is first disturbed and ends with final stabilization. In addition:
    b. The entire period of construction activity falls within the following timeframes:
        i. June 15 – October 15
        For sites east of the Cascades Crest, excluding the Central Basin[1]; or
        ii. For sites within the Central Basin: No Timeframe Restrictions

(1) The Central Basin is defined as those portions of Eastern Washington with mean annual precipitation of less than 12 inches. For a map of the Central Basin (Region 2) refer to the Erosivity Waiver Certification Form, available at **www.ecy.wa.gov/biblio/ecy070202.html**.

3. Construction site operators must submit a complete Erosivity Waiver Certification Form to Ecology at least one week before disturbing the land. Certification must include statements that the operator will:
    a. Comply with applicable local stormwater requirements; and
    b. Implement appropriate erosion and sediment control BMPs to prevent violations of water quality standards.
4. This waiver is not available for facilities declared significant contributors of pollutants as defined in Special Condition S1.B.1.b of the Construction Stormwater General Permit.
5. This waiver does not apply to construction activities which include non-stormwater discharges listed in Special Condition S1.C.3 of the Construction Stormwater General Permit.
6. If construction activity extends beyond the certified waiver period for any reason, the operator must either:
    a. Recalculate the rainfall erosivity "R" factor using the original start date and a new projected ending date and, if the "R" factor is still under 5 and the entire project falls within the applicable regional timeframe, complete and submit an amended Erosivity Waiver Certification Form before the original waiver expires; or
    b. Submit a complete Construction Stormwater General Permit application to Ecology in accordance with Special Condition S2.A and B before the end of the certified waiver period.

Erosivity Waiver Criteria for Local Construction Permit

Local jurisdictions may or may not offer such an erosivity waiver from their local stormwater construction permits. Check with the local jurisdiction to find out exactly what the local stormwater construction requirements are.

Local Stormwater Numbers

Wenatchee: (509)888-3235

Chelan County: (509)667-6415

East Wenatchee: (509)884-1829

Douglas County: (509)884-7173

Wenatchee Valley Stormwater Program

Chelan County · Wenatchee · Douglas County · East Wenatchee

www.WenatcheeWa.gov/WVSTAC