



Erosion and Sediment Control Field Guide For Maintenance Activities

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Location & Design Division
1401 East Broad Street
Richmond, VA 23219

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1.0 CONTACT INFORMATION

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT) Stormwater Contact Information & Service Areas

| | |
|---|----------------|
| Bristol District L&D Engineer | (276) 669-9910 |
| Culpeper District L&D Engineer | (540) 829-7546 |
| Fredericksburg District L&D Engineer | (540) 899-4494 |
| Lynchburg District L&D Engineer | (434) 856-8276 |
| Northern Virginia District L&D Engineer | (703) 259-2949 |
| Richmond District L&D Engineer | (804) 524-6145 |
| Salem District L&D Engineer | (540) 378-5053 |
| Staunton District L&D Engineer | (540) 332-9118 |
| Hampton Roads District L&D Engineer | (757) 925-2561 |

2.0 NOTES AND LIMITATION OF USE

This guide provides a framework for sound Erosion and Sediment Control (ESC) implementation. It is not designed as an engineering specification guidebook and its use is limited to a reference for maintenance activities only. For the purpose of this guide, maintenance is defined as activities performed to maintain the original line and grade, hydraulic capacity, or original construction of the facility (which follows the State's definition of Routine Maintenance). Any ESC measure implementation beyond the scope of the original plans or an activity that would not meet the above definition of maintenance should be directed toward VDOT's Hydraulics Division for review. Use of this guide alone does not guarantee compliance with DCR and/or VSMP regulations. This guide should be used in conjunction with an approved ESC Plan as an aid to VDOT field personnel.

A complete plan produced with the ESC Plan Template software (including the project narrative, typical sketches for each activity, and any required site-specific sketches for critical areas, wetlands, etc.) in combination with the most up-to-date version of the VDOT Road and Bridge Standards and Specifications constitutes a complete and compliant ESC Plan as allowed by VDOT's approved ESC and stormwater management (SWM) program.

No work will be conducted within wetlands, live waterways or other aquatic resources without review & approval from the applicable Residency Environmental Specialist. All work is to be conducted in the dry. **All erosion & sediment controls will be in place prior to commencement of work related to the land disturbing activity.**

3.0 REFERENCES

The maintenance ESC measures discussed in this field guide are based upon design and installation specifications currently found in Section 100 (Drainage Items) of the 2008 VDOT Road and Bridge Standards (Volume 1) and in Section 244 (Roadside Development Materials) of the 2007 VDOT Road and Bridge Specifications. These references include the following details and specifications:

2008 Road and Bridge Standards (Volume 1)

| <u>Sheet</u> | <u>Measure (Designation Number)</u> |
|--------------|--|
| 113.01 | Culvert Outlet Protection (EC-1) |
| 113.02 | Protective Covering Installation Criteria (EC-2) |
| 113.03 | Soil Stabilization Mat Ditch Installation Type A or B (EC-3) |
| 113.04 | Soil Stabilization Mat Culvert Outlet Protection Installation (EC-3) |
| 113.05 | Soil Stabilization Mat – Slope Installation Type C (EC-3) |
| 113.06 | Rock Check Dams Type I & II (EC-4) |
| 113.06(A) | Gravel Bag Check Dam Type III (EC-4) |
| 113.07 | Temporary Silt Barriers (EC-5) |
| 113.09 | Inlet Protection Type A and B (EC-6) |
| 113.10 | Inlet Protection Type C (EC-6) |
| 113.11 | Typical Sediment Trap (EC-7) |
| 113.12 | Dewatering Basin (EC-8) |
| 113.13 | Temporary Diversion Dike (EC-9) |
| 113.14 | Temporary Berm & Slope Drain (EC-10) |
| 113.15 | Stabilized Construction Entrance (EC-11) |
| 113.16 | Temporary Diversion Channel (EC-12) |
| 113.17 | Riprap Weirs (EC-13) |
| 113.18 | Temporary Vehicular Watercourse Crossing (EC-14) |
| 113.19 | Temporary Super Silt Barrier (EC-15) |
| 113.20 | Level Spreader (EC-16) |
| 113.21 | Turbidity Curtain (EC-17) |
| 113.22 | Turbidity Curtain Type I & Type II (EC-17) |
| 113.23 | Turbidity Curtain Type III (EC-17) |

2007 Road and Bridge Specifications

| <u>Section</u> | <u>Specification</u> |
|----------------|--|
| 414 | Riprap |
| 244.02(b) | Topsoil |
| 244.02(c) | Seeds |
| 244.02(d) | Fertilizers |
| 244.02(e) | Lime |
| 244.02(g) | Mulch (Vegetative, Wood Cellulose for Hydraulic, Wood Chips) |
| 244.02(h) | Sod |
| 244.02(k) | Soil Retention Coverings (Jute Mesh, Retention Mats, Stabilization Mats) |

All documents can be downloaded from www.virginiadot.org. Additional references regarding ESC Controls can be found in the VDOT Drainage Manual, Appendix 10B-1; VDOT IIM 11.27 (SWM ESC Program); and the VDOT ESC & SWM Standards & Specifications. Substitutions can be made for ESC measures provided they are on the VDOT approved product list for the respective measure. For additional information, contact your supervisor or project engineer regarding the installation or maintenance of the ESC measures.

4.0 INTRODUCTION TO THE ESC FIELD GUIDE

This guide is a quick-reference tool for maintenance personnel and installers of ESC measures during field maintenance activities within the VDOT right-of-way and off-site properties associated with the maintenance activity.

This guide is intended for use in conjunction with an approved ESC Plan that has been developed using the ESC Plan software for routine maintenance activities. Use of this guide for non-routine maintenance activities or other construction activities should also be done in accordance with the specific ESC Plan that was developed by the Project Engineer.

This guide contains basic installation and maintenance tips for typical VDOT ESC work, and associated VDOT maintenance activities. The guide is sectioned by the ESC Measure that can be identified on the ESC Plan.

5.0 EROSION AND SEDIMENT CONTROL PLAN

An ESC Plan is a document that describes the potential for erosion and sedimentation of surface soils associated with VDOT construction projects or maintenance tasks and the necessary associated control measures.

The ESC Plan typically includes two main components: a written narrative and a site illustration. The ESC Plan explains (Narrative) and illustrates (Site Plan) the measures that are to be taken to control erosion and sediments in stormwater runoff. An ESC Plan is required by the Virginia Erosion and Sediment Control Law (*Code of Virginia* § 10.1-560 et. seq.).

An ESC Plan includes specific ESC measures, which are defined as stormwater runoff best management practices (BMPs). This guide focuses on specific maintenance ESC measures typically shown on an ESC Plan. Maintenance ESC measures can be divided into six categories:

- Perimeter Controls
- Exposed Areas
- Check Dams
- Slope Stabilization and Scour Repair
- Inlet and Outlet Protection
- Other Controls

The use of appropriate maintenance ESC measures should:

- Prevent the discharge of sediment into drainage systems, such as ditches, curbs and gutters, storm drain inlets, streams, rivers, and wetlands;
- Contain potential sediment on the construction site;
- Prevent off-site water from running on-site and becoming contaminated with sediment or other pollutants;
- Minimize disturbance of existing vegetation; and
- Stabilize disturbed areas as soon as possible.

Visit the Virginia Stormwater Management Program Permitting web page at <http://www.dcr.state.va.us/sw/vsmp.htm> for more information.

6.0 MAINTENANCE ESC MEASURES

6.1 PERIMETER CONTROLS

Perimeter controls are used to control sediment-laden runoff from leaving a construction site, and define the constructing perimeter and sensitive areas. It is important that perimeter controls are in place before any earth-moving or maintenance activity begins. The following ESC measures are considered perimeter controls:

- Temporary Diversion Dike
- Temporary Diversion Channel
- Silt Fence and Super Silt Fence
- Stabilized Construction Entrance

TEMPORARY DIVERSION DIKE VDOT R&B STD 113.13 (EC-9)

A temporary diversion dike is a gravel, stone, or soil berm, dike, or ridge that slows and filters flow and diverts stormwater from an open traffic area or slope. Clean water diversion dikes are designed to intercept and divert clean upland runoff around bare soil areas or to collect runoff from work areas for treatment and safe disposition.

Installation Tips

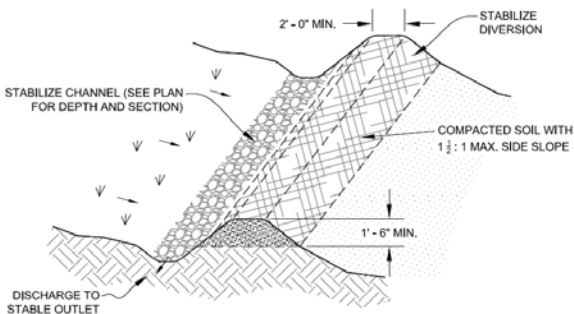
- Berms shall have a minimum height of 18", side slopes of 1.5:1 (maximum) or flatter, and a minimum top width of 2.0'.
- Berms should not be used in high-traffic areas where they will be continually run over.
- The channel created behind the dike shall have a positive grade to a stabilized outlet (see EC-1). The channel shall be stabilized, as necessary, to prevent erosion.
- Berms shall be compacted adequately to prevent failure and shall be stabilized with seeding and mulch immediately following their construction.

Maintenance Tips

- The measure shall be inspected after every storm and repairs made to the dike, flow channel, outlet or sediment trapping facility, as necessary and once every two weeks, whether a storm event has occurred or not.
- Damages caused by construction traffic or other activity must be repaired before the end of each working day.



Source: Mount St. Mary's University



TEMPORARY DIVERSION CHANNEL VDOT R&B STD 113.16 (EC-12)

A larger form of a temporary diversion dike, temporary diversion channels are a shaped and sloped depression (swale) in the soil surface used to divert runoff or channel water to a desired location. Often, the channel will be lined with riprap, stone, geotextile materials, or vegetation.

Installation Tips

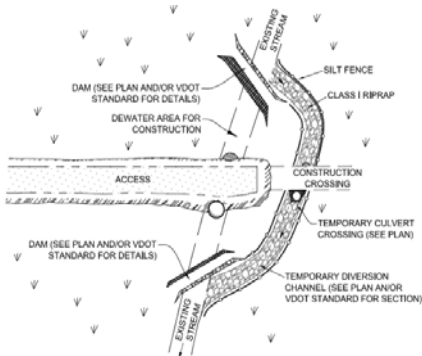
- Bottom of the temporary diversion channel shall approximate the bottom width of the natural stream channel.
- Channel side slopes at 1:1 (maximum) or flatter. 2:1 side slopes are desirable.
- Channel cross-section dimensions shall be per the ESC plan.
- Class A lining: EC-2 geotextile bedding material (black).
- Class B lining: EC-2 geotextile bedding material (black) under class I riprap or sandbag liner.
- Place diversion channel above or below cut or fill slope.
- Compact any fill material along the path of the channel.
- Do not construct channel out of soils that are easily eroded.
- Soil must be stabilized when construction of channel is complete.

Maintenance Tips

Sediment shall be removed from the channel and repairs made. Seeded areas which fail to establish a stabilized cover shall be reseeded as necessary.



Source: SCI Engineering.



SILT FENCE AND SUPER SILT FENCE VDOT R&B STD 113.07, 113.08 & 113.19 (EC-5)

Silt fences are used as temporary filter barriers. They can also be used to delineate special features or limits of disturbance in the field. A silt fence consists of a length of filter fabric stretched between anchoring posts spaced at regular intervals. Super silt fence is a temporary wire-backed silt barrier where a wire fence is securely fastened to the fence posts with wire ties or staples. When installed correctly and inspected frequently, silt fences can be an effective barrier to sediment leaving the site in stormwater runoff. Silt fence is used to filter sediment-laden runoff and decrease velocity of sheet flows.

Installation Tips

- Install silt fence along contours, or where sheet flow approached perpendicular to the fence, to avoid concentrated flows. Concentrated flows could cause silt fence failure.
- Silt fence shall be installed prior to any grubbing or grading activity.
- Along the toe of fills, install silt fence along a level contour and provide an area behind the fence for runoff to pond and sediment to settle. Silt fence should be installed approximately 5' away from the toe of the fill when feasible.
- The use of temporary silt barriers is limited to situations in which only sheet flows are expected and where concentrated flows originate from drainage areas of 1 acre or less.
- Where the size of the drainage area is no more than one quarter of an acre per 100 acres of silt fence length; the maximum slope behind the barrier is 50% (2:1).
- Do not place silt fence in or adjacent to existing wetlands where trenching could impact the wetlands.
- Silt fences do not have to be on the property line. Stagger fence sections to ensure total coverage. Repair as needed, and remove when grass is well established.
- Silt fences should be installed on the contour below bare soil areas. Use multiple fences on long slopes.
- The posts shall be embedded into the ground and do not need to be set in concrete. Wooden posts shall have a diameter of 2" when oak and 4" when pine. Steel posts shall have a minimum weight of 1.33 pounds per linear foot.
- Wire fence shall be fastened securely to the posts with wire ties and embedded a minimum of 2".
- Geotextile fabric shall be fastened securely to the wire fence with ties spaced every 24" at the top and mid-section.
- Geotextile shall be embedded a minimum 6" into the ground.
- When two separate sections of geotextile fabric adjoin each other, they shall overlap by 6" and be twice folded.

Maintenance Tips

- Silt fences shall be inspected immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately.
- Close attention shall be paid to the repair of damaged silt fence resulting from end runs and undercutting.
- Should the fabric on a silt fence decompose or become ineffective prior to the end of the expected usable life and the barrier still be necessary, the fabric shall be replaced promptly.

- Sediment deposits should be removed after each storm event. They must be removed when deposits reach approximately one-half the height of the barrier.
- Any sediment deposits remaining in place after the silt fence is no longer required shall be dressed to conform with the existing grade, prepared and seeded.

Temporary Silt Fence Spacing on Slopes:

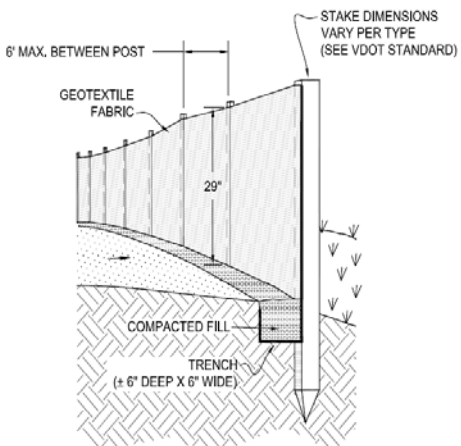
| <u>Slope (%)</u> | | <u>Placement interval (ft)</u> |
|------------------|-------|--------------------------------|
| 3:1 | (33%) | 40 |
| 4:1 | (25%) | 50 |
| 5:1 | (20%) | 60 |
| 10:1 | (10%) | 100 |
| < 50:1 | (2%) | 150 |

Temporary Silt Fence Spacing in Ditches:

| <u>Ditch Grade (%)</u> | <u>Approximate Spacing (ft)</u> |
|------------------------|---------------------------------|
| 1-2 | 150 |
| 2-4 | 75 |
| 4-6 | 40 |
| >6 | 25 |



Source: WYCOCK.org



STABILIZED CONSTRUCTION ENTRANCE VDOT R&B STD 113.15 (EC-11)

A construction entrance is a stabilized stone pad with a geotextile underliner located at points of vehicular ingress and egress on a construction site. Construction entrances stabilize the entrance to a construction site to minimize the amount of sediment leaving the area in the form of mud attached to vehicle tires. As a vehicle drives over the construction entrance, it removes mud and sediment from the tires and reduces soil transport off the site.

Installation Tips

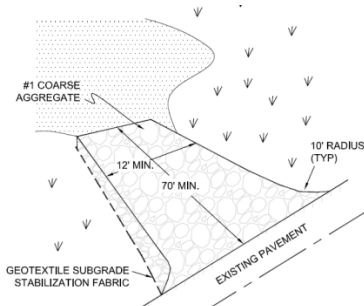
- Clean up mud or dirt tracked onto paved surfaces the same day.
- Damaged curb, gutter, or sidewalk should be replaced.
- Make sure all vehicles use the stabilized construction entrance.
- Replace and/or add aggregate as needed to prevent tracking mud and debris into the street. Choose stones 3 to 6" in diameter; Stones should be approximately 6" deep.
- Gravel should be placed on top of geotextile material.

Maintenance Tips

- The entrance shall be maintained in a condition which will prevent tracking or flow of mud onto public rights-of-way. This may require periodic top dressing with additional stone or the washing and reworking of existing stone as conditions demand and repair and/or cleanout of any structures used to trap sediment.
- All materials spilled, dropped, washed, or tracked from vehicles onto roadways or into storm drains must be removed immediately.
- The use of water trucks to remove materials dropped, washed, or tracked onto roadways will not be permitted under any circumstances.



Source: University of Virginia



6.2 EXPOSED AREAS

According to VDOT Specifications, the duration of the exposure of uncompleted construction to the elements shall be as short as practicable. Removing vegetation and topsoil can quickly result in erosion. This section discusses measures used to stabilize exposed areas to reduce erosive conditions and sediment from being transported downstream.

PERMANENT SEEDING VDOT STD & SPEC 244.02(c)

Permanent seeding is the establishment of perennial vegetative cover on disturbed areas by planting seed. Seeding is economical, adaptable to different site conditions, and allows for the selection of the most appropriate plant materials. Permanent seeding is used to control runoff and erosion on disturbed areas by establishing perennial vegetative cover from seed. It is used to reduce erosion, to decrease sediment yields from disturbed areas, and to provide permanent stabilization.

Installation Tips

- Prepare seed bed by loosening surface to a minimum depth of 4".
- Perform all drill seeding operations with the slope contour.
- Mulch or jute nets should be applied immediately, but no more than 4 hours after seeding.
- The area should be re-seeded if the seeded areas fail to establish, provide adequate ground coverage, or is disturbed.
- Seeding should occur throughout the duration of the project as construction is completed, during each growing season.
- Seeding should only take place during the appropriate seeding seasons. Seeding outside the seasonal constraints may cause seeding failures.
- Please check Road and Bridge Specifications for type(s) of seed appropriate for particular State regions.

Maintenance Tips

- Even with careful, well-planned seeding operations, failures can occur. When it is clear that plants have not germinated on an area or have died, these areas must be reseeded immediately to prevent erosion damage.
- It is extremely important to determine the reason germination did not take place and make any corrective action necessary prior to reseeding the area. Healthy vegetation is the most effective erosion control available.



Source: www.trahonhydroseeding.com/pics.htm

MULCHING

VDOT STD & SPEC 244.02(g)

Mulching is the application of plant residues or other suitable materials to the soil surface. The primary function of mulching is to reduce erosion by protecting bare soils from rainfall, increasing infiltration, and reducing runoff. Mulching can also be used in conjunction with temporary and permanent seeding to enhance plant establishment. When used in combination with seeding or planting, mulching can aid plant growth by holding seeds, fertilizers, and topsoil in place, preventing birds from eating seeds, retaining moisture, and insulating plants roots from extreme temperatures.

Installation Tips

- Mulch must cover the entire site with no bare areas and should be applied within 4 hours of seeding.
- Avoid placing the material on roads, sidewalks, drainage channels, or existing vegetation.
- Mulch should not be applied when windy conditions are present.
- Dry straw: Apply 1.5–2 tons per acre, 70 lbs per 1,000 square feet. Straw mulching can be applied either by machine or by hand. The straw needs to be anchored to the soil. One method of anchoring is pressing the straw into the soil with a mulching tiller (a machine designed for this purpose), or applying a cutback asphalt tack at 1,200 per acre.
- Mulching applied at the correct rate will allow approximately 50% of the soil to be visible.
- Hay: Apply 2 tons per acre, 90 lbs per 1,000 square feet. The remainder of application is the same as straw.

Maintenance Tips

- All mulches and soil coverings should be inspected periodically (particularly after rainstorms) to check for erosion. Where erosion is observed in mulched areas, additional mulch should be applied. Nets and mats should be inspected after rainstorms for dislocation or failure.
- If washouts or breakage occur, re-install netting or matting as necessary after repairing damage to the slope or ditch. Inspections should take place up until grasses are firmly established. Where mulch is used in conjunction with ornamental plantings, inspect periodically throughout the year to determine if mulch is maintaining coverage of the soil surface; repair as needed.



Source: County of San Mateo, California

PROTECTIVE COVERING INST. (GEOTEXTILES) VDOT R&B STD 113.02 (EC-2)

Protective coverings/mats are used to cover bare soil and reduce erosion. These mats may also be used to stabilize soil for the establishment of vegetation. Protective coverings are geotextile materials composed of natural materials or synthetic fibers. Protective coverings may be composed of several different types of materials: jute, straw, wood fiber, coconut fiber, plastic and synthetic fibers.

Installation Tips

- Grade the site prior to geotextile installation.
- Loosen the top 2-3" of topsoil.
- Seed the area before applying the mat.
- Anchor slots, junction slots, and check slots to be buried 6" to 12" and variable.
- Staples formed from No. 8 steel wire with 8" minimum length for sandy soil and 6" minimum length for other soil.
- Maximum spacing is 5' for 4:1 slopes or flatter.
- Maximum spacing is 3' for slopes steeper than 4:1.
- Overlap the edges of adjacent parallel rolls by 2" minimum.

Maintenance Tips

- Inspect after rainstorms to check for erosion and undermining. Repair any dislocation or failure immediately.
- If washout or breakage occurs, reinstall the material only after repairing damage to the slope or ditch.



Source: City of Milwaukee, Wisconsin

6.3 CHANNEL STABILIZATION

The conveyance of concentrated stormwater runoff results in the need for specific measures within channels to protect the channel bed and banks from erosion and subsequent transport of sediment. Matting assists in protecting the soils from erosion with concentrated flows, while check dams can decrease the velocities of these flows while also allowing for sediment to settle from the water due to a ponding behind these inline measures.

SOIL STABILIZATION MATS – IN DITCHES: TYPE A/B VDOT R&B STD 113.03 (EC-3)

Soil stabilization mats designated as Type A or B (EC-3) are geotextile materials used as protective lining in ditches. These types of mattings can mitigate erosive conditions in ditches with flows at the specified velocities.

Installation Tips

- Stakes shall be wood or metal and shall be a minimum 12" in length. In sandy soils, metal stakes a minimum of 18" in length shall be used.
- Soil stabilization mat should be installed to the shoulder break or existing ground then embedded 6". Material on both sides of the ditch shall be installed to the same elevations.
- If more than 3 lines of material are required parallel to the centerline of the ditch, material shall be installed perpendicular to the centerline of the ditch, starting at the lowest centerline elevation of the ditch.
- Entrench edges of material 6".
- Use a 3' overlap between material rolls.
- Maximum stake spacing is 3' on center.
- Overlap the edges of adjacent parallel rolls by 3" minimum.

Maintenance Tips

- If washout or breakage occurs, the design criteria may need to be determined valid by an engineer.
- All soil stabilization blankets and matting should be inspected periodically following installation, particularly after rainstorms to check for erosion and undermining.
- Any dislocation or failure should be repaired immediately. Continue to monitor these areas until which time they become permanently stabilized; at that time an annual inspection should be adequate.



Source: City of Milwaukee, Wisconsin

ROCK CHECK DAMS VDOT R&B STD 113.06 (EC-4)

Check dams are small temporary stone dams constructed across a swale or drainage ditch. This measure reduces the velocity of concentrated stormwater flows, thereby reducing erosion of the swale or ditch. This practice also traps sediment by ponding the stormwater runoff. Check dams may be constructed of rock, gravel bags, sandbags, fiber rolls, straw bales, or other reusable materials. They are most effective when used with other stormwater, erosion, and sediment-control measures.

Installation Tips

- Check dams should be used in the following areas:
 - Small open channels or swales that drain areas of 10 acres or less.
 - Steeply sloped swales or channels.
 - Swales or channels where adequate vegetation cannot or has not become established.
- Check dams should not be used in:
 - Live streams.
 - Large channels.
- Check dams should be installed at a distance and height to allow small pools to form between each dam. As a general rule, the maximum spacing between dams should be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam (see Table 8.3.2(a) for spacing guidance).
- A 2-year or larger storm should safely flow over the rock check dam without an increase in upstream flooding or destruction of the rock check dam.
- The maximum height of the rock check dam at the center should not exceed 2' or one-half the depth of the ditch. The rock check dam shall be wide enough to reach from bank to bank of the ditch or swale. Type I to be composed of #57 stone and Class I riprap. If riprap size is required as part of the design, contact a VDOT Hydraulic Engineer. Type II to be composed of #57 stone and #1 coarse aggregate.
- Center of check dam elevation should be 6-inches lower than side of dam
- Seed ditches and install check dams before excavating, filling, or grading uphill areas
- Do not install check dams in state waters.

Check Dam Spacing Guidance

| Ditch grade (%) | Spacing (feet) |
|---|----------------|
| 1 | 200 |
| 2 | 100 |
| 4 | 50 |
| 6 | 33 |
| Above 6% ditch grade, you may need to flatten the slope | |
| 8 | 25 |
| 10 | 20 |

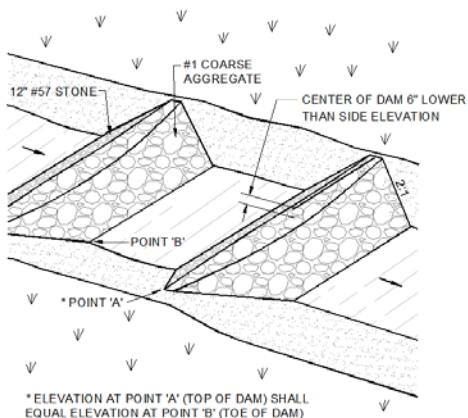
Maintenance Tips

- Check dams should be checked for sediment accumulation after each run-off producing storm event. Sediment should be removed and properly disposed of from behind the check dams when it has accumulated to one-half of the original height of the dam.

- Inspect for erosion along the ends of the check dams and repair immediately when necessary.
- Temporary check dams should be removed when their useful life has been completed. In the case of grass-lined ditches, check dams should be removed when the grass has matured sufficiently to protect the ditch or swale from erosion. The area beneath the check dams should be seeded and mulched immediately after the check dams are removed.



Source: Delaware Department of Transportation



Rock check dam, Type 2.

GRAVEL BAG CHECK DAM TYPE III VDOT R&B STD 113.06(A) (EC-4)

Gravel Bag Check Dams are used to control the velocity of concentrated runoff in ditches and swales to prevent gully erosion until the channel can be established. Gravel bag check dams (Type III) are similar to rock check dams.

Installation Tips

- For use in small, shallow roadside ditches and ditch maintenance operations.
- Gravel bag check dams shall be comprised of 4 gravel bags placed at a distance and height to allow small pools to form behind them.
- Where drainage areas exceed 1 acre or ditch grade exceeds 3%, a temporary sediment forebay shall be installed with minimum dimensions of 12" depth, 2' width, and 6' length.
- See Standard EC-4 for suggested rock check dam spacing.
- Maximum gravel bag check dam height shall be 3' from the bottom of lowest bag to top point of highest bag.
- Do not install check dams in live streams.

Maintenance Tips

- Check dams should be checked for sediment accumulation after each runoff producing storm event. Sediment should be removed when it reaches one half of the original height of the measure.
- Inspect for erosion along the ends of the check dams and repair immediately when necessary.
- Bags are to be flushed out and cleaned for reuse. Any tears or rips in the bag shall be repaired or the bag material replaced before reuse.



Source: stormh2o.org

6.4 SLOPE STABILIZATION AND SCOUR REPAIR

Slopes-especially steep and/or long ones must be protected to prevent sheet, rill, and gully erosion. Slopes should be stabilized immediately after grading work is completed. Soil retention blankets or riprap are needed on most slopes steeper than 3:1; depending on soil types. 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. If slopes are broken up into benches or steps, runoff can be collected and diverted to channels that lead to a pipe or to open channel embankment protectors that have stable outlets. Combine the following ESC measures with seeding and mulching to protect slopes.

RIPRAP ARMORING SPECIFICATION BOOK S-414

Riprap armoring for slope stabilization is a permanent, erosion resistant ground cover of large, loose, angular stone with a geotextile or granular lining. Riprap for slope stabilization shall be designed so that the natural angle of repose of the stone mixture is greater than the gradient of the slope being stabilized. A PROFESSIONAL ENGINEER SHOULD COMPLETE THE RIPRAP DESIGN FOR SLOPE STABILIZATION.

Installation Tips

- The subgrade for the riprap or filter shall be prepared to the required lines and grades.
- Any fill required in the subgrade shall be compacted to a density approximately that of the surrounding undisturbed material. Brush, trees, stumps and other objectionable material shall be removed.
- Placement of the filter fabric should be done immediately after slope preparation. For granular filters, the stone should be spread in a uniform layer to the specified depth (normally 6"). Where more than one layer of filter material is used, the layer should be spread so that there is minimal mixing of the layers.
- When installing geotextile filter cloths, the cloth should be placed directly on the prepared slope. The edges of the sheets should overlap by at least 12". Anchor pins, 15" long, should be spaced every 3' along the overlap.
- The upper and lower ends of the cloth should be buried at least 12".
- Care should be taken not to damage the cloth when placing the riprap. If damage occurs, that sheet should be removed and replaced. For large stone (Class II or greater), a 6" layer of granular filter will be necessary to prevent damage to the cloth.
- Placement of riprap should follow immediately after placement of the filter. The riprap should be placed so that it produces a dense well-graded mass of stone with a minimum of voids. The desired distribution of stones throughout the mass may be obtained by selective loading at the quarry, controlled dumping of successive loads during final placing, or by a combination of these methods.
- The riprap should be placed to its full thickness in one operation. The riprap should not be placed in layers. The riprap should not be placed by dumping into chutes or similar methods which are likely to cause segregation of the various stone sizes.
- Care should be taken not to dislodge the underlying material when placing the stones.
- The finished slope should be free of pockets of small stone or clusters of large stones. Hand placing may be necessary to achieve the required grades and a good distribution of stone sizes. Final thickness of the riprap blanket should be within plus or minus 1/4 of the specified thickness.

Maintenance Tips

Once a riprap installation has been completed, it should require very little maintenance. It should, however, be inspected periodically to determine if high flows have caused scour beneath the riprap or filter fabric or dislodged any of the stone. Care must be taken to properly control sediment-laden construction runoff which may drain to the point of the new installation. If repairs are needed, they should be accomplished immediately.

SOIL STABILIZATION MATS – ON SLOPES: TYPE C VDOT R&B STD 113.05 (EC-3)

Soil Stabilization Mats are used to temporarily stabilize and protect disturbed soil from raindrop impact and surface erosion, to increase infiltration, decrease compaction and soil crusting, and to conserve soil moisture. The blankets also reduce desiccation and evaporation by insulating the soil and seed environment. Maintenance of steep slopes shall be protected with standard EC-3 (Type C) soil stabilization mats. Soil stabilization mats are placed on the soil in disturbed or non-stabilized areas to control erosion, retain sediment resulting from sheet-flow runoff, and protect newly seeded areas. When properly applied, soil retention blankets completely cover the ground surface.

Installation Tips

- The ground should be smooth, with no large rocks, vegetation or rilling on the surface, before placing blankets.
- Areas where blankets are to be used shall be properly prepared with topsoil or soil conditioning, and fertilized if required, and seeded before the blankets are placed.
- The blankets shall be placed smoothly but loosely on the soil surface without stretching.
- Re-anchor loosened matting and replace missing matting and staples as required.
- Blankets at the top of the slope and every 35' shall be trenched in 6" wide by 6" deep.
- Trenching at the top of the slope should be beyond the crest of the slope to avoid undercutting. Steep, long slopes need blankets. Install blankets up and down long slopes. For channels below slopes, install horizontally. Don't forget to apply seed and fertilizer (if necessary) before installing blankets. Overlap the edges of abutting blankets and anchor the overlap.

Maintenance Tips

- All soil stabilization blankets and matting should be inspected periodically following installation, particularly after rainstorms to check for erosion and undermining.
- Any dislocation or failure should be repaired immediately. If a washout or breakage occurs, reinstall the material after damage to the slope or ditch.
- Continue to monitor these areas until which time they become permanently stabilized; at that time an annual inspection should be adequate.



Source: LakeSuperiorStreams.org

TEMPORARY SLOPE DRAIN VDOT R&B STD 113.14 (EC-10)

A temporary slope drain is a flexible tubing or conduit extended from the top to the bottom of a cut or fill slope. This measure temporarily conveys concentrated runoff safely down the face of the cut or fill slope without causing erosion on or below the slope and used in combination with a diversion dike. Slope drains intercept and direct surface runoff or groundwater into a stabilized watercourse, trapping device, or stabilized area.

Installation Tips

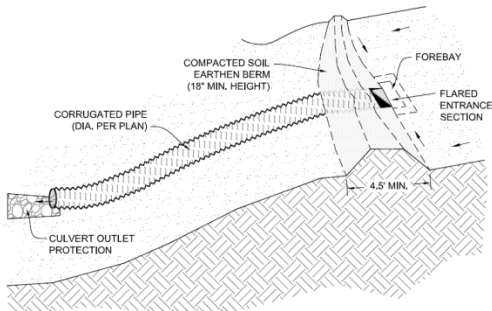
- Stabilize the area disturbed by the installation of the drain or it will be subject to erosion
- Install slope drains perpendicular to slope contours
- Size slope drain based on drainage area to the drain (see Table 8.4.3(a))
- Compact the soil around/under inlet, outlet, and along pipe length
- Anchor and stabilize pipe/tubing securely into soil
- Provide inlet and outlet protection for each slope drain.
- Temporary slope drains shall utilize at least 6" flexible pipe.
- Temporary slope drains with a diameter of 12-inches or larger shall be securely fastened together, have water-tight fittings, and be securely anchored to the slope.
- Temporary slope drains shall be inspected for erosion and accumulation of debris at the inlet and outlet after each significant rainfall.

Maintenance Tips

- The slope drain structure shall be inspected weekly and after every storm, and repairs made if necessary.
- Inspect the inlet for undercutting and to determine if water is bypassing the slope drain inlet. Repair if undercutting or bypass is occurring.
- The contractor should avoid the placement of any material on and prevent construction traffic across the slope drain.



Source: Missouri Department of Transportation



6.5 INLET AND OUTLET PROTECTION

Culverts and ditches are designed and installed to receive concentrated flows and convey them to receiving streams and other water bodies. Inlet protection helps prevent sediment from entering concentrated flows from transporting sediment and other pollutants downstream by reducing sediment entering culverts and ditches, while outlet protection prevents erosion at the outfall of these conveyances.

INLET PROTECTION

VDOT R&B STD 113.09 & 113.10 (EC-6 (Type A, B, &C))

Storm drain inlet protection ESC measures are devices that prevent soil and sediment from entering existing storm drains. Storm drain inlet protection measures are usually temporary and may consist of one or more of the following: excavation around the perimeter of a storm drain inlet, silt fences around inlet entrances, block and gravel protection, or gravel bags. These BMPs are designed either to temporarily pond water (allowing sediment to settle) or to remove sediment by filtration.

Installation Tips

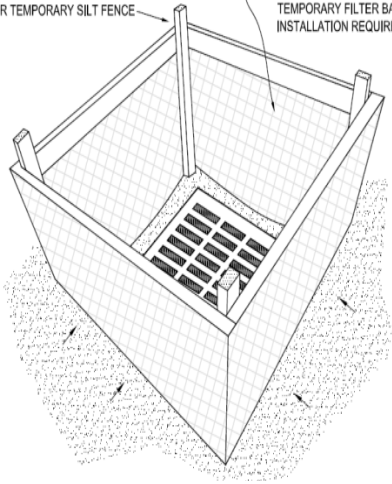
- Barrier (Type A)
 - Install as recommended with filter barrier, rock check dam or gravel bags.
 - Construct in the area upstream of drain inlet with bags that will allow water to pond and sediment to settle
 - Pack bags close together, overlap, and stack several layers high.
 - Leave an area on top level to act as a spillway for overflow.
- Block and Gravel Protection (Type B)
 - Lay wire mesh over inlet structure (overlap if necessary).
 - Place concrete blocks on top of mesh and fabric with openings facing out, not up.
 - Place wire mesh over outside face of the blocks and pile stone against mesh to the top of the blocks.
- Silt Fence (Type C)
 - Install around the perimeter of the storm drain inlet as recommended by the silt fence specifications. If erosion bales are utilized, place silt fence outside of bales.

Maintenance Tips

- The structure shall be inspected after each rain and repairs made as needed.
- Aggregate shall be replaced or cleaned when inspection reveals that clogged voids are causing ponding problems which interfere with on-site construction.
- Sediment shall be removed and the impoundment restored to its original dimensions when sediment has accumulated to one-half the design depth. Removed sediment shall be deposited in a suitable area and in such a manner that it will not erode and cause sedimentation problems.
- Temporary structures shall be removed when they have served their useful purpose but not before the upslope area has been permanently stabilized.

POST AND TOP RAIL SHALL BE A NOMINAL 2½" X 2½"
OR A 3" DIA. NO. 2 SOUTHERN PINE, A NOMINAL 2" X
2" OAK, OR STEEL HAVING A MIN. WEIGHT OF 1,25
LBS PER LINEAR FOOT AND HAVE A MIN. LENGTH
OF 5' FOR TEMPORARY SILT FENCE

SEE VDOT STANDARD 113.07 FOR
TEMPORARY FILTER BARRIER
INSTALLATION REQUIREMENTS



Inlet Protection Detail, Type A



Source: St. Mary's Soil Conservation District, Maryland

Type B Inlet Protection Detail

OUTLET PROTECTION – SOIL STABILIZATION MAT VDOT R&B STD 113.04 (EC-3)

Outlet protections are structurally-lined aprons or other acceptable energy dissipating devices placed at the outlets of pipes or channels and prevent scour and erosion at the outlet of a channel or culvert by reducing the velocity of stormwater flow as it is discharged. To prevent scour and erosion at the outlet of a channel or culvert by reducing the velocity of stormwater flow as it is discharged.

Installation Tips

- For multiple line installations, pipe diameter (S) is to govern the protection outside the channel width (W).
- Soil stabilization mat Type B shall be used for culvert outlet protection where the outlet velocity is 6 fps or less. If the outlet velocity is greater than 6 fps, use standard EC-1 material.

Maintenance Tips

- Soil stabilization blankets and matting should be inspected periodically following the installation, particularly after rain events.
- Any erosion, undermining, or dislocation should be repaired immediately.
- Continue to monitor these areas until which time they become permanently stabilized; at that time an annual inspection should be adequate.



Source: CENews.com

OUTLET PROTECTION - RIPRAP VDOT R&B STD 113.01 (EC-1)

Outlet protection prevents scour and erosion at the outlet of a channel or culvert by reducing the speed of stormwater. Riprap consists of a layer of large, angular stones placed on top of or in erodible areas. Generally, this is a permanent erosion control. Riprap protects areas that are subject to concentrated flows and is particularly useful in outlet protection.

Installation Tips

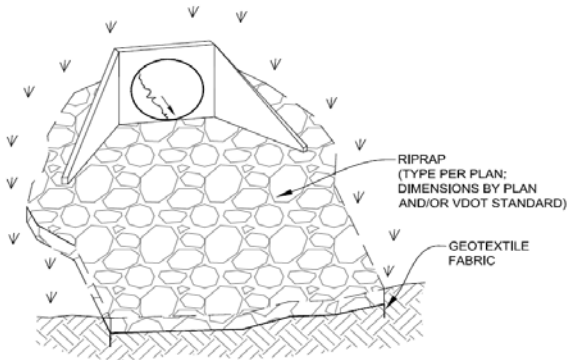
- A professional engineer should complete any riprap designs.
- Do not use rounded stones or cobbles - angular edges are needed.
- Riprap is generally clean machined shot rock composed of limestone or granite. It should be free from impurities such as dust, sand, and organic materials, and should be durable enough to withstand freeze/thaw cycles. Reject any riprap with cracks or fissures.
- Do not use uniformly-sized riprap: it should be a mixture of sizes (graded riprap) for maximum effectiveness
- Riprap should be installed immediately after initial land disturbance.
- Install a geotextile liner so riprap does not come in direct contact with underlying soils. Geotextiles should be installed under Class A1, I, and II materials in accordance with the specifications.
- The thickness of each riprap layer should be twice the largest stone diameter, but not less than 6".
- The riprap apron shall be installed with no slope along its entire length (0.0% grade).
- The invert elevation at the downstream end of the apron shall be equal to the elevation of the invert of the receiving channel. There shall be no overfall at the end of the apron.

Maintenance Tips

Once a riprap installation has been completed, it should require very little maintenance. It should, however, be inspected periodically to determine if high flows have caused scour beneath the riprap or filter fabric or dislodged any of the stone. Care must be taken to properly control sediment-laden construction runoff which may drain to the point of the new installation. If repairs are needed, they should be accomplished immediately.



Source: H. Stewart Kline & Associates



Rip-Rap Outlet Protection

6.6 OTHER CONTROLS

This section discusses measures that are not clearly fit within the other sections of this guide. However, these controls can be used either commonly or routinely during routine maintenance activities.

DEWATERING BASINS OR BAGS VDOT R&B STD 113.12 (EC-8)

Dewatering Basins or Bags are used for collecting silt and debris from water being pumped from ditches, runoff collection ponds, and drilling before it is allowed to leave a construction site and are designed to replace expensive retention basins and to hasten the dewatering process. Dewatering bags are the most effective when there is not a good open pit solution. This method allows the material to be pumped into bags which retain the sediment but allow the water to exit and return to the source clean.

Installation Tips

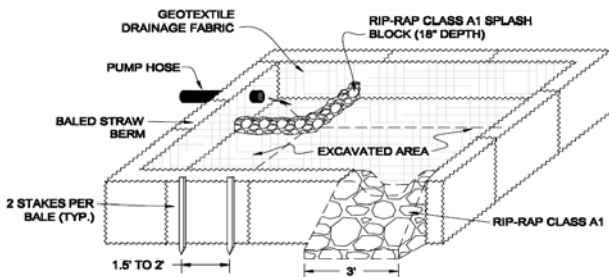
- Water from dewatering operations shall not be directly discharged into any state waters including wetlands, irrigation ditches, canals, or storm sewers, unless allowed by the permit.
- Discharge into sanitary sewers will not be allowed unless written permission is obtained from the municipality or owner of the sanitary sewer system.
- Dewatering bags must be placed on level ground that has been stabilized with blanket, rock, or another approved BMP.

Maintenance Tips

- Replace dewatering bags when trapped sediment has accumulated to 50% of the bag capacity or in accordance with the manufacturer.
- Dewatering Bags are full when they no longer efficiently filter sediment or pass water at a reasonable rate.
- Incoming flow rates will vary depending on the size of bag, the type and amount of sediment discharged into the dewatering bag, the permeability of the underlying aggregate, and the degree of slope on which the bag lies.



Source: The Pond & Lake Connection



Dewatering Basin

LEVEL SPREADER VDOT R&B STD 113.20 (EC-16)

A level spreader is a stormwater control used to convert concentrated flow into diffuse flow and consist of an excavated depression constructed at zero grade across a slope. By eliminating concentrated flow, level spreaders promote infiltration, sorption of pollutants onto surficial soils, biological uptake of pollutants, and reduction of downgrade erosion. Level spreaders are implemented in an offline configuration to protect the level spreader from failure and to prevent flow re-concentration.

Installation Tips

- Level spreaders must be constructed on undisturbed soil (not fill material).
- The entrance to the spreader must be shaped in such a manner as to insure that runoff enters directly onto the 0% channel.
- The level lip shall be constructed at 0% grade to ensure uniform spreading to the width and depth of the spreader.
- Protective covering for vegetative lip should be a minimum of 4' wide extending 6" over the lip and buried 6" deep in a vertical trench on the lower edge. The upper edge should butt against smoothly cut sod and be securely held in place with closely spaced heavy duty wire staples.
- Rigid level lip should be entrenched at least 2" below existing ground and securely anchored to prevent displacement. An apron of VDOT # 3, #357, #5, #56 or #57 Coarse Aggregate should be placed to top of level lip and extended downslope at least 3'. Place filter fabric under stone and use galvanized wire mesh to hold stone securely in place.
- The released runoff must outlet onto undisturbed stabilized areas with slope not exceeding 10%. Slope must be sufficiently smooth to preserve sheet flow and prevent flow from concentrating.
- Immediately after its construction seed and mulch the entire disturbed area of the spreader.

Maintenance Tips

- The measure shall be inspected after every rainfall and repairs made, if required.
- Level spreader lip must remain at 0% slope to allow proper function of measure. The contractor should avoid the placement of any material on and prevent construction traffic across the structure.
- If the measure is damaged by construction traffic, it shall be repaired immediately.



Source: Lake County, Illinois

TURBIDITY CURTAINS

VDOT R&B STD 113.21, 113.22, and 113.23 (EC-17)

A turbidity curtain is a temporary measure to minimize the drift of suspended material within a watercourse during construction of the project. A turbidity curtain is used to provide protection for a watercourse or body of water from upland land disturbance where conventional erosion and sediment control is not sufficient.

Installation Tips

- The curtain shall extend the entire depth of the watercourse whenever the watercourse is not subject to tidal action and/or significant wind/wave action.
- In tidal and/or wind and wave action situations, the curtain shall never touch the bottom. A minimum 1' gap shall be established between the weighted lower end of the skirt and the bottom at the mean low water.
- The curtain shall be synthetic fabric coated with suitable elastomeric or polymeric compound; having high resistance to weathering, hydrocarbons, fresh and salt water, and temperature extremes.
- The curtain shall form a continuous vertical and horizontal barrier for the entire width and length of each section. Seams, if required, shall be either vulcanized welded or sewn and shall develop the full strength of the fabric.
- Floatation shall be flexible, buoyant units contained in a floatation sleeve or collar attached to the curtain.
- Load lines shall be fabricated into the top and bottom of the curtain.
- External anchors shall consist of wooden or metal stakes (2"-x4" minimum diameter wood or 1.33 pounds/linear foot steel) when Type I installation is used; when Type II or Type III installations are used, bottom anchors should be used.
- Bottom anchors shall be sufficient to hold the curtain in the same position relative to the bottom of the watercourse without interfering with the action of the curtain.

Maintenance Tips

- Filter fabric maintenance is required for the duration of the project. When the curtain is no longer required, the curtain and related components shall be removed in such a manner as to minimize turbidity.
- The developer/owner shall be responsible for maintenance of the filter curtain for the duration of the project in order to ensure the continuous protection of the watercourse.
- Should repairs to the geotextile fabric become necessary, there are normally repair kits available from the manufacturers; manufacturer's instructions must be followed to ensure the adequacy of the repair.
- When the curtain is no longer required as determined by the inspector, the curtain and related components shall be removed in such a manner as to minimize turbidity. Remaining sediment shall be sufficiently settled before removing the curtain.

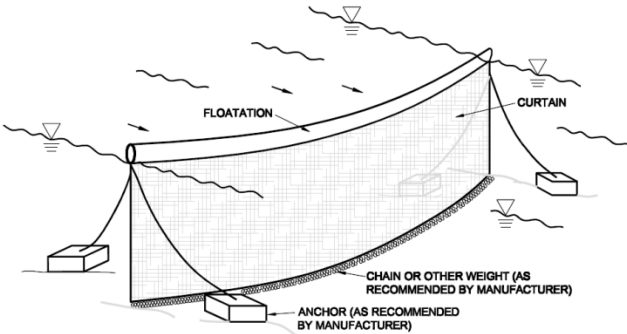
TYPE I configuration shall be used in protected areas where there is not current and the area is sheltered from wind and waves. Type I installation usually occurs in calm water associated with lakes and ponds.

TYPE II configuration shall be used in areas where there may be small to moderate current running (up to 2 knots or 3.5' per second) and/or wind and wave action. Type II installation usually occurs in rivers or tidal waters.

TYPE III configuration shall be used in areas where considerable current (up to 3 knots or 5' per second) may be present, where tidal action may be present and/or where the curtain is potentially subject to wind and wave action. Type III installation usually occurs in rivers or tidal waters.



Source: Schuylkill Headwaters Association, Pennsylvania



TEMPORARY SEDIMENT TRAP VDOT R&B STD 113.11 (EC-7)

A temporary sediment trap is a ponding area formed by constructing an earthen embankment with a stone outlet to detain sediment-laden runoff from the disturbed areas of the site by holding the water long enough for sediment to fall out. With respect to VDOT maintenance tasks, a temporary sediment trap is typically used in conjunction with the construction of stockpile/disposal site.

Installation Tips

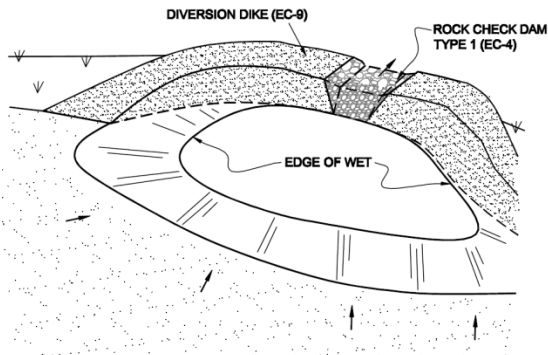
- The sediment storage volume shall be 134 cubic yards per acre of total contributing drainage area and shall consist of half in the form of wet storage and half in the form of dry storage.
- The dimensions and elevations of the temporary sediment trap design should be performed by an engineer.

Maintenance Tips

- When the sediment reached the maximum level per design it should be removed.
- The trap should be inspected after any rainfall event. The embankments and spillways should also be inspected and repaired.
- If the outlet becomes clogged with sediment, it should be cleaned out to bring the basin back to its original designed operational condition.



Source: St. Marys Soil Conservation District, Maryland



RIPRAP WEIRS VDOT R&B STD 113.17 (EC-13)

A Riprap weir is a dam of large, loose, angular stone used to temporarily divert water while working on a multiple barrel culvert. A PROFESSIONAL ENGINEER SHOULD COMPLETE THE RIPRAP DESIGN FOR A RIPRAP WEIR.

Installation Tips

- The riprap should be placed so that it produces a dense well-graded mass of stone with a minimum of voids. The desired distribution of stones throughout the mass may be obtained by selective loading at the quarry, controlled dumping of successive loads during final placing, or by a combination of these methods.
- The riprap should be placed to its full thickness in one operation. The riprap should not be placed in layers. The riprap should not be placed by dumping into chutes or similar methods which are likely to cause segregation of the various stone sizes.
- Care should be taken not to dislodge the underlying material when placing the stones.
- Hand placing may be necessary to achieve the required grades and a good distribution of stone sizes. Final thickness of the riprap blanket should be within plus or minus 1/4 of the specified thickness.

Maintenance Tips

Once a riprap installation has been completed, it should require very little maintenance. It should, however, be inspected periodically to determine if high flows have caused scour beneath the riprap or dislodged any of the stone. Care must be taken to properly control sediment-laden construction runoff which may drain to the point of the new installation. If repairs are needed, they should be accomplished immediately.

TEMPORARY VEHICULAR WATERCOURSE CROSSING VDOT R&B STD 113.18 (EC-14)

A Temporary Vehicular Stream Crossing is used as a means for construction traffic to cross flowing streams without damaging the channel or banks and to keep sediment generated by construction traffic out of the stream. Temporary stream crossings are necessary to prevent construction vehicles from damaging stream banks and continually tracking sediment and other pollutants into the flow regime.

Installation Tips

- Clearing and excavation of the stream bed and banks shall be kept to a minimum.
- The invert elevation of the culvert shall be installed on the natural streambed grade to minimize interference with fish migration.
- Filter cloth shall be placed on the streambed and stream banks prior to placement of the pipe culvert(s) and aggregate. The filter cloth shall cover the streambed and extend a minimum of six inches and a maximum of one foot beyond the end of the culvert and bedding material. Filter cloth reduces settlement and improves crossing stability.
- The culvert(s) shall extend a minimum of 1' beyond the upstream and downstream toe of the aggregate placed around the culvert. In no case shall the culvert exceed 40' in length.
- The culvert(s) shall be covered with a minimum of one foot of aggregate. If multiple culverts are used, they shall be separated by at least 12" of compacted aggregate fill. At a minimum, the bedding and fill material used in the construction of the temporary access culvert crossings shall conform with the aggregate requirements cited in part "i" under "Temporary Culvert Crossing."
- When the crossing has served its purpose, all structures including culverts, bedding and filter cloth materials shall be removed. Removal of the structure and clean-up of the area shall be accomplished without construction equipment working in the waterway channel.
- Upon removal of the structure, the stream shall immediately be shaped to its original cross-section and properly stabilized.

Maintenance Tips

Structures shall be inspected after every rainfall and at least once a week, whether it has rained or not, and all damages repaired immediately.

Appendix A

Erosion and Sediment Control Minimum Standards

EROSION AND SEDIMENT CONTROL MINIMUM STANDARDS

(1) Soil Stabilization - Permanent or temporary soil stabilization shall be applied to denuded areas within seven days after final grade is reached on any portion of the site. Temporary soil stabilization shall be applied within seven days to denuded areas that may not be at final grade but will remain dormant for longer than 30 days, but less than one year.

Permanent stabilization shall be applied to areas that are to be left dormant for more than one year.

(2) Soil Stockpile Stabilization - During construction, soil stockpiles and borrow areas shall be stabilized or protected with sediment trapping measures. Temporary protection and permanent stabilization shall be applied to all soil stockpiles on site and borrow areas or soil intentionally transferred off site.

(3) Permanent Stabilization - Permanent vegetative cover shall be established on denuded areas not otherwise permanently stabilized. Permanent vegetation shall not be considered established until a ground cover is achieved that is:

- Uniform
- Mature enough to survive
- Will inhibit erosion

(4) Sediment Basins & Traps - Sediment basins, sediment traps, perimeter dikes, sediment barriers, and other measures intended to trap sediment shall be constructed as a first step in any land-disturbing activity and shall be made functional before upslope land disturbance takes place.

(5) Stabilization of Earthen Structures - Stabilization measures shall be applied to earthen structures such as dams, dikes, and diversions immediately after installation.

(6) Sediment Traps & Sediment Basins - Sediment traps and basins shall be designed and constructed based upon the total drainage area to be served by the trap or basin.

(7) Cut and Fill Slopes Design & Construction - Cut and fill slopes shall be designed and constructed in a manner that will minimize erosion. Slopes found to be eroding excessively within one year of permanent stabilization shall be provided with additional slope stabilizing measures until the problem is corrected.

(8) Concentrated Runoff down Slopes - Concentrated runoff shall not flow down cut or fill slopes unless contained within an adequate temporary or permanent channel, flume, or slope drain structure.

(9) Slope Maintenance - Whenever water seeps from a slope face, adequate drainage or other protection shall be provided.

(10) Storm Sewer Inlet Protection - All storm sewer inlets made operable during construction shall be protected so that sediment-laden water cannot enter the stormwater conveyance system without first being filtered/treated to remove sediment.

(11) Stormwater Conveyance Protection - Before newly constructed stormwater conveyance channels or pipes are made operational, adequate outlet protection and any required temporary or permanent channel lining shall be installed in both the conveyance channel and the receiving channel.

(12) Work in Live Watercourse - When work in a live watercourse is performed: Precautions shall be taken to minimize encroachment, control sediment transport, and stabilize the work area to the greatest extent possible during construction. Non-erodible material shall be used for the construction of causeways and cofferdams. Earthen fill may be used for these structures if armored by non-erodible cover materials.

(13) Crossing Live Watercourse - When a live watercourse must be crossed by construction vehicles more than twice in any six-month period, a temporary vehicular stream crossing constructed of non-erodible material shall be provided.

(14) Regulation of Watercourse Crossing - All applicable federal, state and local regulations pertaining to working in or crossing live watercourses shall be met.

(15) Stabilization of Watercourse - The bed and banks of a watercourse shall be stabilized immediately after work in the watercourse is completed.

(16) Underground Utility Line Installation - Underground utility lines shall be installed in accordance with the following standards in addition to other applicable criteria:

- No more than 500 linear feet of trench may be opened at one time
- Excavated material shall be placed on the uphill side of trenches
- Effluent from dewatering operations shall be filtered or passed through an approved sediment trapping device, or both, and discharged in a manner that does not adversely affect flowing streams or off-site property
- Material used for backfilling trenches shall be properly compacted in order to minimize erosion and promote stabilization
- Re-stabilization shall be accomplished in accordance with these regulations
- Comply with applicable safety regulations

(17) Vehicular Sediment Tracking - Where construction vehicle access routes intersect paved or public roads:

Provisions shall be made to minimize the transport of sediment by vehicular tracking onto the paved surface.

Where sediment is transported onto a paved or public road surface, the road surface shall be cleaned thoroughly at the end of each day. Sediment shall be removed from the roads by shoveling or sweeping and transported to a sediment control disposal area. Street washing shall be allowed only after sediment is removed in this manner.

(18) Removal of Temporary Measures - All temporary erosion and sediment control measures shall be removed within 30 days after final site stabilization or after the temporary measures are no longer needed, unless otherwise authorized by the program authority. Trapped sediment and the disturbed soil areas resulting from the disposition of temporary measures shall be permanently stabilized to prevent further erosion and sedimentation.

(19) Stormwater Management - Properties and waterways downstream from development sites shall be protected from sediment deposition, erosion, and damage due to increases in volume, velocity, and peak flow rate of stormwater runoff for the stated frequency storm of 24-hour duration.

Appendix B
Common ESC Measures for Routine Maintenance

| Maintenance ESC Measures | Ditching | Pipe Replacement | Bank Stabilization and Scour Repair | Slope Repair | Disposal/Borrow Areas |
|--------------------------|----------|------------------|-------------------------------------|--------------|-----------------------|
| Check Dam | X | | X | X | |
| Construction Entrance | X | X | X | X | X |
| Diversion Channel/Dike | X | X | | X | |
| EC-2 Matting | X | | X | X | |
| EC-3 Stabilization | X | | X | X | |
| Inlet Protection | X | X | | X | X |
| Dewatering Bag | | X | X | X | |
| Outlet Protection | | X | | | |
| Silt Fence | X | X | X | X | X |
| Slope Drain | | | | X | |
| Cofferdams | | X | X | | |
| Rip Rap | | X | X | X | |
| Seeding & Mulching | X | X | X | X | X |

Note: This table represents those ESC Measures that are typically used for various maintenance activities. However, depending on site conditions, other ESC Measures could be more appropriate. Therefore, always rely on those ESC Measures that have been identified in the approved ESC Plan.