Alabama Handbook for

Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas

Volume 2

Installation, Maintenance, and Inspection of Best Management Practices

2018

Alabama Soil and Water Conservation Committee
Montgomery, Alabama

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Introduction

The *Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas* (Rev. No. 4 July 2018) provides guidance for preventing or minimizing the related problems of erosion, sediment and stormwater on construction sites associated with non-agricultural development.

This latest update of the Handbook corrected some misspellings, made changes to several practices based on recent research of The Auburn University Erosion and Sediment Control Test Facility, consolidated the Inlet Protection practice, and incorporated more specific geotextile property requirements.

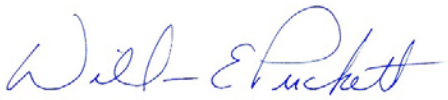
Volume 1 provides essential information that can be used by trained planners and designers to develop sound plans and designs.

Volume 2 provides information that can be used by developers, contractors and inspectors to install and maintain the measures, commonly referred to as Best Management Practices.

Potential Handbook users should recognize that plans, designs, installation and maintenance are integral and related aspects of site development. Each aspect has a role in sound development and protection of natural resources. With this viewpoint, we recognize that both volumes of the Handbook contain information necessary for site stewardship. Depending upon their role in the development process, users may need one or both of the volumes.

Yes, regulations are necessary for several reasons, but a stewardship ethic that recognizes that our natural resources should be protected during and after development should be a mindset of each party involved in land development. This approach puts the tasks of erosion control, sediment control and stormwater management in a proactive mode which is essential to minimize negative impacts during development.

The Alabama Soil and Water Conservation Committee encourages those involved in construction activities to voluntarily and aggressively embrace sound technology and practice strong stewardship of our land and water resources. This approach maximizes benefits to those involved and protects the environment.



Dr. William E. Puckett, Executive Director
Alabama Soil and Water Conservation Committee

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Chapter 1

Erosion, Sedimentation and Stormwater Processes (An Overview)

This chapter presents a simple overview of the processes referred to as erosion, sedimentation and stormwater. If in-depth information is needed on these subjects, other references, including Volume I, should be used.

Processes

Erosion is the process by which the land surface is worn away by the action of water, wind, ice or gravity. Water-related erosion is the primary problem in developing areas of Alabama.

With the exception of shorelines and stream channels where erosion may be rapid and catastrophic, geologic erosion occurs at very slow rates. This natural erosion process, which has taken place over millions of years, has probably occurred at rates comparable to erosion in our forests that have no current disturbances.

The erosion accelerated by the disturbances of humans is referred to as "accelerated erosion" and can be significant and create adverse impacts.

Sedimentation is the process that describes soil particles settling out of suspension. Associated with sedimentation is **turbidity**, a cloudy or muddy condition of water usually resulting from eroded soil suspended in the water column.

Stormwater refers to the water flowing over the land during and immediately following a rainstorm.

Factors Influencing Erosion, Sedimentation and Stormwater

Erosion is influenced primarily by climate, topography, soils, and vegetative cover.

Climate includes rainfall, wind and temperature. The frequency, intensity and duration of rainfall are the principal aspects of rainfall influencing the volume of runoff and sediment (potential) from a given area. As the volume and intensity of rainfall increase, the ability of water to detach and transport soil particles increases. When storms are frequent, intense, and of long duration, the potential for erosion of bare soils is high. Temperature has a major influence on soil erosion. Frozen soils are relatively erosion resistant. However, bare soils with

high moisture content are subject to uplift or "spew", by freezing action, and are usually very easily eroded upon thawing. And temperature is a major factor affecting the species that cover the earth.

Topography includes the shape and slope characteristics of an area or watershed and influences the amount and duration of runoff. The greater the slope length and slope gradient, the greater the potential for runoff, erosion and sediment delivery.

Soils aspects include soil texture, soil structure, organic matter content and permeability. In addition, in many situations compaction is significant. These aspects greatly determine the erodibility of soil.

Soils containing high percentages of sand and silt are the most susceptible to detachment because they lack inherent cohesiveness characteristics. However, the high infiltration rates of sands either prevent or delay runoff except where overland flow is concentrated. Clearly, well-graded and well-drained sands are usually the least erodible soils in the context of sheet and rill erosion.

Clay and organic matter act as a binder to soil particles thus reducing erodibility. As the clay and organic matter content of soils increase, the erodibility decreases. But, while clays have a tendency to resist erosion, they are easily transported by water once detached.

Soils high in organic matter resist raindrop impact and the organic matter also increases the binding characteristics of the soil.

Sandy and silty soils lack inherent cohesiveness and are highly susceptible to gully erosion where flows concentrate on slopes and in channels.

Vegetative cover is an extremely important factor in reducing erosion at a site. It will:

a. Absorb energy of raindrops.
b. Bind soil particles.
c. Slow velocity of runoff water.
d. Increase the ability of a soil to absorb water.
e. Remove subsurface water between rainfall events through the process of evapotranspiration.

By limiting the amount of vegetation disturbed and the exposure of soils to erosive elements, soil erosion can be greatly reduced.

Sedimentation is influenced by the nature of the suspended particles and by the velocity of the runoff.

Gravel and sand, the heavier and larger particles, settle out more rapidly than silt and clay particles.

Silt and clay particles are easily transported and settle out very slowly.

Slower *velocities* associated with flatter terrain or structures such as silt fence and sediment basins dissipate the energy in runoff and allow sediment to be deposited. However, it is difficult, and perhaps impossible in some instances, to totally eliminate the transport of the clay and silt particles even with the most effective sediment control practices. It is the clay particles that are suspended in the runoff that have the most effect on turbidity and have the most adverse impacts on water quality.

Stormwater (rate and total flow) is influenced by climate, soils, geology, topography, vegetative cover and, most importantly, land use.

Runoff intercepted by *vegetation* and evaporated or transpired is lost from runoff. A small portion of the water that infiltrates into the soil and groundwater is delivered to streams as delayed flow and does not contribute directly to peak stormwater runoff.

As an area becomes *urbanized*, the peak rate of runoff and volume of runoff increase. These effects are caused by: 1) a reduction in the opportunity for infiltration, evaporation, transpiration and depression storage; 2) an increase in the amount of imperviousness; 3) modification of the surface drainage pattern, including the associated development of stormwater management facilities.

Impacts of Land Development on Water Quality and Water Quantity

Of primary importance to water quality is the "first flush" in a watershed. This term describes the combined actions that erosion, sedimentation and stormwater have on accumulated pollutants (sediment, pesticides, fertilizers, animal wastes, petroleum products and heavy metals). In the early stages of runoff the land surfaces are flushed by the stormwater. This flushing creates a loading of pollutants. Extensive studies in Florida have determined that the first flush equates to the first one inch of runoff which carries 90% of the pollution load from a storm (USGS, 1984). Other studies have suggested that the first one-half inch of runoff provides the “first flush”.

The “first flush” is dependent upon several factors unique to each site, i.e. percent impervious surface, condition of vegetative cover and soil permeability. “First flush” effects generally diminish as the size of the drainage basin increases and the amount of impervious area decreases.

The potential off-site effects of land development include increased flooding, accelerated erosion of stream systems, increased sediment deposition in both streams and floodplains and adverse impacts on the biological communities associated with the streams and floodplains.

Each progression toward more intensive land use tends to disrupt the ongoing natural processes which protect and preserve water quality and water quantity. Therefore, to ensure future protection of water resources, it is imperative that land uses be managed in a responsible way.

As we reflect on the processes and the potential impact, we recognize the importance of sound site planning, timely and proper installation of the measures planned and the need for long-term maintenance of measures that sustain site stabilization.

We see an increasing need for preserving existing vegetation at construction sites either as long as the project plan permits or, if planned for permanent retention, protecting during the duration of the construction project. Preserving vegetation and adopting low impact development practices will significantly help offset the potential adverse impacts of using our landscapes more intensely.

If the best available technology is used for planning, design, installation and maintenance of erosion and sediment control and stormwater management the impacts of land development will be minimized.

Chapter 2

Plans for Erosion Control, Sediment Control and Stormwater Management (An Overview)

The purpose of this chapter is to provide an overview of erosion control, sediment control and stormwater management (ESC) plans. Plans and practice specifications should be referred to throughout a construction project and are, therefore, important to contractors and inspectors.

Construction plans for site development should include sound plans for erosion control, sediment control and stormwater management. Because of its significance as an indicator of water quality, turbidity should be included in the thought process during planning for erosion and sediment control. Although they may sometimes be discussed separately, erosion control, sediment control and stormwater management are interrelated and when planning occurs the process must conceive a system of practices and measures that consider all three together.

Property owners or operators are responsible for providing sound ESC plans. This is accomplished by using qualified professionals for ESC plan preparation. ESC plan preparation should be an integral part of the facility plan development. Those involved in ESC construction can benefit by understanding some of the basic planning concepts which should be embedded in ESC plans. Such an understanding makes schedules, sequence of installation and maintenance more supportable. These concepts include the following items.

1. Minimize the area disturbed by leaving existing vegetation that does not have to be removed.

2. Minimize the period of bare ground by shortening construction periods and staging a project (dividing the project into sectors that will be done independently of other sectors) when possible.

3. Install practices in a sequence that supports shortened construction periods and permits the use of temporary and permanent seeding when the practices can be most effective.

4. Use perimeter and interior sediment control measures that minimize sediment transport off of the disturbed site.

5. Plan erosion control for all kinds of erosion that may occur depending upon specific site conditions.

6. Give special attention to cut and fill slopes because these are the most difficult to establish effective vegetation.

7. Give special attention to sites that are transected by streams or are in close proximity to streams and wetlands because close proximity to these areas increase the importance of effective erosion and sediment control.

8. Make erosion control plantings at every opportunity.

9. Prevent sediment from leaving a construction site at entrance/exits during muddy periods.

10. Maintain practices to ensure their effectiveness. This includes regular inspections of the practices, the site, adjacent off-site areas and receiving streams.

There are typically two components of an ESC plan: a site plan map showing locations of the planned practices, referred to by most persons as best management practices or BMPs, and a written narrative. It is common to see the written narrative recorded on the site plan map.

ESC plans should contain enough information to ensure that the party responsible for development of a site can install the measures in the correct sequence at the appropriate season of the year. Sufficient information should be included to provide for maintaining the practices and measures during construction and after installation has been completed. A schedule of regular inspections should be set forth to ensure that repairs and maintenance receive appropriate attention and is accomplished.

Associated with ESC plans are designs that show details of the practices. Designs include essential information such as size, shape, elevations and materials for the practices. Designs should be made available at all times for use by contractors during construction.

It is important to recognize that most ESC plans need revising periodically because of a number of reasons such as (a) interruptions by weather or contractual reasons alter the construction schedule, (b) a determination after construction begins that a different combination of practices is needed, and (c) design specifications cannot be met because of unavailability of materials.

For more details on planning concepts and plan preparation, additional information can be found in Volume I (Chapter 2 General Planning Concepts, and Chapter 3 Plan Preparation).

Chapter 3

Installation and Maintenance of Best Management Practices

Construction Exit Pad (CEP)

Practice Description

A construction exit pad is a stone base pad designed to provide a buffer area where mud and caked soil can be removed from the tires of construction vehicles to avoid transporting it onto public roads. This practice applies anywhere traffic will be leaving a construction site and moving directly onto a public road or street.

Typical Components of the Practice

- Site Preparation
- Grading
- Stabilization with Geotextile Fabric (where needed to provide stability)
- Aggregate Placement
- Construction Verification

Construction

Prior to start of construction, temporary gravel construction entrance/exit pads should be designed by a qualified design professional and plans and specifications should be available to field personnel.

Site Preparation

Remove all vegetation and other unsuitable material from the foundation area.

Grading

Grade and crown the area for positive drainage.

Utilize a diversion to direct any surface flow away from the construction exit pad.

Install pipe under the pad if needed to maintain drainage ditches along public roads.

Divert all construction exit pad runoff and drainage to a sediment trap or basin.

Stabilization

If project specified, or if wet conditions or soft soils are anticipated, place non-woven geotextile fabric on the graded foundation prior to placing the aggregate to improve stability.

Aggregate Placement

Place specified stone size to lines and grade shown on plans. Leave surface smooth and sloped for drainage.

Construction Verification

Check all components during construction and installation to ensure that specifications are being met for the components.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Inadequate runoff control and sediment washes onto public road: install diversions or other runoff control measures.
- Ruts and muddy conditions develop as stone are pressed into soil; increase stone size or pad thickness, or add geotextile fabric.
- Pad too short for heavy construction traffic: consult design professional about extending pad to the necessary length.

Maintenance

Remove large chunks of mud or caked soil from construction exit pad daily to minimize sediment buildup.

Inspect stone pad and sediment disposal area weekly and after storm events or heavy use.

Reshape pad as needed for drainage and runoff control.

Top-dress with clean specified stone as needed to maintain effectiveness of the practice.

Immediately remove mud or sediment tracked or washed onto public road. Repair any broken road pavement immediately.

Remove unneeded exit pad materials from areas where permanent vegetation will be established.

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Land Grading (LG)

Practice Description

Land grading is reshaping of the ground surface to provide suitable topography for buildings, facilities and other land uses, to control surface runoff, and to minimize soil erosion and sedimentation both during and after construction. This practice applies to sites where the existing topography must be modified to prepare for another land use, or where adapting proposed development to the existing landscape can reduce the erosion potential of the site and the cost of installing erosion and sediment control measures. In some instances other practices such as diversions or benches can be used to reduce the length of continuous slopes and reduce erosion potential.

Typical Components of the Practice

- Scheduling
- Outlet
- Sediment Control
- Site Preparation
- Grading
- Erosion Control
- Construction Verification

Construction

Prior to start of construction, the site grading plan should be designed by a qualified design professional. The grading plan should show disturbed areas, cuts, fills, and finished elevations for all graded areas. Plans and specifications should be referred to by field personnel throughout the construction process.

Scheduling

Grading activities should be scheduled to minimize the area disturbed.

Outlet

Runoff from disturbed areas should be controlled at the outlets with proper runoff conveyance practices, such as drop structures, riprap-lined swales, or rock outlets.

Sediment Control

Appropriate sediment control measures should be installed to minimize sediment delivery off-site until other measures can be installed to prevent erosion. The measures should be installed as specified and in the sequence shown in the design plan.

Site Preparation

Determine exact location of underground utilities.

Remove and stockpile topsoil (see Topsoiling practice).

Clear and grub areas by removing trees, vegetation, roots and other debris. Check fill to make sure it is does not contain brush, rubbish, oversized rocks or other objectionable material.

Grading

Place fill in layers and compact as specified by the grading plan

Construct slope breaks as shown on the grading plan.

Keep diversions and other water conveyance measures free of sediment during all phases of development, including grading.

Install subsurface drains (see Subsurface Drains practice) in areas where seepage interferes with the grading operations, or where required to improve slope stability or soil bearing capacity.

The final trip over slopes using equipment with tracks should be made up-and-down the slopes to establish cleat marks on the contour (“tracking”).

Erosion Control

Use temporary stabilization measures on graded areas when work is to be interrupted or delayed for 14 calendar days or longer. A shorter period may be appropriate in critical situations (for example, steep bare slopes close to the drainageway that discharges into sensitive waters).

Stabilize graded areas that have "final grading completed" within 10 working days. Use permanent vegetation or other appropriate stabilization measures. If grading is completed out of season for the desired vegetation, a temporary planting may be made first and the permanent planting made later during the recommended planting period.

Construction Verification

Check all finished grades for conformance with grading plan and correct as necessary.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on-site indicate grading plan will be ineffective or unfeasible.
- Seepage is encountered during construction. It may be necessary to install drains.
- Subgrade is soft or has high organic content and can hinder proper compaction of fill. It may be necessary to undercut and replace unsuitable subgrade soil.
- Design specifications for sediment control measures, seed variety, seeding dates or other erosion control measures or materials cannot be met. Substitutions may be required. Unapproved substitutions could result in erosion and lead to failure of sediment and erosion control measures.

Maintenance

Periodically check all graded areas and the related erosion and sediment control practices for damage by equipment and especially after heavy rainfalls for damage by runoff. Repair silt fences and other temporary sediment control measures. Clean sediment out of adjacent diversions and other structures as needed. Repair any failures that occur in surface stabilization measures such as plantings.

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Topsoiling (TSG)

Practice Description

Topsoiling is the removal of a desirable soil surface, referred to as topsoil, at a site prior to construction and using it on areas to be vegetated. Topsoiling a site usually improves the quality of the plant growth medium at the site and increases the likelihood of successful plant establishment and performance. This practice applies to sites that are to be disturbed by excavation, compaction or filling, and to other areas where the subsoil is unsuitable for plant growth.

Typical Components of the Practice

- Scheduling
- Removal of Topsoil (Stripping)
- Stockpiling
- Temporary Erosion Control
- Spreading Topsoil
- Construction Verification

Construction

Prior to start of construction, topsoiling should be planned by a qualified design professional and incorporated in the development plan. The grading plan should show disturbed areas and the stockpile area(s). Areas to receive topsoil after

grading should be included in the erosion and sediment control plan. Plans and specifications should be referred to throughout the construction process.

Scheduling

Stripping should be scheduled to precede or be done concurrently with land grading.

Stripping

Strip topsoil from areas that will be disturbed by excavation, filling or compaction by equipment. Locations and depths to remove the topsoil should be based on the design plan. In the absence of details in the plan, determine depth of stripping by taking soil cores at several locations within each area to be stripped and remove the friable and loamy surface (typically 4" to 6"). Stumps, roots, trash, noxious weeds, and soils containing toxic chemicals should be removed separately and disposed of according to locally accepted procedures.

Stockpiling

Stockpile topsoil at the site(s) identified in the design plan. In the absence of details in the plan locate the stockpile so that natural drainage is not obstructed. Avoid stockpiling on steep slopes. Side slopes of stockpiles should not exceed 2:1. Use silt fences or other barriers where necessary to complement temporary erosion control and prevent sediment movement.

Temporary Erosion Control

Protect stockpile as specified in the design plan. In the absence of details in the plan use temporary seeding as soon as possible, but not more than 14 working days after formation of the stockpile. Mulching may be substituted for temporary seeding on stockpiles that will be used within 2 months. If stockpiles will not be used within 12 months, they should be stabilized by permanent vegetation to control erosion and weed growth.

Spreading Topsoil

Immediately prior to spreading topsoil, loosen the subgrade of the site to receive the topsoil by disking or scarifying to a depth of at least 2" to ensure bonding of the topsoil and subsoil.

Uniformly spread topsoil to a lightly compacted depth of 4" or greater. For long-term growth of vegetation without irrigation, minimum soil depth (subsoil and topsoil) should be 8" to 12" over loose sand or rock fragments, and 24" of soil depth is needed over bedrock. Established grades should be maintained according to the approved plan and should not be altered by adding topsoil.

Avoid spreading when either soil or subgrade is wet or frozen.

Construction Verification

Check all components of topsoiling that occur on the construction site to ensure that specifications are being met for the components.

Common Problems

Consult with qualified design professional if any of the following occur:

- Depth of surface being stripped is significantly different than anticipated.
- Topsoil appears to contain contaminants.
- Topsoil appears too compacted during spreading; may need to loosen by disking or scarifying.

Maintenance

Inspect topsoiled areas frequently until vegetation is established.

Repair eroded or damaged areas and revegetate.

Repair sloughing on steep slopes—remove topsoil, roughen subgrade and respread topsoil. Consult with qualified design professional if drainage (wetness caused by seepage) or shallowness to bedrock (less than 24”) is involved.

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Chemical Stabilization (CHS)

Photo courtesy of Sunshine Supplies, Inc.

Practice Description

Chemical Stabilization erosion control involves the use of products, including soil binders that help to hold the soil in place, thereby reducing soil particle detachment and short-term erosion caused by water and wind. Water-soluble polyacrylamide (PAM) is often used for this purpose. Other products may also provide this benefit. The products are typically applied with temporary seeding and or mulching on areas where the timely establishment of temporary erosion control is so critical that seedings and mulching need additional reinforcement.

Typical Components of the Practice

- Site Preparation
- Equipment Preparation
- Chemical Application
- Installation Verification

Application

Prior to the start of construction, the application of chemicals for surface stabilization should be designed by a qualified design professional and plans and specifications should be available to field personnel.

The application should conform to the design and specifications provided in the plans.

Site Preparation

Prepare site following design and specifications.

Equipment Preparation

When using chemicals that can clog a liquid application system, pump a surfactant through the injection system before and after injecting concentrated chemicals into the sprinkler irrigation system to prevent valves and tubing from clogging.

Chemicals used in hydroseeding applications should be the last additive to the mix.

After use, rinse all mixing and application equipment thoroughly with water to avoid formation of residues. Rinse residue should be applied to soil areas needing stabilization.

Chemical Application

Site testing for a product should be conducted before application to verify the product performance. Test reports (recommendations) should be supplied to the design professional and contractor before product application.

Toxicity reports should be provided by the supplier to the contractor before application of a product (this is to assure that applications from the recommended product will be non-toxic).

Chemicals should be mixed and/or applied in accordance with all Occupational Safety and Health Administration (OSHA) Material Safety Data Sheet requirements and the manufacturer's recommendations for the specified use conforming to all federal, state and local laws, rules and regulations.

Emulsion batches should be mixed following recommendations of a testing laboratory that determines the proper product and rate to meet site requirements.

Never add water to chemicals, but instead add the chemical slowly to water.

Dry form (powder) may be applied by hand spreader or a mechanical spreader.

Mixing with dry silica sand will aid in spreading. Pre-mixing of dry form chemicals into fertilizer, seed or other soil amendments is allowed when specified in the design plan. Application method should ensure uniform coverage to the target area.

If near a water body, observe the identified Buffer Zone for the job.

Installation Verification

Check all components of the practice during installation to ensure that specifications are being met.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Problems with application equipment clogging.
- Application specifications for chemicals cannot be met; alternatives may be required. Unapproved application techniques could lead to failure.
- Visible erosion occurs after application.

Maintenance

An operation and maintenance plan must be prepared for use by the operator responsible for chemical application. Plan items should include the following items:

- Reapply chemicals to disturbed or tilled areas that require continued erosion control.
- Maintain equipment to provide uniform application rates.
- Rinse all mixing and application equipment thoroughly with water to avoid formation of residues and discharge rinse water to soil areas where stabilization may be helpful.
- Down gradient deposition from the use of chemicals may require periodic sediment removal to maintain normal functions of sediment control practices.

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Dune Sand Fence (DSF)

Photo courtesy of Alabama Department of Environmental Management

Practice Description

A dune sand fence is a temporary barrier consisting of wooden slots installed across a dune landscape perpendicular to the prevailing wind. Dune sand fence reduces wind velocity at the ground surface and traps blowing sand. Sand fencing and appropriate plant materials can be used to build frontal ocean dunes to control beach erosion and flooding behind frontal dunes from wave overwash. Sand fence is applicable where sand can be trapped to enhance dune vegetation.

Typical Components of the Practice

- Scheduling
- Site Preparation
- Installation
- Construction Verification

Note: To attain maximum benefits of a dune sand fence, the beach/dune area designated for sand trapping should be renourished with appropriate plantings before the installation of the dune sand fence (in the absence of a dune vegetation planting plan, see Dune Vegetation Planting for guidance).

Construction

Prior to start of construction, sand fence should be designed by a qualified design professional and necessary federal, state and local permits should be obtained. Plans and specifications should be referred to by field personnel throughout the construction process.

Attempt to schedule the installation of dune sand fence during the recommended planting periods for the associated dune vegetation plantings that are planned.

Site Preparation

Determine if underground utilities exist in the area and if they do, determine their locations so that fence lines and placement of stakes can be selected where utilities will not be damaged.

Remove any obstacles that will prevent installation of the fence.

Installation

Install the fence according to details in the design plan. If design details are not available guidelines should be obtained from the Alabama Department of Environmental Management Costal Zone Program office or the following items should be considered for guidance.

Establish the position for the sand fence: (a) a minimum of 100 feet (horizontal) from the MHT (mean high tide) line with 2 parallel rows of fence approximately 30 feet apart. The row alignment should be roughly parallel to the water line, yet as close as possible to a right angle to the prevailing winds. Figure DSF-1 shows a plan view of a conceptual erosion and sediment control system with the Dune Sand Fence configured to minimize adverse impacts to nesting endangered sea turtles.

Install posts a minimum of 3 feet deep and 10 feet apart. Do not concrete in place.

Use 4 galvanized wire ties to fasten the fence to the wood posts. Weave the fence between posts so that every other post will have fencing on the ocean side of posts.

If widening an old dune, the new fence should be set seaward 15 feet from its current base.

Construction Verification

Check materials for compliance with specifications.

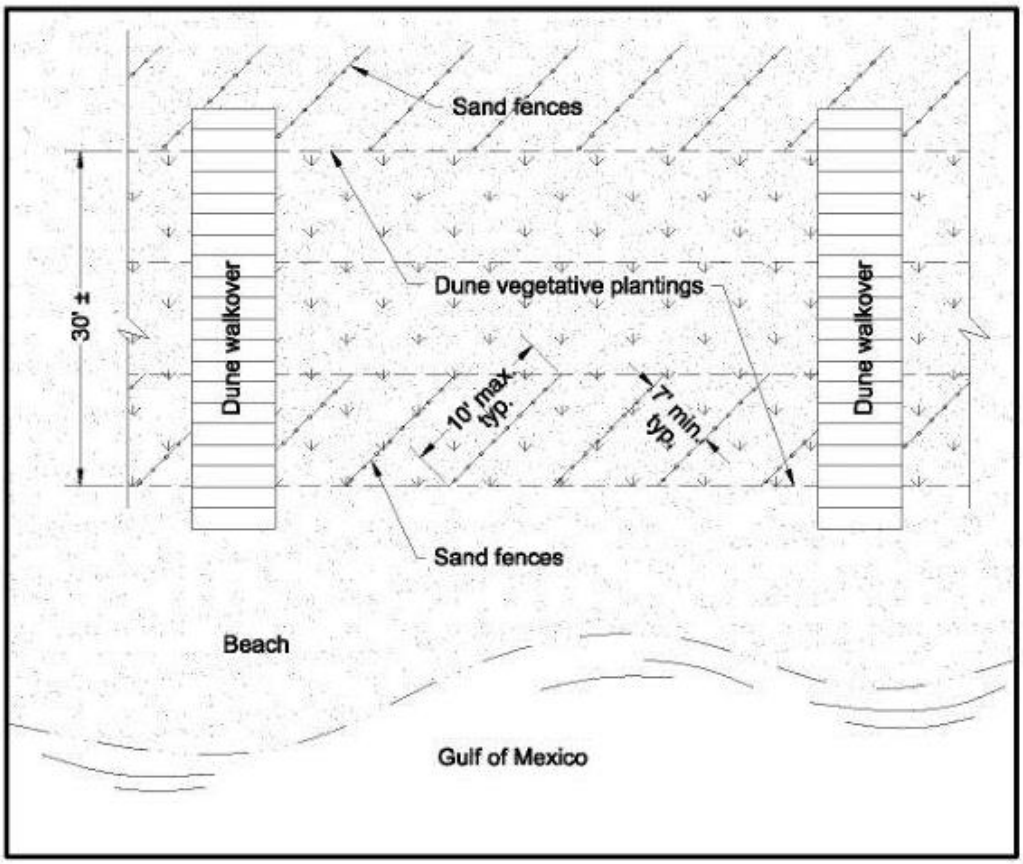

Figure DSF-1 Typical Dune Sand Fence

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate dune sand fence will not function as intended; changes in plan may be needed.
- Design specifications for materials cannot be met; substitutions may be required. Unapproved substitutions could lead to failure.

Maintenance

Inspect dune sand fences monthly and after each significant event with high winds and waves. Make required repairs immediately if fence is damaged by high wind or water.

As the fences fill with sand, additional sets of fence can be placed over those almost filled until the barrier dune has reached a protective height. To widen an old dune, fencing should be set seaward at a distance of 15 feet from its base.

Dune Vegetation Planting (DVP)

Photo courtesy of Alabama Department of Environmental Management

Practice Description

Dune vegetation planting is the establishment of perennial vegetation on dunes from seed or vegetative material. Perennial dune vegetation provides economical long-term erosion control and helps prevent sediment from leaving the site. This practice is used where vegetation is desired and appropriate to permanently stabilize the dune. Additional measures, such as crosswalks and barriers, are often needed to develop successful establishment of the vegetation.

Typical Components of the Practice

- Scheduling
- Site Preparation
- Fertilizing
- Planting
- Irrigation
- Inspection

Installation

Prior to start of construction, details of the planting (species, rates, planting dates, etc.) should be specified by a qualified design professional. Plans and

specifications should be referred to by field personnel throughout the installation process.

Scheduling

The schedule for work at the site should consider the recommended planting period and whenever practical the site work should accommodate planting during the recommended planting period.

Site Preparation

Construction of crosswalks and installation of sand fence, or other barriers, should be coordinated with the planting according to the design plan.

Seedbed preparation typical for non-dune plantings is not normally done.

Fertilizing

Fertilizer may be applied either before or after the planting, depending upon the specifications in the design plan. Apply fertilizer at rates specified in the design plan or as recommended by soil tests. In the absence of a design plan, use the following as a guide:

Evenly spread 13-13-13 at the rate of 200-300 lbs/ac (4.6 to 6.9 lbs /1000 ft^2) either before or within 6 weeks after planting.

Note: Fertilizer can be blended to meet exact fertilizer recommendations and spread by a vendor. This may be more economical than spreading bagged fertilizer.

Planting

Plant the species specified in the plan at the rate and depth specified in the planting plan. In the absence of a plan consider the following guidelines.

Seed

Select adapted species from Table DVP-1.

Apply seed uniformly using a cyclone seeder or drop-type spreader.

When planting by methods other than a drill seeder, cover seed by raking, or dragging a chain, brush or mat.

Table DVP-1 Commonly Used Plants for Dune Stabilization

Species	Plant Spacing	Planting Period	Method
Sea Oats Uniola paniculata	12 – 36”	March – June	Potted plants
Atlantic Coastal Panigrass (Panicum amarum var-amarulum)	12 – 36”	March – June	Seed or sprigs
Flageo Marshhay Cordgrass (Spartina patens)	12 – 24”	March – June	Sprigs
Sharpe Marshhay Cordgrass (Spartina patens)	12 – 24”	March – June	Sprigs
North PA Bitter Panicum (Panicum amarum)	24 – 36”	March – June	Potted plants or bare root plugs
South PA Bitter Panicum (Panicum amarum)	24 – 36”	March – June	Potted plants or bare root plugs

Vegetative Material

Select adapted species from Table DVP-1.

Plant the species specified in the plan at the rate and depth specified. In the absence of a plan consider the following guidelines.

Plant vegetative material 6” to 10” or deep enough to have adequate soil moisture at the time of planting.

Herbaceous plant spacing ranges from 1 to 3 feet, but is typically 18” for 1” to 4” potted stock or bare root plugs of the same diameter.

Irrigation

Apply irrigation as specified in the planting plan.

Installation Verification

Check materials and installation for compliance with specifications during installation of products.

Common Problems

Consult with a qualified design professional if the following occurs. Design specifications for plant species or planting dates cannot be met; substitutions may be required. Unapproved substitutions could lead to failure.

- Planting at the wrong time of the year results in an inadequate stand. Replant according to specifications of a qualified design professional (see recommendations under Maintenance)

Maintenance

Inspect plantings monthly for stand survival and vigor. Generally, a stand of vegetation cannot be determined to be fully established until vegetative cover has been maintained for 1 year from planting.

Replanting

Stand conditions, particularly the coverage, will determine the extent of remedial actions. A qualified design professional should be consulted to advise on remedial actions.

Fertilizing

Apply fertilizer at rates specified in the design plan or as recommended by soil tests. In the absence of a design plan, follow soil test recommendations or apply 13-13-13 at the rate of 400 lbs/acre annually (approximately 9 lbs/1000 ft^2) during the growing season before September.

Fertilization is recommended until the plants spread to provide complete cover and after storms damage stands.

Dune Walkover (DW)

Photo courtesy of Alabama Department of Environmental Management Coastal Programs Office

Practice Description

A dune walkover is a measure consisting of elevated walks that are constructed across the dune system. It provides pedestrian access to the beach area and protects the dunes from erosion. It is applicable on sparsely vegetated dunes where pedestrian access adversely impacts the vegetation and on dunes with adequate vegetation where pedestrian access is planned and vegetation is needed to protect the dunes from erosion.

Typical Components of the Practice

- Scheduling
- Site Preparation
- Installation and Removal
- Erosion Control
- Safety
- Construction Verification

Construction

Prior to start of construction, a dune walkover should be designed by a qualified design professional and necessary federal, state and local reviews and permits should be obtained. Plans and specifications should be referred to by field personnel throughout the construction process.

Scheduling

Attempt to construct dune walkover during the recommended planting periods for the associated dune vegetation plantings that are planned.

Site Preparation

Ensure that all necessary materials are on the site before any work begins.

Installation

Install the structure according to the design plan.

Erosion Control

Minimize the size of all disturbed areas and vegetate as soon as each phase of construction is complete. Establish vegetation on all renourished disturbed areas in accordance with the design plan.

If a planting plan is not available, refer to the Dune Vegetation Planting practice and Figure DW -1 for guidance.

Safety

Equipment used in construction should be free of leaks of fuel and hydraulic fluids.

Install fencing and post warning signs if trespassing is likely during construction.

Construction Verification

Check to determine that materials and construction meet plan specifications.

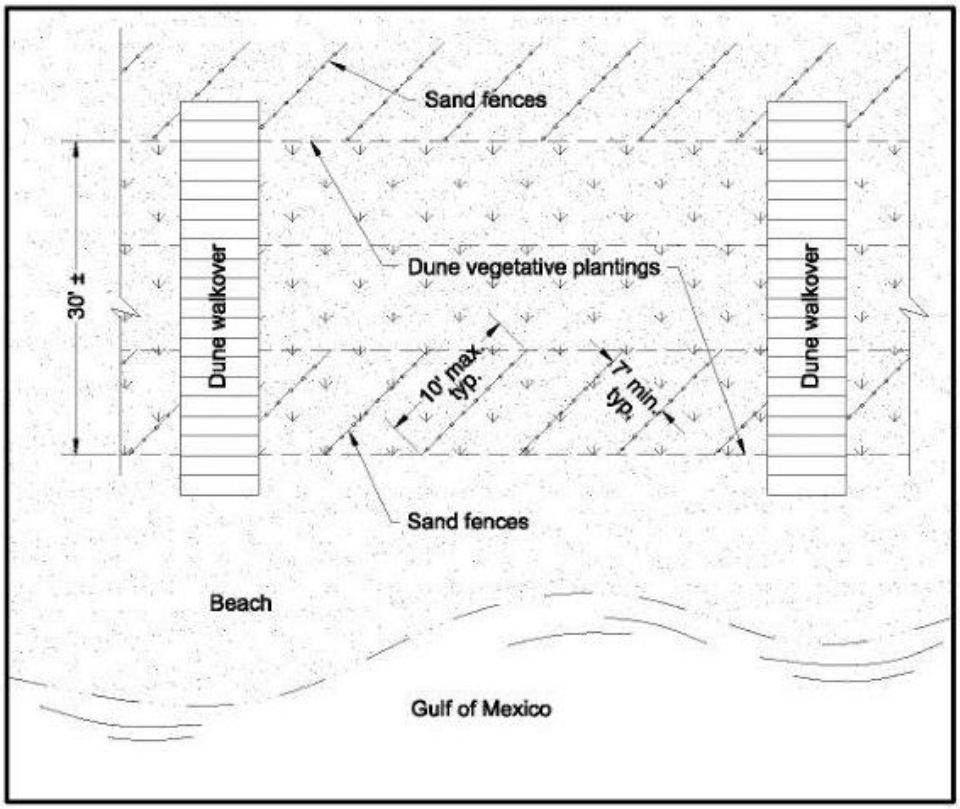

Figure DW-1 Typical Dune Walkover System

Common Problems

Consult with qualified design professional if any of the following occur:

- Variations in topography on site indicate dune walkover will not function as intended; changes in plan may be needed.
- Design specifications for materials cannot be met; substitution may be required. Unapproved substitutions could result in the crossing being washed out.

Maintenance

Inspect the dune walkover for damage to the structure after each major storm event.

Repair any damages to structural measures found during inspections. Replant materials that have been destroyed by high tides and major hurricanes.

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Dust Control (DC)

Practice Description

Dust control includes a wide range of techniques that prevent or reduce movement of wind-borne soil particles (dust) during land disturbing activities. This practice applies to construction routes and other disturbed areas where on-site and off-site damage or hazards may occur if dust is not controlled.

Typical Components of the Practice

- Scheduling
- Erosion Control
- Other Potential Components
  - Sprinkling
  - Barriers
  - Spray-on Adhesives
  - Stone
  - Street Cleaning
- Installation Verification

Construction

Dust control requirements should be designed by a qualified design professional and plans and specifications should be made available to field personnel prior to start of construction. Whenever possible, leave undisturbed vegetated buffer areas between graded areas.

Scheduling

Schedule construction operations so that the smallest area is disturbed at any one time.

Erosion Control

Install surface stabilization measures (vegetative cover or mulch) immediately after completing the land grading.

Vegetative Cover

See Temporary or Permanent Seeding practice for guidance. Vegetation provides the most practical method of dust control for areas not subject to traffic.

Mulching

See Mulching practice for guidance on applying mulch and tackifiers or binders. Mulching is not recommended for areas with heavy traffic.

Sprinkling

Sprinkle the site with water until the surface is moist. This practice is effective for dust control on haul roads or other traffic routes, but constant repetition is required for effective control.

Barriers

Install board fences perpendicular to the prevailing winds at intervals (distance) of 15 times the barrier height.

Calcium Chloride

Apply with a mechanical spreader at a rate that keeps the surface moist.

Consult with a qualified design professional to determine if a permit is required.

Spray-on Adhesives

Spray adhesives according to the design plan.

Consult with a qualified design professional if spray-on adhesives are specified. A permit may be needed.

In the absence of a detailed plan, use manufacturers' recommendations. Table DC-1 presents examples of spray-on adhesives that have been used successfully for dust control.

Table DC-1 Application Rates for Spray-on Adhesives Used in Dust Control

Adhesive	Water Dilution (adhesive: water)	Type of Nozzle	Application Rate (gallons/acre)
Anionic Asphalt Emulsion	7:1	Coarse	1200
Latex Emulsion	12.5:1	Fine	235
Resin in Water	4:1	Fine	300
Acrylic Emulsion (Non-traffic)	7:1	Coarse	450
Non-Acrylic Emulsion (Traffic)	3.5:1	Coarse	350

Source: Virginia Erosion and Sediment Control Handbook, 1993

Consult with a qualified design professional if spray-on adhesives are specified. A permit may be needed.

Stone

Stone should be placed to the width and thickness specified in the design.

Street Cleaning

Use a street sweeper to remove the source materials.

Construction Verification

Check installation of product(s) to verify use of proper product and quantity.

Common Problems

Drought conditions result in dry soils and increase in dust problems—use greater precautions during these periods.

Maintenance

Check construction site during vehicular traffic or windy conditions to see if measures are working adequately. Maintain dust control measures continuously throughout dry weather periods, until all disturbed areas have been stabilized.

Erosion Control Blanket (ECB)

Photo courtesy of Sunshine Supplies, Inc.

Practice Description

To aid in controlling erosion on critical areas by providing a protective cover made of straw, jute, wood or other plant fibers; plastic, nylon, paper or cotton. This practice is best utilized on slopes and channels where the erosion hazard is high, and plant growth is likely to be too slow to provide adequate protective cover. Erosion control blankets are typically used as an alternative to mulching but can also be used to provide structural erosion protection. Some important factors in the choice of a blanket are: soil conditions, steepness of slope, length of slope, type and duration of protection required to establish desired vegetation, and probable sheer stress.

Typical Components of the Practice

- Site Preparation
- Erosion Control Planting
- Blanket Installation
- Construction Verification

Construction

Prior to the start of construction, the application of erosion control blankets should be designed by a qualified design professional and plans and specifications should be available to field personnel.

Numerous products designed to control erosion are available. Product installation procedures for manufactured erosion control blanket products should always be available from the manufacturer. Table ECB-1 lists some of the more common products available.

Table ECB-1 Types of Erosion Control Blankets

Type of Erosion Control	Main Use	Comments
Netting	Synthetic or natural fiber mesh installed over disturbed area to hold organic mulch and/or seed in place.	Provides minimal structural erosion resistance. Mulch applied using standard procedures.
Biodegradable Erosion Control Blanket	Natural fiber blanket held together by netting to provide temporary erosion protection on slopes up to 1:1; and channels with permissible shear stress up to 4 lbs./ft.	Provides 1- to 5-year protection from erosion. Metal staples used as anchors.
Permanent Erosion Control Blanket	Synthetic blanket material which provides permanent erosion control on slopes up to 1:1; channels with increased water flow velocities and increased shear stress.	Provides minimal protection from wave action around ponds and lakes. Permanent erosion control blankets extend the limits of vegetation. Metal staples used as anchors.
Turf Reinforcement Mat	3-dimensional permanent synthetic mat that provides a matrix to greatly reinforce the root system of the desired vegetation for permanent erosion protection in high flow channels and on critical slopes.	Provides a substantial increase in erosion resistance. May provide erosion protection equivalent to stone or concrete liners.

The field inspector should verify that installation is in accordance with the plans and specifications.

Site Preparation

Grade the site in accordance with the approved design to a smooth and uniform surface, free of debris.

Add and incorporate topsoil where needed.

Make sure seedbed is firm yet friable.

Erosion Control Planting

Spread and incorporate lime and fertilizer as described in the design plan.

Spread seed and incorporate as described in the planting specifications.

Blanket Installation

Erosion control blanket products should be installed in accordance with the manufacturer's recommendations and specifications, including check slots and stapling materials.

Anchor product so that a continuous, firm contact (no tenting) with the soil surface/seed bed is maintained. This is best accomplished on slopes by working from the bottom to the top.

Construction Verification

Check finished grade, dimensions and staple spacing of erosion control blankets. Check materials for compliance with specifications.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Movement of the blanket or erosion under the blanket is observed.
- Poor contact between the soil and the erosion control blanket results in surface water flowing under rather than over the blanket, causing erosion; retrench or reanchor to direct water over blanket.
- Blanket inadequately or improperly stapled results in tenting, blanket movement or displacement; reinstall and ensure blanket is properly anchored.
- Unstable slope results in blanket or slope failure; determine cause of slope failure, stabilize slope and reinstall blanket.
- Variations in topography on site indicate erosion control mat will not function as intended; changes in plan may be needed, or a blanket with a shorter or longer life may be needed.
- Design specifications for seed variety, seeding dates or erosion control materials cannot be met; substitution may be required. Unapproved substitutions could result in failure to establish vegetation or breach of contract.

Maintenance

Inspect after storm events until vegetation is established for erosion or undermining beneath the blankets. If any area shows erosion, pull back that portion of the blanket, add tamped soil and reseed; then resecure the blankets.

If blankets should become dislocated or damaged, repair or replace and resecure immediately.

Groundskeeping (GK)

Practice Description

Groundskeeping or “good housekeeping” describes the various activities and measures, in addition to the specific practices used for erosion and sediment control that are essential during construction for the protection of environmental quality. Groundskeeping is applicable at all construction sites.

Typical Components of the Practice

Prior to the start of construction, Groundskeeping activities and measures should be identified by a qualified design professional and included in the construction and pollution prevention plan. The essential components of Groundskeeping should be provided to the prime contractor for a project. Groundskeeping activities and measures essential at construction sites vary based on the complexity of the site and the project. Groundskeeping typically includes the following activities and measures:

- Inspections During Construction/Installation of Erosion and Sediment Control and Stormwater Measures (BMPS)
- Spill Prevention and Material Management
- Spill Controls

- Other Potential Activities and Measures (examples: removal of contaminated soils, management of hazardous products, protection of air quality, etc.)

Details about Components

Inspections of BMPs

Inspections should be made regularly and timely to ensure that erosion and sediment control and stormwater management practices are performing as planned and whether or not maintenance is needed. In addition, inspections and reports should meet local and state requirements.

Spill Prevention and Material Management

Alabama Department Environmental Management (ADEM) regulations require that an operator/owner implement a Spill Prevention Control and Counter Measures (SPCC) Plan for all temporary and permanent onsite fuel or chemical storage tanks or facilities to address the safe storage, handling and cleanup of petroleum products and other chemicals.

All vehicles kept on the site need to be monitored for leaks and receive regular preventive maintenance to reduce the chance of leakage.

If petroleum products are stored on site, a secondary containment facility will be required if the cumulative storage capacity of all tanks, greater than 55 gallons, at the site exceeds 1,320 gallons. The secondary containment facility must be designed by a qualified design professional.

Petroleum products should be stored in labeled tightly sealed containers.

Any asphalt substances used on-site should be applied according to the manufacturer's recommendations.

No fueling, servicing, maintenance, or repair of equipment or machinery should be done within 50 feet of a stream, or within 100 feet of a stream classified for public water supply (PWS) or Outstanding Alabama Water (OAW), or designated as an Outstanding National Resource Water (ONRW) or a sinkhole.

Only designated entrances should be used for construction access to the site. Mud tracked from the site onto streets and roads should be cleaned on a daily basis if needed.

Concrete trucks should be allowed to wash only in locations where discharge is appropriately treated to meet applicable regulatory requirements. It is not permissible to discharge concrete wash directly to streams or storm drains. Concrete wash can contain sediment, as well as, alkalinity and chemical additives that could be harmful to fish, stream bottom macroinvertebrates and wildlife.

No fuels, oils, lubricants, solvents, or other hazardous materials can be disposed of on the site. All hazardous material must be properly disposed of in accordance with state law.

Solid waste should be disposed of in accordance with state law. Dumpsters or other collection facilities must be provided as needed.

Portable toilets should be located so that accidental spills will not discharge into a storm sewer or concentrated flow area.

Water for pressure testing sanitary sewers, flushing water lines, etc., may be discharged only in approved areas and to prevent discharging to surface waters. Discharge of hydrostatic test water may require additional permitting, particularly if chlorinated public water is used.

Spill Controls

The operator/owner is expected to maintain on-site or have readily available sufficient oil & grease absorbing material and flotation booms to contain and clean-up fuel or chemical spills and leaks.

Equipment and materials include, but are not limited to brooms, dust pans, mops, rags, gloves, goggles, absorbent clay, sand, sawdust, and plastic and metal trash containers specifically for this purpose.

Spills of toxic or hazardous material must be reported immediately. The operator/owner is required to immediately notify ADEM after becoming aware of a significant spill/leak or visible oil sheen in the vicinity of the construction activity. In the event of a spill with the potential to impact groundwater or other waters of the State, the operator/owner is expected to immediately call the National Response Center (NRC) at 1-800-424-8802 and the Alabama Emergency Management Agency (AEMA) at 1-800-843-0699. The caller should be prepared to report the name, address and telephone number of person reporting spill, the exact location of the spill, the company name and location, the material spilled, the estimated quantity, the source of spill, the cause of the spill, the nearest downstream water with the potential to receive the spill, and the actions taken for containment and cleanup.

All spills need to be cleaned up immediately after discovery and properly containerized for proper disposal. Refer to Material Safety Data Sheets for safe handling procedures. Burial is not acceptable.

The spill area must be kept well ventilated and personnel need to wear appropriate protective clothing to prevent injury from contact with a hazardous substance.

The spill prevention plan needs to be adjusted to include measures to prevent any spill from being repeated, and the plan needs to show how to clean up the spill if another one does occur.

Removal of Contaminated Soils and Underground Storage Tanks

Site assessment and removal of contaminated soils and underground storage tanks should be done following a site assessment based on procedures provided by the Alabama Department of Environmental Management.

Management of Hazardous Products

Products must be kept in original containers unless they are not resealable. If a product is transferred to a new container, it must be properly marked and labeled.

Original labels and Material Safety Data Sheets should be retained until the related product is no longer on the site.

If surplus product must be disposed of, disposal must be done in accordance with state (Alabama Department of Environmental Management regulations).

Protection of Air Quality

Smoke

Burning on the site may require a permit from the Alabama Forestry Commission. County and city ordinances may also apply. Starting disposal fires with diesel fuel, petroleum products, or old tires is not a recommended practice. Burn pits with fans to generate hot disposal fires decreases the fire time and minimizes smoke. Burning may be prohibited by State “burn bans” to reduce potential for ground-level ozone.

Dust

Dust should be controlled if it will create a problem either on or off of the site. If measures are not included in the site design plan see the practice Dust Control for potential measures to use to eliminate or minimize dust.

Other Good Groundskeeping Practices

The following measures may be needed:

- All materials stored on-site should be stored in a neat, orderly manner in their appropriate containers and, if possible, under a roof or other enclosure.
- Products should be kept tightly sealed in their original containers with the original manufacturer's label.
- Whenever possible, all of a product should be used up before disposing of the container.
- Manufacturer's recommendations for proper use and disposal must be followed. See Material Safety Data Sheets for product of concern.
- The site superintendent or a designated employee should inspect daily to ensure proper usage, storage and disposal of material

Mulching (MU)

Practice Description

Mulching is the application of plant residues such as straw or other suitable fibrous materials to the soil surface. Mulch protects the soil surface from the erosive force of raindrop impact and reduces the velocity of overland flow. It helps seedlings germinate and grow by conserving moisture, protecting against temperature extremes and controlling weeds. Mulch also maintains the infiltration capacity of the soil. Mulch can be applied to seeded areas to help establish plant cover. It can also be used in unseeded areas to protect against erosion over the winter or until final grading and shaping can be accomplished except in areas of concentrated flow.

Typical Components of the Practice

- Site Preparation
- Application of Material
- Verification of Installation

Installation

Mulching should be designed by a qualified design professional and plans and specifications should be made available to field personnel prior to start of construction.

Site Preparation

Divert runoff water from areas above the site that will be mulched.

Remove stumps, roots and other debris from the construction area.

Grade area as needed to permit the use of equipment for seeding, mulching and maintenance. Shape area so that it is relatively smooth.

If the area will be seeded, follow seeding specifications in the design plan and apply mulch immediately after seeding.

Application of Material

Spread straw mulch, preferably cereal grain, uniformly over the area with a power blower, hydroseeder or by hand. Mulch should be uniformly spread and not clumped in piles. In a seeded area, about 25% of the ground surface should be visible after mulching. It is important when mulching a seeded area that an excessive quantity of straw is not applied – too much mulch will retard or reduce the future stand. When mulch is used for erosion control without seeding, 100% of the soil surface should be covered.

Hydraulic Erosion Control Products (HECPs) as defined by the Erosion Control Technology Council (ECTC) are also used for mulch and should be applied with the appropriate equipment and at the recommended or specified rates.

Apply mulches at the rates shown in the plan or in Table MU-1 if there is not a plan.

Anchor straw or wood cellulose mulch by one of the following methods:

- Crimp with a mulch anchoring tool, as near on the contour as practical, to punch the straw into the soil.
- Tack with a liquid tackifier designed to hold mulch in place. Use suitable spray equipment and follow manufacturer's recommendations.
- In more erosive areas, cover with netting, using a degradable natural or synthetic mesh. The netting should be anchored according to manufacturer's specifications (see Erosion Control Blanket practice).
- On steep slopes and other areas needing a higher degree of protection, use heavy natural nets without additional mulch, synthetic netting with additional mulch or erosion control mats/blankets. These areas include grassed waterways, swales and diversion channels.
- Install netting and mats/blankets according to manufacturer's specifications making sure materials are properly anchored (see Erosion Control Blanket).

Table MU-1 Mulching Materials and Application Rates

Material	Rate Per Acre and (Per 1000 ft.^{2})	Notes
Straw (with Seed)	1 ½ - 2 tons (70 lbs - 90 lbs)	Spread by hand or machine; anchor when subject to blowing.
Straw Alone (no seed)	2 ½ - 3 tons (115 lbs - 160 lbs)	Spread by hand or machine; anchor when subject to blowing.
Wood Chips	5-6 tons (225 lbs - 270 lbs)	Treat with 12 lbs. nitrogen/ton.
Bark	35 cubic yards (0.8 cubic yard)	Can apply with mulch blower.
Pine Straw	1-2 tons (45 lbs - 90 lbs)	Spread by hand or machine; will not blow like straw.
Peanut Hulls	10-20 tons (450 lbs - 900 lbs)	Will wash off slopes. Treat with 12 lbs. nitrogen/ton.
HECPs	0.75 – 2.25 tons (35 lbs – 103 lbs)	Refer to ECTC or Manufacturer's Specifications.

Verification of Installation

Check materials and installation for compliance with specifications.

Common Problems

Consult with qualified design professional if either of the following occurs:

- Variations in topography on site indicate the mulching materials will not function as intended; changes in plan may be needed.
- Design specifications for mulching materials or seeding requirements cannot be met; substitution may be required. Unapproved substitutions could result in erosion or seeding failure.

Problems that require remedial actions:

- Erosion, washout and poor plant establishment; repair eroded surface, reseed, remulch and anchor mulch.
- Mulch is lost to wind or stormwater runoff; reapply mulch and anchor appropriately by crimping, netting or tacking.

Maintenance

Inspect all mulched areas periodically and after rainstorms for erosion and damage to the mulch. Repair promptly and restore to original condition. Continue inspections until vegetation is well established. Keep mower height high if plastic netting is used to prevent netting from wrapping around mower blades or shaft.

Permanent Seeding (PS)

Practice Description

Permanent seeding is the establishment of perennial vegetation on disturbed areas from seed. Permanent vegetation provides economical long-term erosion control and helps prevent sediment from leaving the site. This practice is used when vegetation is desired and appropriate to permanently stabilize the soil.

Typical Components of the Practice

- Scheduling
- Seedbed Preparation
- Applying Soil Amendments (lime and fertilizer)
- Planting
- Mulching or Installation of Erosion Control Blanket
- Inspection

Installation

Prior to start of construction, plant materials, seeding rates and planting dates should be specified by a qualified design professional. Plans and specifications should be referred to by field personnel throughout the installation process.

Permanent seeding should be made during the specified planting period whenever possible. When sites are only available for planting outside of the recommended planting period, either an out-of-season permanent seeding, a temporary seeding, mulching or chemical stabilization should be applied. If lime and fertilizer application rates are not specified, take soil samples during final grading from the top 6" in each area to be seeded. Submit samples to a soil testing laboratory for lime and fertilizer recommendations.

Scheduling

The schedule for work at the site should consider the recommended planting period and whenever practical the site work should accommodate seeding during the recommended planting period.

Seedbed Preparation

Grade and loosen the soil to a smooth firm surface to enhance rooting of seedlings and reduce rill erosion. Break up large clods and loosen compacted, hard or crusted soil surfaces with a disk, ripper, chisel, harrow or other tillage equipment. Avoid preparing the seedbed under excessively wet conditions to minimize compaction. Operate the equipment on the contour.

For either broadcast seeding or drill seeding, the tillage, as a minimum, should adequately loosen the soil to a depth of at least 6", alleviate compaction, and smooth and firm the soil for the proper placement of seed.

For no-till drilling, the soil surface should not be loosened unless the site has surface compaction and if compaction exists, special care with soil loosening will be needed to retain the desired residue on the soil surface.

Incorporate lime and fertilizer to a depth of at least 6" with a disk or rotary tiller on slopes of up to 3:1. On steeper slopes, lime and fertilizer may be applied to the surface without incorporation. Lime and fertilizer may be applied through hydroseeding equipment; however, fertilizer should not be added to the seed mixture during hydroseeding. Liming materials such as liquid lime may be added with the seed mixture.

Liming

Follow the design plan or soil test recommendation. If a plan or soil test is not available, use 2 tons/acre of ground agricultural lime on clayey soils (approximately 90 lbs/acre) and 1 ton/acre on sandy soils (approximately 45 lbs/acre). Exception to situation without a design or a soil test: If the cover is tall fescue and clover, use 2 tons of agricultural lime (approximately 135 lbs/1000 ft^2) on both clayey and sandy soils.

Spread the specified amount of lime and incorporate into the top 6" of soil after applying fertilizer.

Fertilizing

Apply a complete fertilizer at rates specified in the design plan or as recommended by soil tests. In the absence of soil tests, use the following as a guide:

Grass Alone

Use 8-24-24 or equivalent – apply 400 lbs/acre (approximately 9 lbs/1000 ft^2) starting. When vegetation has emerged to a stand and is growing, 30 lbs/acre (approximately 0.8 lbs/10000 ft^2) of additional nitrogen fertilizer should be applied.

Grass-Legume Mixture

Use 5-10-10 or equivalent – apply 800 - 1200 lbs/acre (approximately 18 - 27 lbs/1000 ft^2).

Legume Alone

Use 0-20-20 or equivalent – apply 400 - 600 lbs/acre (approximately 9 - 14 lbs/1000 ft^2) at planting.

Note: Fertilizer can be blended to meet exact fertilizer recommendations. Take soil test recommendations to local fertilizer dealer for bulk fertilizer blends. This may be more economical than bagged fertilizer.

Planting

Plant the species specified in the plan at the rate and depth specified. In the absence of plans and specifications, plant species and seeding rates may be selected by qualified persons using Figure PS-1 and Table PS-1.

Apply seed uniformly using a cyclone seeder, drop-type spreader, drill, cultipacker seeder or hydroseeder.

When using a drill seeder, plant grasses and legumes ¼" to ½" deep. Calibrate equipment in the field.

When planting by methods other than a drill seeder, cover seed by raking, or dragging a chain, brush or mat. Then firm the soil lightly with a roller. Seed can also be covered with hydro-mulched wood fiber and tackifier. Legumes require inoculation with nitrogen-fixing bacteria to ensure good growth. Purchase inoculum specific for the seed and mix with seed prior to planting.

Figure PS-1 Geographical Areas for Species Adaptation

Note: Site conditions related to soils and aspect in counties adjacent to or close to county boundaries may justify adjustments in adaptable areas by qualified design professionals.

Mulching

Mulching is extremely important for successful seeding. Whether the mulching material is straw or a manufactured product, the material needs to be applied properly. Uniformly spread organic mulches by hand or with a mulch blower at a rate which provides about 75% ground cover. Spread HECPs utilizing appropriate equipment and at rates as specified in the plan or by the manufacturer. Caution, an over-application of wheat straw will reduce stand success – do not over-apply wheat straw when mulching a seeding! (See Mulching practice for more details).

Table PS-1 Commonly used Plants for Permanent Cover with Seeding Rates and Dates

Species	Seeding Rates/Ac PLS	North	Central	South
		Seeding Dates		
Bahiagrass, Pensacola	40 lbs	--	Mar 1-Jul y 1	Feb 1-Nov 1
Bermudagrass, Common	10 lbs	Apr 1-July 1	Mar 15-July 15	Mar 1-July 15
Bahiagrass, Pensacola Bermudagrass, Common	30 lbs 5 lbs	--	Mar 1-July 1	Mar 1-July 15
Bermudagrass, Hybrid (Lawn Types)	Solid Sod	Anytime	Anytime	Anytime
Bermudagrass, Hybrid (Lawn Types)	Sprigs 1/sq ft	Mar 1-Aug 1	Mar 1-Aug 1	Feb 15 - Sep 1
Fescue, Tall	40-50 lbs	Sep 1-Nov 1	Sep 1-Nov 1	--
Sericea	40-60 lbs	Mar 15-July 15	Mar 1-July 15	Feb 15 -July 15
Sericea & Common Bermudagrass	40 lbs 10 lbs	Mar 15 -July 15	Mar 1-July 15	Feb 15-July 15
Switchgrass, Alamo	4 lbs	Apr 1-Jun 15	Mar 15-Jun 15	Mar 15-June 15

PLS means pure live seed and is used to adjust seeding rates. For example, to plant 10 lbs PLS of a species with germination of 80% and purity of 90%, PLS= 0.8X 0.9 = 72%. 10 lbs PLS = 10/0.72 = 13.9 lbs of the species to be planted.

Hydroseeding

Surface roughening is particularly important when hydroseeding, as roughened slope will provide some natural coverage for lime, fertilizer, and seed. The surface should not be compacted or smooth. Smooth seedbed preparation is not necessary for hydroseeding operations; large clods, stones, and irregularities provide cavities in which seeds can lodge.

Mix seed, inoculant if required, and a seed carrier with water and apply as a slurry uniformly over the area to be treated. The seed carrier should be a cellulose fiber, natural wood fiber or cane fiber mulch material which is dyed an appropriate color to facilitate uniform application of seed. Use the correct legume inoculant at 4 times the recommended rate when adding inoculant to a hydroseeder slurry. The mixture should be applied within one hour after mixing to reduce damage to seed.

Fertilizer should not be mixed with the seed-inoculant mixture because fertilizer salts may damage seed and reduce germination and seedling vigor.

Fertilizer may be applied with a hydroseeder as a separate operation after seedlings are established.

Agricultural lime is usually applied as a separate operation and spread in dry form. It is not normally applied with a hydraulic seeder because it is abrasive and, also, may clog the system. On the other hand, liquid lime is applied with a hydraulic seeder but because of cost is used primarily to provide quick action for benefit of plants during their seedling stage with the bulk of liming needs to be provided by agricultural lime. Dry lime may be applied with the fertilizer mixture.

Installation Verification

Check materials and installation for compliance with specifications during installation of products.

Common Problems

Consult with a qualified design professional if the following occurs:

- Design specifications for seed variety, seeding dates or mulching cannot be met; substitutions may be required. Unapproved substitutions could lead to failure.
- Seeding at the wrong time of the year results in an inadequate stand. Reseed according to specifications of a qualified design professional (see recommendations under Maintenance)
- Inadequate mulching results in an inadequate stand, bare spots or eroded areas-prepare seedbed, reseed, cover seed evenly and tack or tie down mulch, especially on slopes, ridges and in channels (see recommendations under Maintenance).

Maintenance

Generally, a stand of vegetation cannot be determined to be fully established until vegetative cover has been maintained for 1 year from planting.

Reseeding

Inspect seedings monthly for stand survival and vigor. Also, inspect the site for erosion.

If stand is inadequate identify the cause of failure (choice of plant materials, lime and fertilizer quantities, poor seedbed preparation or weather) and take corrective action. If vegetation fails to grow, have the soil tested to determine whether pH is in the correct range or nutrient deficiency is a problem.

Stand conditions, particularly the coverage, will determine the extent of remedial actions such as seedbed preparation and reseeding. A qualified design professional should be consulted to advise on remedial actions. Consider drill seeding where possible.

Eroded areas should be addressed appropriately by filling and/or smoothing, and reapplication of lime, fertilizer, seed and mulch.

Fertilizing

Satisfactory establishment may require fertilizing the stand in the second growing season. Follow soil test recommendations or the specifications provided to establish and maintain the planting. After the second year, fertilizing is often needed annually or periodically to maintain a healthy stand and cover sufficient for erosion control.

Mowing

Mow vegetation on structural practices such as embankments and grass-lined channels to prevent woody plants from invading.

Other areas should be mowed to compliment the use of the site.

Certain species can be weakened by mowing regimes that significantly reduce their food reserves stored for the next growing season: fescue should not be mowed close during the summer; sericea should not be mowed close in late summer.

Bermudagrass and bahiagrass are tolerant of most mowing regimes and can be mowed often and close, if so desired, during their growing season.

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Preservation of Vegetation (PV)

Practice Description

Preservation of vegetation is the avoidance of an area during land disturbing and construction activity to prevent mechanical and other injury to desirable plants in the planned landscape. The practice provides erosion and sediment control and is applicable where vegetative cover is desired and the existing plant community is compatible with the planned landscape.

Typical Components of the Practice

- Mark Plant Area for Retention
- Plant Protection
- Treating Damaged Plants
- Verification of Practice

Installation

Preservation requirements should be designed by a qualified design professional and plans should be made available to field personnel prior to start of construction

Mark Plant Area for Retention

Clearly indicate the areas to be avoided by marking with tape (flagging), barricade netting or other appropriate means.

Plant Protection

Protect plants that are identified for preservation from compaction by equipment, cutting and filling operations, trenching, and tunneling.

Treating Damaged Plants

Treat damaged trees and shrubs as soon after damage as practical. Treatment may include shaping a wound for proper healing, pruning of jagged roots, pruning of damaged limbs and fertilization to enhance growth.

Verification of Practice

Check to determine that specifications are met as the areas are identified for retention, as the plants are protected during construction and that damaged plants are treated or replaced.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Soil compaction appears to be retarding plant growth or affecting plant health.
- Damage to plants appears to be severe and life threatening.
- Plants appear of poor quality and are undesirable for retention.

Problems during construction that require remedial actions:

- Erosion – eroded areas should be vegetated to grass or a suitable ground cover.
- Severely damaged trees, shrubs or vines should be replaced.

Maintenance

Enhance and maintain plant growth and health according to the maintenance plan. This may involve applying fertilizer, spreading mulch and pruning trees and shrubs.

Replace dead plants as needed to maintain desired landscape cover. Additional information about plantings is found in the following practices: Permanent Seeding: Shrub, Vine and Groundcover Planting: and Tree Planting on Disturbed Areas.

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Retaining Wall (RW)

Practice Description

A retaining wall is a constructed wall used to eliminate steep slopes between areas that have abrupt changes in grade. This practice is used to replace cut or fill slopes in confined areas or where a wall is necessary to achieve stable slopes. A retaining wall can be constructed of reinforced concrete, treated timbers, gabions, reinforced earth (a system of face panels and buried reinforcement strips), or other manufactured products such as interlocking concrete blocks.

Typical Components of the Practice

- Site Preparation
- Grading
- Foundation Preparation
- Installation of Wall
- Drain Installation
- Backfill Installation
- Erosion Control
- Construction Verification

Construction

Prior to the start of construction, a qualified design professional should design and specify the construction requirements for retaining walls. Plans and specifications should be available to field personnel.

Site Preparation

At least 3 days prior to construction, contact the Alabama Line Location Center (dial 811) to identify, locate and mark all underground utilities within the project area.

Clear installation area of debris and obstacles, such as tree and stumps, that might hinder grading and installation of the wall.

Grading

Grade existing embankments according to the design plan to provide a stable slope until construction of the retaining wall is complete.

Grade the top of the embankments according to the design plan to direct stormwater runoff around the area where retaining walls are being constructed.

Foundation Preparation

Prepare the foundation for the retaining wall in accordance with the design plans.

Installation of Wall

Concrete Wall Installation

The placement of reinforcing steel, the construction of forms, concrete batching, mixing, placement, curing, and finishing should be in accordance with the project specifications and the American Concrete Institute (ACI) standards. The concrete mix quantities, air entrainment, slump, temperature, and compressive strength should be in accordance with the plans for the job.

Compressive strength of the concrete should be verified by laboratory tests on representative cylinders made during concrete placement.

Drains and weep holes should be installed as shown on the design plans.

Modular Block Wall Installation

Prepare a leveling pad of compacted, crushed rock (typically 6” thick and 18” wide). Place the first row of modular blocks on the leveling pad (not a footing, as the geosynthetic reinforcement will bear the weight of the block and the backfill). Install additional modular blocks and geosynthetic reinforcement (geogrid or geotextile) according to design plans.

Timber Wall Installation

Timbers should be new pressure-treated (usually 0.6 pcf for ground contact) members having a design life consistent with that of the project and free of splits and deep cracks.

Proper tiebacks are essential to the stability of timber retaining walls. Install tiebacks according to design plans.

Manufactured Products Installation

Specifications for manufactured products should be provided by the manufacturer or in the design plan. Inspect all such materials for damage prior to installation.

Drain Installation

Install drains as specified in the design plans.

Backfill Installation

Backfill for all wall types should be placed carefully in layers not exceeding 8" (loose) and compacted with hand-operated tampers. The degree of compaction should be provided as specified in the design plans. Before compacting, the soil should be moistened or dried as necessary to obtain the optimum moisture content specified. Backfill should not be placed on surfaces that are muddy, frozen or contain frost or ice.

Backfill for retaining walls built of manufactured products such as reinforced earth or interlocking concrete blocks should be placed according to manufacturer's recommendations. Tiebacks or geosynthetic reinforcements should be placed as specified in the design plans.

Nonwoven geotextile fabric should be used behind timber or modular block walls to help keep soil in place.

Erosion Control

Stabilize all bare areas according to the vegetation plan.

Safety

Steep slopes are subject to collapse and can be a safety hazard to persons in the area. No person should work adjacent to steep slopes without shoring protection or properly sloping the embankment.

Construction Verification

Check finished retaining wall for conformance with design plans and specifications.

Check for cracks or movement of the retaining wall.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate retaining wall will not function as intended.
- Seepage is encountered during construction. It may be necessary to install drains.
- Poor foundation soils are encountered under the proposed wall location.
- Design specifications for concrete, timbers, backfill or other materials cannot be met; substitutions may be required. Unapproved substitutions could lead to failure.
- High soil and water pressures result in structural failure of the wall—consult qualified design professional and rebuild according to revised plan and specifications.

Maintenance

Inspect retaining walls periodically and after heavy rains for cracks, undercutting of the foundation, piping erosion, wetness or movement.

Repair problems determined during inspections. Repair cracks according to manufacturer's recommendations.

Shrub, Vine and Groundcover Planting (SVG)

Practice Description

Shrub, vine and groundcover planting is establishing shrubs, vines or groundcover to stabilize landscapes where establishing grass is difficult and mowing is not feasible. The practice is especially suited for steep slopes where aesthetics are important. Incidental benefits include providing food and shelter for wildlife, windbreaks or screens and improved aesthetics.

Typical Components of the Practice

- Site Preparation
- Soil Amendments (lime and fertilizer)
- Planting
- Mulching
- Watering
- Inspection

Installation

Shrub, vine and groundcover planting requirements should be designed by a qualified design professional and plans and specifications should be made available to field personnel prior to start of planting.

Site Preparation

Sites should be prepared in strips along the contour or by individual spots. Site preparation may include contour tilling or the digging of individual holes. Site preparation will vary according to type of plant.

On steep slopes, till the soil in contour rows or dig single holes for each plant. Blend the needed lime, fertilizer, and organic material with the soil removed from each hole or furrow. Mix fertilizer thoroughly with the soil before planting, and use it sparingly to avoid burning roots. To eliminate harmful competition from weeds, an appropriate pre-emergent herbicide may be useful if weeding is not practical.

Soil Amendments (lime and fertilizer)

Plantings of shrubs, vines and groundcovers may need applications of fertilizer and lime. Amendments should be applied according to the site plan or by soil test recommendations. In the absence of a plan or soil test recommendations, apply agricultural limestone into the top 6" of soil at the rate of 50 lbs. of agricultural limestone and 25 lbs. of 8-8-8 per 1000 ft^2 for group plantings of groundcovers and vines. For individual shrub plantings apply ½ pound of lime and ¼ pound of 8-8-8 per individual hole. Soils low in organic matter may be improved by incorporating organic matter in the form of peat, compost, aged sawdust or well-rotted manure.

Planting

In the absence of a site-specific planting plan consider the following guidelines.

Shrubs

Late winter (before leaves emerge) is the best time for planting deciduous shrubs and early fall is the best for evergreens. Shrubs grown and marketed in containers can be planted anytime during the year except when the ground is frozen.

Individual Shrubs

Provide as large an area as possible for initial root development. The hole should be dug to a depth that allows the root ball to extend 1" above the soil surface, and should be as big around as 3 to 5 times the diameter of the root ball.

Shrubs in Prepared Beds

Bed preparation differs somewhat from planting in individual holes. Bed areas are usually tilled or spaded, typically to a depth of 8" to 12". Contrary to the individual planting, soil amendments, such as peat or compost at a rate of 1 part amendment to 3 parts native soil, are beneficial to shrubs because they provide a uniform root environment across the bed area. This type of soil amendment also enables plants to respond positively to water and fertilizers when they are applied. The hole for the shrub planted in a bed area should be a few inches wider in diameter than the root ball.

Container Plants

Remove container plants from their containers, cutting the container if necessary. If the plant is root-bound (roots circling the outside of the root ball), score the roots from top to bottom about 4 times, cutting about ¼" deep with a knife, or gently massage the root ball until roots point outward. Place the shrub into the hole. Using only the native backfill, add soil back to the hole until it is ½ to ⅔ full. Add water to the backfill soil around the root ball. Add soil to ground level and thoroughly water again. A small dike may be formed around the edge of the planting hole to hold water around the root ball if in sandy soils or on slopes. *Caution: In a tight clay soil, plants may be adversely by affected wetness caused by the clay soil trapping additional water in the root zone.*

Bare Root Plants

Soak roots in water. When planting, spread the roots in the hole and gradually add soil. Firm the soil, being careful to avoid breaking roots. Fill the hole with water, and allow it to drain. Then fill the hole with soil, and water again thoroughly.

Burlapped Plants

Cut any wire or string around the plants' stems. Do not remove the burlap. Fold the burlap back so it will be buried by soil. Burlap which is allowed to remain exposed after planting can act as a wick, causing the root ball to dry out. From this point, follow the same procedure for filling the hole as that described for container plants.

Vines and Groundcovers

Early fall or early spring is the best time to plant vines and ground covers.

Transplanting to the prepared seedbed can be done using a small trowel or a spade. Make a hole large enough to accommodate the roots and soil. Backfill and firm the soil around the plant, water immediately, and keep well watered until established. Water slowly and over long periods to allow for infiltration end reduce runoff.

Note: Most groundcovers are planted from container-grown nursery stock. Planting density determines how quickly full cover is achieved; one foot spacing is often used for rapid cover. Large plants such as junipers can be spaced on 3-foot centers.

Mulching

Apply mulch according to the site plan for the project. On slopes where erosion may be a problem and a plan is not available consider the following guidelines.

Use a thick durable mulch such as shredded bark (not chips) or pine straw. On steep slopes, install erosion control netting or matting prior to planting, and tuck plants into the soil through slits in the net. Plant using a staggered pattern.

Watering

Shrubs

Water shrubs immediately after planting and keep well watered for the first few weeks. Apply water weekly if rainfall does not supply 1" of water per week. Be conscious of plants that have been in the ground for less than 1 year and water them regularly and thoroughly during extended dry periods.

Vines and Groundcover

Water vines and groundcover immediately after planting and keep well watered until established. Vines and groundcover need about an inch of water a week for the first 2 years after planting.

Verification of Practice

Check all components of the practice during installation to ensure that specifications are being met.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Soil compaction at planting time appears so significant that it will prevent adequate plant growth. Compaction should be addressed during site preparation.
- Design specifications for plants (species, variety, planting dates) and mulch cannot be met. Unapproved substitutions could lead to failure.

Problems that require remedial actions:

- Erosion, washout and poor plant establishment – repair eroded surface, replant, reapply mulch and anchor.
- Mulch is lost to wind or stormwater runoffs – reapply mulch and anchor.

Maintenance

Replant shrubs, vines or groundcovers where needed to maintain adequate cover for erosion control. Repair eroded surfaces by reapplying the previous treatment

and determine if an additional practice is needed, .i.e. installing erosion netting. Maintain shrubs, vines and ground covers with applications of fertilizer and mulching. Reapply mulch that is lost to wind, stormwater runoff or decomposition.

Shrubs, vines and groundcovers need about an inch of water a week for the first 2 years after planting. When rain does not supply this need, shrubs should be watered deeply not less than once a week.

Fertilization needs should be determined by a professional because different plants have different needs. In the absence of a recommendation from a landscape professional, a soil test is the best way to determine what nutrient elements are needed. Fertilizer formulations of 12-4-8 or 15-0-15 can be used in the absence of a soil test. Apply 2 lbs of fertilizer per 1000 ft^2 of area.

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Sodding (SOD)

Practice Description

Sodding is the use of a transplanted vegetative cover to provide immediate erosion control in disturbed areas. Sodding is well suited for stabilizing erodible areas such as grass-lined channels, slopes around storm drain inlets and outlets, diversions, swales, and slopes and filter strips that cannot be established by seed or that need immediate cover.

Typical Components of the Practice

- Plant Selection
- Surface Preparation
- Soil Amendments (lime and fertilizer)
- Installing the Sod
- Irrigation
- Installation Verification

Installation

Prior to start of installation, Typical Components of the Practice should be specified by a qualified design professional. Plans and specifications should be referred to by field personnel throughout the installation process.

Failure to remove compaction and to address pH and soil fertility deficiencies will likely cause a sodded stand to perform poorly or fail.

Plant Selection

Use plants specified in plan. If not specified, select a variety using Figure SOD-1 and Tables SOD-1 and SOD-2.

Figure SOD-1 Geographical Areas for Species Adaptation
Note: Site conditions related to soils and aspect in counties adjacent to or close to county boundaries may justify adjustments in adaptable areas by qualified design professionals.

Table SOD-1 Grasses Adapted for Sodding in Alabama

Warm Season Species	Variety	Area Adapted
Bermudagrass	Tifway, TifSport, Celebration, TifGrand, Common	North, Central, South
Bahiagrass	Pensacola	Central, South
Centipede	Common, TifBlair	Central, South
St. Augustine	Common, and a few commercial varieties	South
Zoysia	Any selection available in Alabama, Zenith is seeded	Central, South
Cool Season Species		
Tall Fescue	Kentucky 31, Rebel (turf type)	North

Table SOD-2 Adaptation and Maintenance of Grasses Used for Sodding

Species	Tolerance Ratings					Maintenance	
	Shade	Heat	Cold	Drought	Wear	Mowing Height	Mowing Frequency
Bermudagrass	No	Good	Poor	Excel.	Excel.	1”	High
Bahiagrass	Fair	Good	Poor	Excel.	Good	2-3”	High
Centipede	Fair	Good	Poor	Good	Poor	1 ½”	Low
Tall Fescue	Good	Fair	Good	Good	Good	3”	High
St. Augustine	Good	Good	Poor	Poor	Poor	2-3”	Medium
Zoysia	Fair	Good	Fair	Excel.	Good	1”	High

Surface Preparation

Clear the area of clods, rocks, etc. and smooth the area. Grade and loosen the soil to a smooth firm surface to enhance rooting. Break up large clods and loosen compacted, hard or crusted soil surfaces with a disk, ripper, chisel, harrow or other tillage equipment. Avoid preparing the seedbed under excessively wet conditions. Operate the equipment on the contour.

Where topsoiling is specified, additional steps will be done based on the design plan or, if not available, according to the Topsoiling practice.

Application of Soil Amendments

Apply fertilizer and lime according to the plan or by soil test recommendations. In the absence of a plan or soil test recommendations apply agricultural limestone

at the rate of 2 tons per acre (90 lbs. per 1000 sq. ft.) and 10-10-10 fertilizer at the rate of 1000 lbs. per acre (25 lbs per 1000 $ft.^2$) Apply ground agricultural limestone unless a soil test shows a pH of 6.0 or greater. Incorporate amendments to depth of 4" to 6" with a disk or rotary tiller.

Rake or harrow to achieve a smooth, final grade on which to lay the sod. Surface should be loose, and free of plants, trash and other debris.

During high temperatures, moisten the soil immediately prior to laying sod. This cools the soil and reduces root burning and dieback.

Installing the Sod

Lay the first row of sod in a straight line with subsequent rows placed parallel to and butting tightly against each other. Stagger joints to create a brick-like pattern and promote more uniform growth and strength. Ensure that sod is not stretched or overlapped and that all joints are butted tight to prevent spaces which would cause drying of the roots (See Figure SOD-2).

On slopes 3:1 or steeper, or wherever concentrated flow may be a problem, lay sod with staggered joints and secure by stapling or pegging. Install sod with the length perpendicular to the water flow (on the contour). See Figure SOD-3. Staple firmly at the corners and middle of each strip. Jute or synthetic netting may be pegged over the sod for further protection against washout during establishment.

Irrigation

Immediately after laying the sod, roll or tamp it to provide firm contact between roots and soil, then irrigate sod deeply so that the underside of the sod pad and the soil 6" below the sod is thoroughly wet.

Until a good root system develops, water sod during dry periods as often as necessary to maintain moist soil to a depth of at least 4".

Construction Verification

Check materials and installation for compliance with specifications.

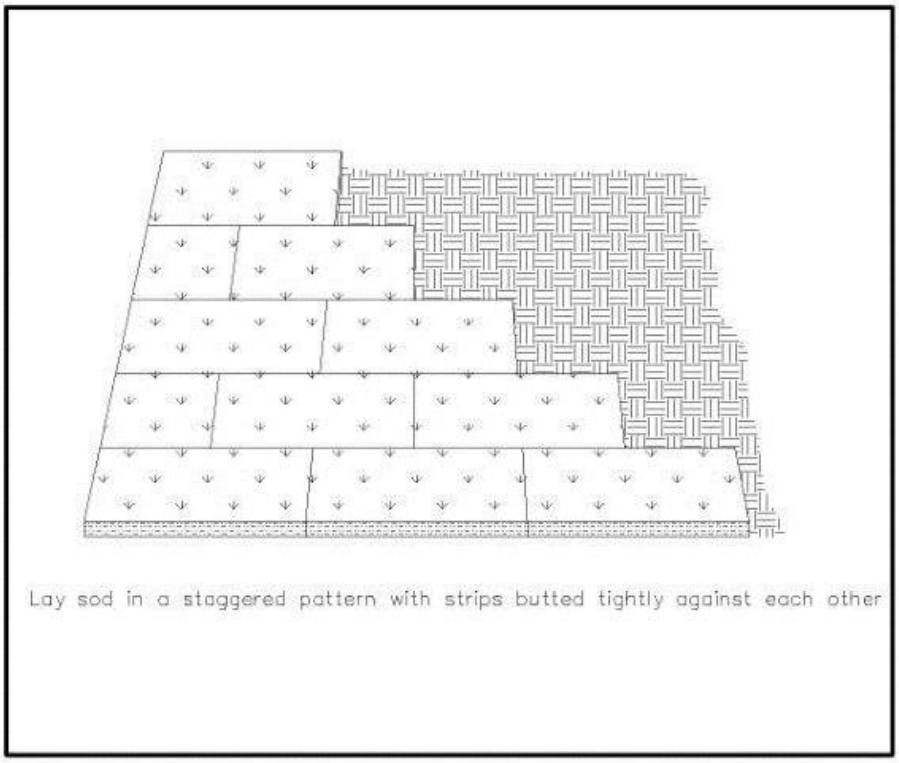

Figure SOD-2 Typical Installation of Grass Sod

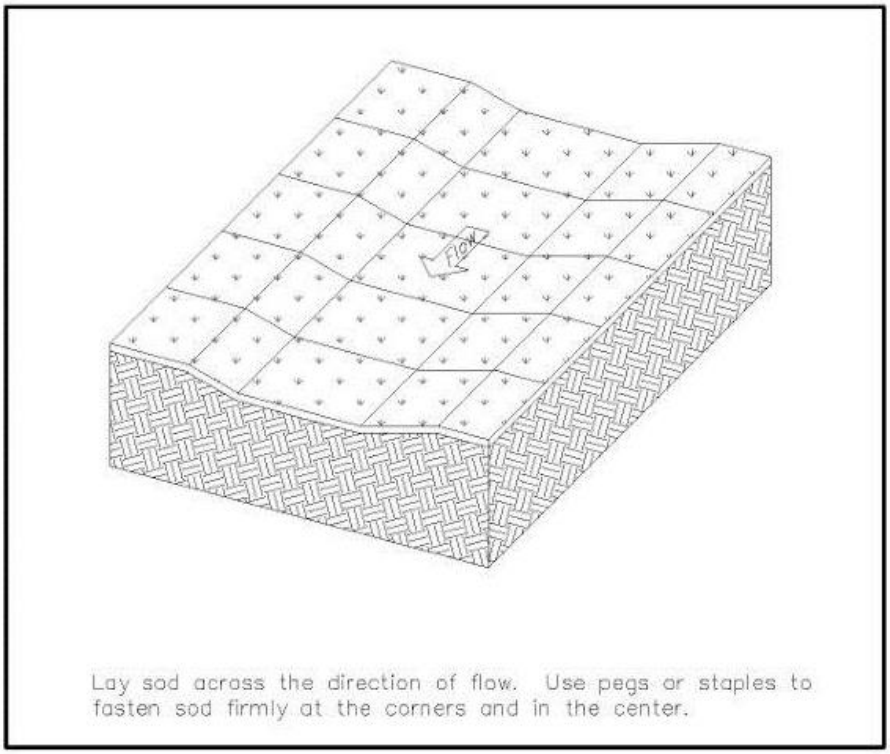

Figure SOD-3 Installation of Sod in Waterways

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate the sodding materials will not function as intended; changes in plan may be needed.
- Design specifications for sod variety cannot be met or irrigation is not possible; substitution or seeding may be required. Unapproved substitutions could result in erosion or sodding failure.
- Sod laid on poorly prepared soil or unsuitable surface and grass dies because it is unable to develop a root system with the soil: remove dead sod, prepare surface properly and resod.
- Sod not adequately irrigated after installation; may cause root dieback or grass does not root rapidly and is subject to drying out: irrigate sod and underlying soil to a depth of 4" and keep moist until roots are established.
- Sod not anchored properly may be loosened by runoff: use guidance under Site Preparation to repair the damaged areas, lay healthy sod, anchor properly and irrigate as planned.
- Slow growth due to lack of nitrogen: apply additional fertilizer.

Maintenance

Keep sod moist until it is fully rooted.

Mow to a height of 2" to 3" after sod is well-rooted, frequently in 2 to 3 weeks. Do not remove more than ⅓ of the leaf blade in any mowing.

Permanent, fine turf areas require yearly fertilization. Fertilize warm-season grass in late spring to early summer; fertilize cool-season grass in early fall and late winter. Fertilize at rates recommended by a soil test.

Temporary Seeding (TS)

Practice Description

Temporary seeding is the establishment of fast-growing annual vegetation from seed on disturbed areas. Temporary vegetation provides economical erosion control for up to a year and reduces the amount of sediment moving off the site.

This practice applies where short-lived vegetation can be established before final grading or in a season not suitable for planting the desired permanent species. It helps prevent costly maintenance operations on other practices such as sediment basins and sediment barriers. In addition, it reduces problems of mud and dust production from bare soil surfaces during construction. Temporary or permanent seeding is necessary to protect earthen structures such as dikes, diversions, grass-lined channels and the banks and dams of sediment basins.

Typical Components of the Practice

- Scheduling
- Seedbed Preparation
- Applying Soil Amendments (fertilizer and lime)
- Planting
- Mulching or Installation of Erosion Control Blanket
- Inspection

Installation

Prior to start of installation, plant materials, seeding rates and planting dates should be specified by a qualified design professional. Plans and specifications should be referred to by field personnel throughout the installation process.

Plantings should be made during the specified planting period if possible. When sites become available to plant outside of the recommended planting period, either a temporary seeding, mulching or chemical stabilization should be applied. If lime and fertilizer application rates are not specified, take soil samples during final grading from the top 6" in each area to be seeded. Submit samples to a soil testing laboratory for lime and fertilizer recommendations.

Seedbed Preparation

Grade and loosen soil to a smooth firm surface to enhance rooting of seedlings and reduce rill erosion. If compaction exists, loosen the surface to 6" to 8". Break up large clods and loosen compacted, hard or crusted soil surfaces with a disk, ripper, chisel, harrow or other tillage equipment. Avoid preparing the seedbed under excessively wet conditions to minimize soil compaction. Operate the equipment on the contour.

For either broadcast seeding or drill seeding, loosen the soil to a depth of at least 6".

For no-till drilling, the soil surface does not need to be loosened unless the site has surface compaction. If shallow compaction exists, the area should be chiseled across the slope at least 6". If compaction exists between 6" and 12" the area should be chiseled or subsoiled at least 12".

Lime and fertilizer should be incorporated during seedbed preparation.

Applying Soil Amendments

Liming

Follow the design plan or soil test recommendation. If a plan or soil test is not available, use 2 tons/acre of ground agricultural lime on clayey soils (approximately 90 lbs/1,000 ft^2.) and 1 ton/acre on sandy soils (approximately 45 lbs/ft^2.).

Spread the specified amount of lime and incorporate into the upper 6" of soil following seedbed preparation and applying fertilizer.

Agricultural lime is usually applied as a separate operation and spread in dry form. It is not normally applied with a hydraulic seeder because it is abrasive and, also, may clog the system. On the other hand, liquid lime is applied with a hydraulic seeder but because of cost, liquid lime is used primarily to provide quick action for benefit of plants during their seedling stage with the bulk of

liming needs to be provided by agricultural lime. Dry lime may be applied with the fertilizer mixture.

Fertilizing

Apply a complete fertilizer at rates specified in the design plan or as recommended by soil tests. In the absence of soil tests, use the following as a guide:

8-24-24 or equivalent – apply 400 lbs/acre (approximately 9 lbs/1000 ft^2) at planting.

When vegetation has emerged to a stand and is growing, 30 to 40 lbs/acre (approximately 0.8 lbs/1000 ft^2) of additional nitrogen fertilizer should be applied.

Note: Fertilizer can be blended to meet exact fertilizer recommendations. Take soil test recommendations to local fertilizer dealer for bulk fertilizer blends. This may be more economical than bagged fertilizer.

Incorporate lime and fertilizer to a depth of at least 6" with a disk or rotary tiller on slopes of up to 3:1.

On steeper slopes, lime and fertilizer may be applied to the surface without incorporation. Lime and fertilizer may be applied together; however, fertilizer should not be added to the seed mixture during hydroseeding. Lime may be added with the seed mixture.

Planting

Plant the species specified in the plan at the rate and depth specified. In the absence of plans and specifications, plant species and seeding rates may be selected by qualified persons from Table TS-1.

Apply seed uniformly using a cyclone seeder, drop-type spreader, drill, drill seeder, cultipacker seeder or by hand on a fresh, firm friable seedbed.

When using a drill seeder, plant seed ¼" to ½" deep. Calibrate equipment in the field.

When planting by methods other than a drill seeder or hydroseeder, cover seed by raking, or dragging a chain, brush or mat. Then firm the soil lightly with a roller. Seed can also be covered with a hydromulch product.

Cover broadcast seed by raking or chain dragging; then firm the surface with a roller or cultipacker to provide good seed contact. Small grains should be planted no more than 1" deep and grasses and legume seed no more than ½" deep.

TS-1 Commonly Used Plants for Temporary Cover

Species	Seeding Rate/Ac PLS	North Seeding Dates	Central	South
Millet, Browntop or German	40 lbs	May 1-Aug 1	Apr 1-Aug 15	Apr l-Aug 15
Rye	3 bu	Sept I-Nov 15	Sept 15-Nov 15	Sept 15-Nov 15
Ryegrass	30 lbs	Aug l-Sept 15	Sept l-Oct 15	Sept 1 -Oct 15
Sorghum-Sudan Hybrids	40 lbs	May l-Aug 1	Apr 15-Aug 1	Apr l-Aug 15
Sudangrass	40 lbs	May l-Aug I	Apr 15-Aug 1	Apr l-Aug 15
Wheat Common	3 bu	Sept I-Nov 1	Sept 15-Nov 15	Sept 15-Nov 15
Common Bermudagrass	10 lbs	Apr 1-July 1	Mar 15-July 15	Mar 1-July 15
Crimson Clover	10 lbs	Sept 1-Nov 1	Sept 1-Nov 1	Sept 1-Nov 1

PLS means pure live seed and is used to adjust seeding rates. For example, to plant 10 lbs PLS of a species with germination of 80% and purity of 90%, PLS= 0.8X 0.9 = 72%. 10 lbs PLS = 10/0.72 = 13.9 lbs of the species to be planted.

Hydroseeding

Surface roughening is particularly important when hydroseeding, as roughened slope will provide some natural coverage for lime, fertilizer, and seed. The surface should not be compacted or smooth. Fine seedbed preparation is not necessary for hydroseeding operations; large clods, stones, and irregularities provide cavities in which seeds can lodge.

Mix seed, inoculant if required, and a seed carrier with water and apply as a slurry uniformly over the area to be treated. The seed carrier should be a cellulose fiber, natural wood fiber or cane fiber mulch material which is dyed an appropriate color to facilitate uniform application of seed. Use the correct legume inoculant at 4 times the recommended rate when adding inoculant to a hydroseeder slurry. The mixture should be applied within one hour after mixing to reduce damage to seed.

Fertilizer should not be mixed with the seed-inoculant mixture because fertilizer salts may damage seed and reduce germination and seedling vigor. Fertilizer may be applied with a hydroseeder as a separate operation after seedlings are established.

Mulching

Mulching is extremely important for successful seeding. Whether the mulching material is straw or a manufactured product, the material needs to be applied properly. Uniformly spread organic mulches by hand or with a mulch blower at a rate which provides about 75% ground cover. Spread HECPs utilizing appropriate equipment and at rates as specified in the plan or by the manufacturer. Caution, an over-application of wheat straw will reduce stand success – do not over-apply wheat straw when mulching a seeding! *(See Mulching practice for more details).*

Verification of Installation

Check materials and installation for compliance with specifications during installation of products.

Common Problems

Consult with a qualified design professional if the following occurs:

- Design specifications for seed variety, seeding dates or mulching cannot be met; substitutions may be required. Unapproved substitutions could lead to failure.
- Seeding outside of the recommended results in an inadequate stand. Reseed according to specifications of a qualified design professional (see recommendations under Maintenance).

Maintenance

Reseeding

Inspect seedings weekly until a stand is established and thereafter at least monthly for stand survival and vigor. Also, inspect the site for erosion.

Eroded areas should be addressed appropriately by filling and/or smoothing, and reapplication of lime, fertilizer, seed and mulch.

A stand should be uniform and dense for best results. Stand conditions, particularly the coverage, will determine the extent of remedial actions such as seedbed preparation and reseeding. A qualified design professional should be consulted to advise on remedial actions. Consider drill seeding when doing a remedial planting.

Fertilizing

If vegetation fails to grow, have the soil tested to determine whether pH is in the correct range or nutrient deficiency is a problem.

Satisfactory establishment may require refertilizing the stand, especially if the planting is made early in the planting season. Follow soil test recommendations or the specifications provided to establish the planting.

Mowing

Temporary plantings may be mowed and baled or simply mowed to compliment the use of the site.

Millet, sorghum-sudan hybrids, sudangrass, rye and wheat may be mowed, but no lower than 6” (closer moving may damage the stand).

Ryegrass is tolerant of most mowing regimes and may be mowed often and as close as 4” to 6” if this regime is started before it attains tall growth (over 8”).

Bermudagrass is tolerant of most mowing regimes and can be mowed often and close, if so desired, during its growing season.

Tree Planting On Disturbed Areas (TP)

Practice Description

Tree planting on disturbed areas is planting trees on construction sites or other disturbed areas to stabilize the soil. The practice reduces erosion and minimizes the maintenance requirements after a site is stabilized. The practice is applicable to those areas where tree cover is desired and is compatible with the planned use of the area, particularly on steep slopes and adjacent to streams. Tree planting is usually used with other cover practices such as permanent seeding or sodding.

Typical Components of the Practice

- Site Preparation
- Planting Seedlings and Trees
- Mulching
- Inspection

Installation

Tree planting requirements should be designed by a qualified design professional and plans and specifications should be made available to field personnel prior to start of planting.

Bare Root Seedlings

Site Preparation

Compacted soil should be ripped or chiseled on the contour to permit adequate root development and proper tree growth. Debris should be removed from the site to facilitate tree planting.

Planting

Planting should be done in accordance with the design plan. If a detailed plan is not available, select trees that are suitable for growing on the disturbed site. Select trees that are long-lived and are not considered invasive or a nuisance. Consideration should be given to trees that are visually pleasing and will provide food and cover for wildlife.

Bare-root seedlings should be planted between December 1 and March 15 when the soil is neither too dry nor too wet. Freezing weather should be avoided.

If planting is being done on sloping land by equipment, the planting should be made on the contour.

Bare-root seedlings should be planted deeper than they grew in the nursery: small stock 1" deeper and medium to large stock ½" deeper. On most soils longleaf pine seedlings should be planted ¼" deeper than they grew in the nursery (note: this not true for planting depth of container grown longleaf seedlings – see Site Preparation in next section for container grown seedlings). Roots should be planted straight down and not twisted, balled, or U-shaped. Soil should be packed firmly around the planted seedlings.

The roots of seedlings must be kept moist and cool at all times. After lifting, seedlings should not be exposed to sun, wind, heating, drying or freezing before they are planted. Baled seedlings may be kept up to 3 weeks if they are properly stacked, watered, and kept in a cool place. When planting is delayed longer than 3 weeks, the roots of seedlings should be covered with moist soil (heeled-in) or the seedlings should be put in cold storage.

During planting, the roots of seedlings must be kept moist and only 1 seedling should be planted at a time. At the end of each day, loose seedlings should be either repacked in wet moss or heeled-in.

If specified, tree tubes and tree mats should be installed according to specifications or manufacturer's recommendations.

Mulching

Mulching may be necessary on sloping land to reduce erosion. Mulch with wood chips, bark, pine needles, peanut hulls etc. should be done to a depth of no more than 3". Mulch should not be placed against the trunk of a tree.

Balled and Burlapped and Container-Grown Trees

The best time to plant hardwood trees is in late winter (before leaves emerge) and the best time to plant evergreens is in early fall. However, these plants may be planted anytime of the year except when the ground is frozen. Watering is essential during dry periods.

Site Preparation

The planting hole should be dug deep and wide enough to allow proper placement of the root ball. The final level of the root ball's top should be level with the ground surface (See Figure TP-1).

As the hole is dug the topsoil should be kept separate from the subsoil. If possible the subsoil should be replaced with topsoil. If topsoil is unavailable the subsoil can be improved by mixing in ⅓ volume of peat moss or well-rotted manure.

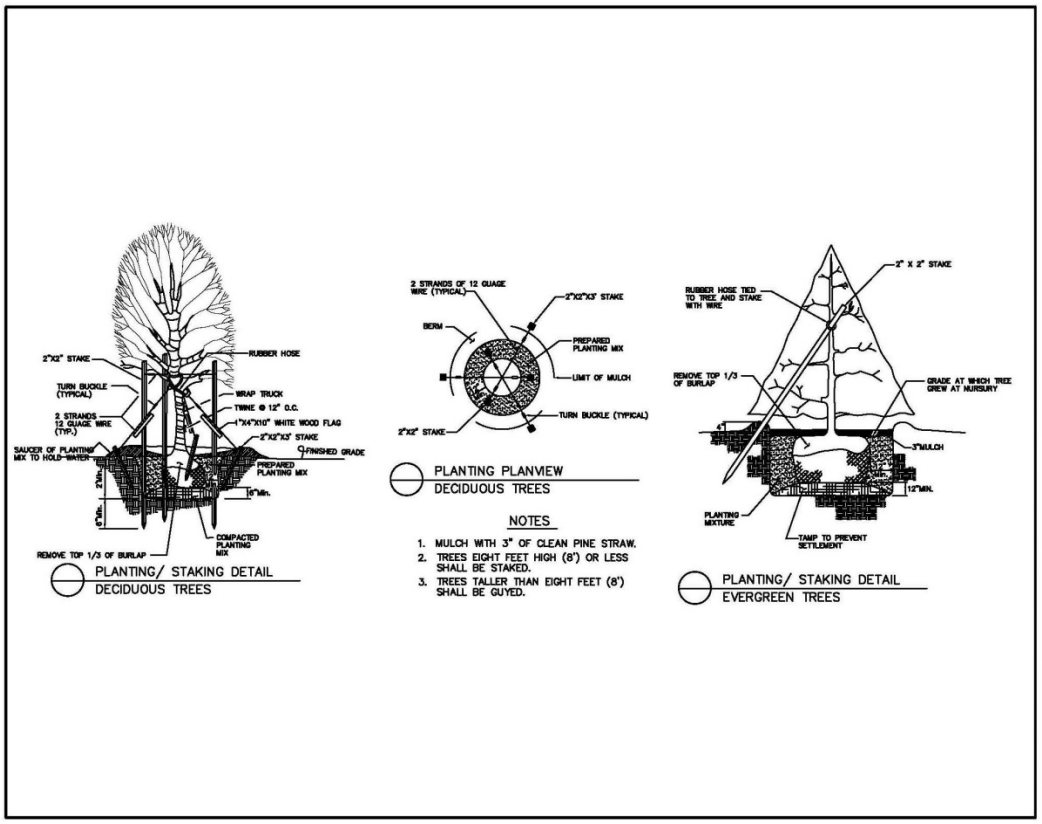

Figure TP-1 Tree Planting Diagram

Planting

Depth of planting must be close to the original depth. The tree may be set just a few inches higher than in its former location, especially if soil is poorly drained. Do not set the tree lower than before. For container grown longleaf seedlings, the planting depth should be slightly higher than the depth grown in the nursery. Soil to be placed around the root ball should be moist but not wet.

Set the tree in the hole and if the tree is balled and burlapped remove the rope which holds the burlap. Loosen the burlap and remove completely if practical. Do not break the soil of the root ball. Fill the hole with soil halfway and add water to settle the soil and eliminate air pockets. When the water has drained off, fill the hole the remainder of the way. Use extra soil to form a shallow basin around the tree. This will help retain water.

Newly planted trees may need artificial support to prevent excessive swaying. Stakes and guy wires may be used (See Figure TP-l). Guying should be loose enough to allow some movement of the tree.

Mulching

Following planting, mulch with wood chips, bark, pine needles, peanut hulls etc. to a depth of no more than 3". Mulch should not be placed against the trunk of the tree.

Mulching may be necessary on sloping land to reduce erosion and should be used around balled and burlapped trees and container grown trees to help conserve soil moisture and reduce competition from weeds and grass.

Verification of Installation

Check all components of the practice during installation to ensure that specifications are being met.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Soil compaction can prevent adequate tree growth. Compaction should be addressed during site preparation.
- Design specifications for trees (species, planting dates) and mulch cannot be met; substitutions may be required. Unapproved substitutions could lead to failure

Problems that require remedial actions:

Erosion, washout and poor tree establishment – repair eroded surface, replant, reapply mulch and anchor.

Mulch is lost to wind or stormwater runoff – reapply mulch and anchor.

Maintenance

Replant dead trees where needed to maintain adequate cover for erosion control.

Periodic fertilization may be beneficial on poor sites to maintain satisfactory tree growth. Transplanted trees should be fertilized 1 year or so after planting. A soil test is the best way to determine what elements are needed. Fertilizer formulations of 10-8-6 or 10-6-4 can be used in the absence of a soil test. About 2 lbs. of fertilizer should be used for each inch of tree diameter measured at 4.5 feet above the ground.

Fertilizer must come in contact with the roots to benefit a tree. The easiest way to apply fertilizer is to simply broadcast it under the tree and over the root system. As a tree grows, the roots will grow well beyond the drip line. This should be taken into account when applying fertilizer by the broadcast method. Another way to apply fertilizer is to make holes in the tree's root area with a bar or auger. Holes should be 18" deep, spaced about 2 feet apart, and located around the drip line of the tree. Distribute the fertilizer evenly into these holes and close the holes with the heel of the shoe or by filling with topsoil or peat moss. Trees should be fertilized in late winter or early spring before leaves emerge.

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Check Dam (CD)

Practice Description

A check dam (also referred to as a "ditch check") is a small barrier or dam constructed across a swale, drainage ditch or other area of concentrated flow for the purpose of reducing channel erosion. Channel erosion is reduced because check dams flatten the gradient of the flow channel and slow the velocity of channel flow. Check dams do not reduce turbidity of runoff. Check dams can be constructed of rock, wattles (sometimes referred to as tubes or rolls), sand bags, or other materials that may be acceptable to the design professional. Unless installed correctly, check dams will not capture a significant amount of sediment. When installed correctly, most check dams can capture the coarser grained material, which can be significant for sandy soils.

This practice applies in small open channels and drainageways, including temporary and permanent swales. It is not to be used in a live stream. Situations of use include areas in need of protection during establishment of grass and areas that cannot receive a temporary or permanent non-erodible lining for an extended period of time.

Typical Components of the Practice

- Site Preparation
- Materials Installation

- Erosion and Sediment Control
- Construction Verification

Construction

Prior to start of construction a qualified design professional should determine the location, elevation and size of the structure to optimize flattening of channel grade. Usually, check dam dimensions are taken from a standard drawing. Check dams are typically constructed using materials specified in a contract which could be rock, wattles, sand bags, or other suitable material, including manufactured products. Most check dams are constructed of rock.

Site Preparation

Determine location of any underground utilities.

Locate and mark the site for each check dam in strategic locations (to avoid utilities and optimize effectiveness of each structure in flattening channel grade).

Remove debris and other unsuitable material which would interfere with proper placement of the check dam materials.

In highly erosive soil conditions it may be specified to excavate a shallow keyway (12”-24” deep and at least 12” wide) across the channel and into each abutment for each check dam. For other soils, geotextile alone without a keyway is often used on the soil.

Materials Installation

For all check dams on compacted soil, install a non-woven geotextile fabric underlayment that extends at least 3 feet up and downstream of the check dam. Bury the upstream edge of the geotextile underlayment, staple it to the trench bottom, and place compacted backfill in the trench. Ensure the geotextile is secured by stapling along its edges.

Always ensure that water flows over and not around the check dam.

Rock Check Dam. Construct the dam of the class riprap specified with a minimum 2:1 side slopes. Position rock to form a parabolic top, perpendicular to channel flow, with the center portion at the elevation shown in the design so that the flow goes over the structure and not around the structure. Small graded aggregate and/or geotextile may be specified on the upstream face of the rock check dam to increase the sediment trapping efficiency.

Wattle Check Dam. Place the specified wattle in a parabolic shape to ensure water flows over and not around the wattle. Staple the wattle in place with sod staples on 10-inch centers on each side of the wattle to prevent flotation, and place wooden stakes over the top in a non-destructive tee-pee fashion.

Silt Fence Check Dam. Construct the silt fence check dam in an upstream "V" configuration and notch the silt fence as shown on the plans.

Sand Bag Check Dam. Ensure the sand bags are properly oriented in each layer as shown on the plans.

Erosion and Sediment Control

Install vegetation (temporary or permanent seeding) or mulching to stabilize other areas disturbed during the construction activities.

Construction Verification

Check finished size, grade and shape for compliance with standard drawings and materials list (check for compliance with specifications if included in contract specifications).

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate check dam will not function as intended. Change in plan will be needed.
- Materials specified in the plan are not available.

Maintenance

Inspect the check dam for material displacement and abutments for erosion around the ends of the dam after each significant rainfall event. Repair as needed.

Inspect the channel after each significant rainfall event. If channel erosion exceeds expectations, consult with the design professional and consider adding another check dam to reduce channel flow grade.

Sediment should be removed if it reaches a depth of ½ the original dam height. If the area behind the dam fills with sediment there is a greater likelihood that water will flow around the end of the check dam and cause the practice to fail.

Check dams may be removed when their useful life has been completed. The area where check dams are removed should be seeded and mulched immediately unless a different treatment is prescribed. In some instances check dams should be left as a permanent measure to support channel stability.

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Diversion (DV)

Practice Description

A diversion is a watercourse constructed across a slope consisting of an excavated channel, a compacted ridge or a combination of both. Most diversions are constructed by excavating a channel and using the excavated material to construct a ridge on the downslope side of the channel. Right-of-way diversions and temporary diversions are sometimes constructed by making a ridge, often called a berm, from fill material.

This practice applies to sites where stormwater runoff can be redirected to permanently protect structures or areas downslope from erosion, sediment, and excessive wetness or localized flooding. Diversions may be used to temporarily divert stormwater runoff to protect disturbed areas and slopes or to retain sediment on site during construction.

Perimeter protection is sometimes used to describe both permanent and temporary diversions used at either the upslope or downslope side of a construction area.

Right-of-way diversions, sometimes referred to as water bars, are used to shorten the flow length on a sloping right-of-way and reduce the erosion potential of the stormwater runoff.

Diversions are designed to intercept and carry excess water to a stable outlet.

Typical Components of the Practice

- Site Preparation
- Grading
- Erosion and Sediment Control
- Construction Verification

Construction

Prior to start of construction, diversions should be designed by a qualified design professional. Plans and specifications should be referred to by field personnel throughout the construction process. A diversion should be built according to planned alignment, grade and cross section. Typically, a diversion is constructed with the following activities.

Site Preparation

Determine exact location of any underground utilities.

Locate and mark the alignment of the diversion as shown on the plans. Minor adjustments to the grade and alignment may be required to meet site conditions. The alignment should maintain a positive grade towards the outlet and end in a stable outlet or an area that can be stabilized.

Clear the construction area of trees, stumps, brush, sod and other unsuitable material which would interfere with compaction of the ridge.

Disk or scarify the area where the ridge is to be installed before placing the fill.

Clean out and refill with compacted earth fill all ditches, swales or gullies to be crossed.

Apply gravel or hard surface protection at vehicle crossings to prevent rutting.

Install stable outlets prior to construction. Adequate vegetation should be established in the outlet channel. If vegetation cannot be established use Lined Swale, Rip-rap Lined Swale, Drop Structure, Sediment Basin or Stormwater Detention Basin .

Grading

Excavate, fill and shape the diversion to planned alignment, grade and cross section. The channel should have a positive grade toward the outlet to avoid ponding. Where possible, blend diversion into the surrounding landscape.

Overfill and compact the ridge, allowing for 10% settlement. Fill should be placed in lifts of no more than 6” to 8” in depth. Compaction may be achieved

by driving wheeled equipment along the ridge as lifts are added. The settled ridge top must be at or above design elevation at all points.

All earth removed and not needed for the practice should be spread or disposed of so that it will not interfere with the functioning of the diversion.

Erosion and Sediment Control

Control sediment along grading limits with sediment control measures.

Leave sufficient area adjacent to the diversion to permit clean out and regrading.

Immediately after installation install vegetation treatment or other means to stabilize the diversion in accordance with plans.

Install gravel or hard surface protection at vehicle crossings.

Stabilize diversion outlets in accordance with plans.

Construction Verification

Check finished grades and cross section of diversions to eliminate constrictions to flow. Check all ridges for low spots and stability.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate diversion will not function as intended. Changes in plans will be needed.
- Design specifications for seed variety or seeding cannot be met. Substitutions not approved by the design professional could result in erosion and lead to diversion failure.
- Seepage is encountered during construction. It may be necessary to install drains.

Maintenance

Inspect weekly and following each storm event for erosion until the diversion is vegetated.

Remove debris and sediment from the channel, and rebuild the ridge to design elevation where needed.

Check diversion outlet for erosion and repair if area becomes unstable. Maintain vegetation with periodic fertilization and mowing to keep vegetation in a vigorous, healthy condition. Mow for weed and brush control during the first

year and as needed to prevent brush and trees seedlings from becoming established after the first year of installation.

When the work area has been stabilized, remove temporary diversions, sediment barriers and traps and repair bare or damaged areas in the vegetation by planting and mulching or sodding.

Stabilize all eroded, rutted or disturbed areas as soon as possible with vegetation or synthetic erosion control measures as specified in the design.

Drop Structure (DS)

Practice Description

A drop structure is an erosion control structure created by construction of a barrier across a drainageway or installing a permanent manufactured product down a slope. The purpose of a drop structure is to convey concentrated flow storm runoff from the top to the bottom of a slope or to lower water from a grassed swale into an open channel such as an intermittent or perennial stream. This practice applies where other erosion control measures are insufficient to prevent excessive erosion and off-site sedimentation.

Typical Components of the Practice

- Site Preparation
- Principal Spillway
- Embankment
- Emergency Spillway
- Erosion Control
- Construction Verification

Construction

Prior to the start of construction, drop structures should be designed by a qualified design professional.

Plans and specifications should be referred to by field personnel throughout the construction process. The drop structure should be built according to planned grades and dimensions.

Note: Construction of an embankment with spillways is the only type of drop structure covered in this edition of the handbook.

Consider the following guidance as construction proceeds

Site Preparation

Locate all utilities at the site to ensure avoidance.

Clear, grub and strip the dam foundation and emergency spillway area, removing all woody vegetation, rocks and other objectionable material. Dispose of trees, limbs, logs and other debris in designated disposal areas.

Stockpile surface soil for use later during topsoiling.

Clear the sediment pool to facilitate sediment clean out and dispose of trees, limbs, logs and other debris in designated disposal areas.

Principal Spillway

Prepare the pipe bedding and situate the spillway barrel (pipe) on a firm, even foundation.

Install anti-seep collars, or sand drainage diaphragm with filter compatible outlet according to the design plan.

Place around the barrel 4” layers of moist, clayey, workable soil (not pervious material such as sand, gravel or silt), and compact with hand tampers to at least the density of the foundation soil. (Do not raise the pipe from the foundation when compacting under the pipe haunches.)

At the pipe inlet, install Inlet Protection according to the design plan.

At the pipe outlet, install Outlet Protection according to the design plan (if not specific, use a riprap apron at least 5 feet wide to a stable grade).

Embankment

Scarify the foundation of the dam before placing fill.
Use fill from predetermined borrow areas. It should be clean, stable soil free of roots, woody vegetation, rocks and other debris; and must be wet enough to form a ball without crumbling, yet not so wet that water can be squeezed out.

Place the most permeable soil in the downstream toe and the least permeable in the center portion of the dam.

Protect the spillway barrel with 2 feet of fill that has been compacted with hand tampers before traversing over the pipe with equipment.

Compact the fill material in 6" to 8" continuous layers over the length of the embankment. One way is by routing construction equipment so that each layer is traversed by at least one wheel of the equipment.

Construct and compact the embankment to an elevation 10% above the design height to allow for settling. The embankment should have a minimum 8 feet top width and 3:1 side slopes, but the design may specify additional width and gentler side slopes.

Emergency Spillway

Construct the spillway at the site located by the qualified design professional according to the plan design (in undisturbed soil around one end of the embankment on natural ground, and so that any flow will return to the receiving channel without damaging the embankment).

Erosion Control

Minimize the size of all disturbed areas.

Use temporary diversions to prevent surface water from running onto disturbed areas.

Vegetate and stabilize the embankment, the emergency spillway and all disturbed areas immediately after construction.

Construction Verification

Check the finished grades and configuration for all earthwork. Check elevations and dimensions of all pipes and structures.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate drop structure will not function as intended.
- Seepage is encountered during construction; it may be necessary to install drains.
- Design specifications for fill, pipe, seed variety or seeding dates cannot be met; substitutions may be required. Unapproved substitutions could lead to failure.

Maintenance

Inspect the drop structure after each storm event until it is completely stabilized with vegetation.

Periodically check the embankment, emergency spillway and outlet for erosion damage, piping, settling, seepage or slumping along the toe or around the barrel and repair immediately.

Grass Swale (GS)

Practice Description

A grass swale is a natural or constructed channel that is shaped or graded to required dimensions and established in suitable vegetation for the stable conveyance of runoff without causing damage to the channel by erosion. This practice applies to sites where concentrated runoff will cause erosion damage, a vegetative lining provides sufficient stability for the channel as designed, and space is available for a relatively large cross section. Typical situations where concentrated flow areas are addressed with a grass swale include roadside ditches, channels at property boundaries, outlets for diversions and other concentrated flow areas subject to channel erosion. Grass swales are generally considered permanent structures but may be used as a temporary measure.

Typical Components of the Practice

- Scheduling
- Site Preparation
- Constructing
- Construction Verification
- Vegetating

Installation

Prior to start of construction, grass swale channels should be designed by a qualified design professional. Plans and specifications should be referred to by field personnel throughout the construction process to ensure that the channel has planned alignment, grade and cross section.

Scheduling

Schedule construction during a period of relatively low rainfall and runoff events if practical. Consider, also, the establishment period (planting dates) for the planned species that will be used for long-term vegetative cover.

Site Preparation

Determine exact location of underground utilities.

Install any structures required to stabilize the swale outlet or to provide drainage along the swale prior to beginning installation of the swale. Refer to design for structures to be installed.

Remove brush, trees and other debris from the construction area and dispose of properly.

Constructing

Excavate and shape the channel to dimensions shown in the design specifications, removing and properly disposing of excess soil so surface water can enter the channel freely. The typical features of a grass swale are shown in Figure GS-1 and listed below, but may be different in the design for a specific site.

Cross Section: trapezoidal or parabolic.

Side Slopes: 3:1 or flatter for trapezoidal channels.

Outlet: Channel should empty into a stable outlet, sediment traps, or detention/retention basins.

Subsurface Drain: Use in areas with seasonally high water tables or seepage problems.

Topsoil: Provide topsoil as needed to grow grass on areas disturbed by construction.

Protect all concentrated inflow points along the channel with erosion resistant linings, such as riprap, sod, mulch, erosion control blankets, turf reinforcement mats or other appropriate practices as specified in the design plan.

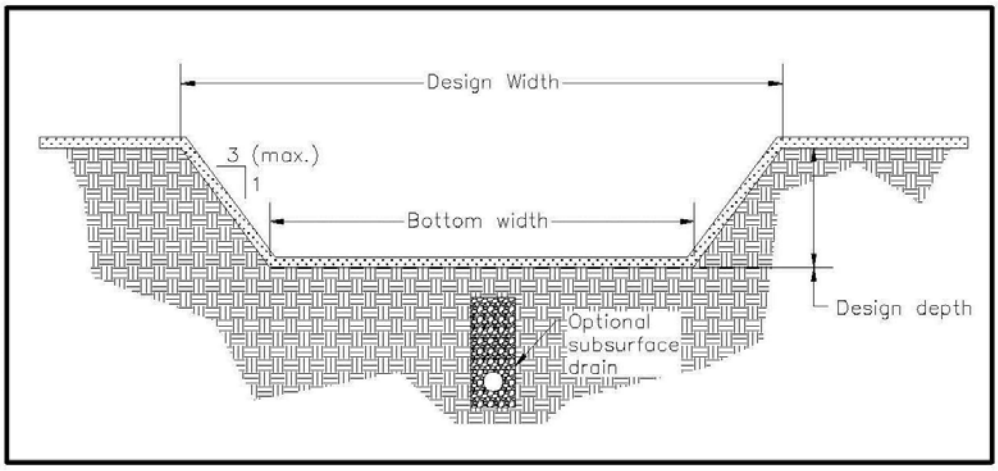

Figure GS-1 Typical Trapezoidal Grass-lined Channel

Construction Verification

Check finished grade and cross section of channel throughout the length of the watercourse. Verify channel cross sections at several locations to avoid constrictions to flow.

Vegetating

Prepare seedbed and apply lime, fertilizer and seed or sod in the swale immediately after grading and protect with erosion control blankets, turf reinforcement mats or mulch according to the design plan. If not specified in a plan, select lime, fertilizer, variety and mulching components from related practices – permanent seeding or temporary seeding, erosion control blanket or sodding.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate practice will not function as intended.
- Changes in plan may be needed.
- Design specifications for seed variety, seeding dates or erosion control materials cannot be met; substitution may be required.

- Erosion occurs in channel before vegetation is fully established.
- Erosion occurs at channel outlet before vegetation is fully established.
- Sediment is deposited at channel outlet before vegetation is fully established.

Maintenance

Inspect the channel following storm events both during and after grass cover is established; make needed repairs immediately.

Check the channel outlet and road crossings for blockage, ponding, sediment, and bank instability, breaks and eroded areas; remove any blockage, and make repairs immediately to maintain design cross section and grade.

Lined Swale (LS)

Practice Description

A lined swale is a constructed channel with a permanent lining designed to carry concentrated runoff to a stable outlet. This practice applies where grass swales are unsuitable because of conditions such as steep channel grades, prolonged flow areas, soils that are too erodible or not suitable to support vegetation or insufficient space and where riprap-lined swales are not desired. The purpose of a lined swale is to conduct stormwater runoff without causing erosion problems in the area of channel flow.

The material that provides the permanent lining may be concrete, manufactured concrete products, or turf reinforcement mat (TRM).

Typical Components of the Practice

- Site Preparation
- Material Placement
- Stabilization
- Construction Verification

Construction

Prior to start of construction, lined swales should be designed by a qualified design professional and specifications should be available to field personnel.

Plans and specifications should be referred to by field personnel throughout the construction process.

Note: Concrete lined channel is the only lining method that is covered in this edition of the handbook. There are numerous permanent erosion control blankets (TRMs) and manufactured concrete products available with similar applications and their unique installation procedures should be obtained from the manufacturer of the product being used. In addition, Riprap-lined Swale is covered in this handbook as a separate practice.

Site Preparation

Determine exact location of underground utilities.

Remove brush, trees and other debris from the channel and spoil areas, and dispose of properly.

Grade or excavate cross section to the lines and grades shown in design for the concrete subgrade.

Remove soft sections and unsuitable material and replace with suitable material. The subgrade should be thoroughly compacted and shaped to a smooth, uniform surface.

Material Placement

Place forms to meet the specific plan design for the project and place concrete of the designed mix into the forms according to construction specifications.

Construction and expansion joints should be used where swale length exceeds 10 feet. Construction joints should be spaced at 10 feet intervals and expansion points at intervals not to exceed 20 feet.

The subgrade should be moist at the time the concrete is placed.

Place concrete for the lined channel to the thickness shown on the plans and finish it in a workmanlike manner.

Coat the concrete with an approved curing compound as soon as finish work is complete and the free water has disappeared from the surface.

Provisions should be made to protect the freshly poured concrete from extreme temperatures to ensure proper curing.

Stabilization

Stabilize channel inlet and outlet points according to the design plan.

Stabilize adjacent disturbed areas after construction is completed with a vegetation treatment (permanent or temporary seeding) and mulching. Provide topsoil, lime and fertilizer as needed to grow grass on areas disturbed by

construction. Many design plans specify a row of sod at the edges of the concrete channel.

If not specified in a plan, select lime, fertilizer, seed variety and mulching components from related practices – Permanent Seeding or Temporary Seeding and Mulching, Erosion Control Blankets or Sodding.

Construction Verification

Check finished grades and cross sections throughout the length of the channel. Verify channel cross section dimensions at several locations to avoid flow constrictions.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate practice will not function as intended; changes in plan may be needed.
- Design specifications cannot be met; substitution may be required. Unapproved substitutions could result in failure of the practice.

Maintenance

Inspect lined channel at regular intervals and after storm events. Check for erosion adjacent to the channel, at inlets and outlets and underneath the lined channel.

Give special attention to the channel inlet and outlet and repair eroded areas promptly.

Inspect for erosion in the entire swale and repair with appropriate vegetative treatment (permanent or temporary seeding and mulching).

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Outlet Protection (OP)

Practice Description

This practice is designed to prevent erosion at the outlet of a channel or conduit by reducing the velocity of flow and dissipating the energy. Outlet protection measures usually consist of a riprap-lined apron, a reinforced concrete flume with concrete baffles a reinforced concrete box with chambers or baffles and possibly pre-manufactured products. This practice applies wherever high velocity discharge must be released on erodible material.

Typical Components of the Practice

- Site Preparation
- Installation of Riprap Structures
- Installation of Concrete Structures
- Erosion Control
- Construction Verification

Construction

Prior to start of construction, the practice should be designed by a qualified design professional. Plans and specifications should be referred to by field personnel throughout the construction process.

The structure should conform to the dimensions, grades and alignments shown on the plans and specifications.

Site Preparation

Completely remove stumps, roots and other debris from the construction area. Fill depressions caused by clearing and grubbing operations with clean, non-organic soil. Grade the site to the lines and grades shown on the plans. Compact any fill required in the subgrade to the density of the surrounding undisturbed material.

If possible, the alignment should be straight throughout its length. If a curve is required, it should be located in the upstream section of the outlet.

Riprap Structures

Ensure that the subgrade for the filter and riprap follows the required lines and grades shown in the plan. Low areas in the subgrade on undisturbed soil may also be filled by increasing the riprap thickness.

Geotextile fabric must meet design requirements and be properly protected from puncturing or tearing during installation. Repair any damage by removing the riprap and placing another piece of fabric over the damaged area. All connecting joints should overlap a minimum of 1.5 feet with the upstream edge over the downstream edge. If the damage is extensive, replace the entire geotextile fabric.

Riprap may be placed by equipment. Care should be taken to avoid damaging the fabric.

Construct the apron on zero grade with no overfall at the end. Make the top of the riprap at the downstream end level with the receiving area or slightly below it.

Concrete Structures

Reinforcing steel welded wire fabric should be placed in strict accordance with the design plans and maintained in the proper position during the pouring of concrete. Concrete should be placed in horizontal layers not exceeding 24” in thickness or as specified in the design, and consolidated by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping.

Concrete should be placed in sturdy wood or metal forms, adequately supported to prevent deformation. Forms should be oiled with form release agent prior to placement to prevent bonding between concrete and forms.

If possible, concrete should not be placed during inclement weather or periods of temperature extremes. If temperature extremes cannot be avoided, American Concrete Institute (ACI) guidelines for placement of concrete during such extremes should be consulted.

Concrete should be allowed to cure as required by the plans and specifications.

Typically, the surface should be kept wet during curing by covering it with wet burlap sacks or other means. Design strengths should be confirmed by laboratory tests on representative cylinders made during concrete placement. Form work should not be removed prior to the specified time.

Erosion Control

Immediately after construction, stabilize all disturbed areas with vegetation.

Construction Verification

Check finished structures for conformance with design specifications.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate measure will not function as intended.
- Design specifications for riprap, filter fabric, concrete, reinforcing steel or backfill cannot be met; substitutions may be required. Unapproved substitutions could lead to failure.
- Problems with the structure develop during or after installation.

Maintenance

Inspect riprap outlet structures after heavy rains to see if any erosion around or below the riprap has taken place or if stones have been dislodged. Check concrete structures for cracks and movement. Immediately make all needed repairs to prevent further damage.

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Riprap-lined Swale (RS)

Practice Description

A riprap-lined swale is a natural or constructed channel with an erosion-resistant rock lining designed to carry concentrated runoff to a stable outlet. This practice applies where grass swales are unsuitable because of conditions such as steep channel grades, prolonged flow areas, soils that are too erodible or not suitable to support vegetation or insufficient space.

Typical Components of the Practice

- Site Preparation
- Foundation Stabilization
- Rock Placement
- Outlet Stabilization
- Construction Verification

Construction

Prior to start of construction, riprap-lined swales should be designed by a qualified design professional.

Plans and specifications should be referred to by field personnel throughout the construction process.

Site Preparation

Determine exact location of underground utilities.

Remove brush, trees and other debris from the channel and spoil areas, and dispose of properly.

Grade or excavate cross section to the lines and grades shown in design. Over-excavate to allow for thickness of riprap and filter material. Foundation excavation not deep enough or wide enough may cause riprap to restrict channel flow and result in overflow and erosion. Side slopes are usually 2:1 or flatter.

Foundation Stabilization

Install geotextile fabric or aggregate in the excavated channel as a foundation for the riprap. Anchor fabric in accordance with design specifications. If the fabric is omitted or damaged during stone placement there may be settlement failure and bank instability.

Installation

As soon as the foundation is prepared, place the riprap to the thickness, depth and elevations shown in the design specifications. It should be a dense, uniform and well-graded mass with few voids. Riprap should consist of a well-graded mixture of stone (size and gradation as shown in design specifications) that is hard, angular, and highly chemical and weather resistant. Larger stone should predominate, with sufficient smaller sizes to fill the voids between the stones. The diameter of the largest stone size should be not greater than 1.5 times the d_{50} size. Minimum thickness of riprap liner should be 1.5 times the maximum stone diameter.

Blend the finished rock surface with the surrounding land surface so there are no overfalls, channel constrictions or obstructions to flow.

Outlet Stabilization

Stabilize channel inlet and outlet points. Extend riprap as needed.

Stabilize adjacent disturbed areas after construction is completed.

Construction Verification

Check finished grades and cross sections throughout the length of the channel.

Verify channel cross section dimensions at several locations to avoid flow constrictions.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate channel will not function as intended; changes in plan may be needed.

- Design specifications for riprap sizing, geotextile fabric or aggregate filter cannot be met; substitution may be required. Unapproved substitutions could result in channel erosion.

Maintenance

Inspect channels at regular intervals and after storm events. Check for rock stability, sediment accumulation, piping, and scour holes throughout the length of the channel.

Look for erosion at inlets and outlets.

When stones have been displaced, remove any debris and replace the stones in such a way as to not restrict the flow of water.

Give special attention to outlets and points where concentrated flow enters the channel and repair eroded areas promptly by extending the riprap as needed.

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Subsurface Drain (SD)

Practice Description

A subsurface drain is a perforated pipe or continuous layer of porous material installed below the ground surface that intercepts, collects and carries excessive groundwater to a stable outlet. Subsurface drains by themselves do not provide erosion control. The purpose of a subsurface drain is to improve soil moisture conditions, vegetation growth and ground stability. Subsurface drains may reduce wet ground from interfering with construction activities. Drains may be constructed using a gravel-filled trench, perforated pipe in gravel bedding or manufactured drain panel products. This practice applies where groundwater is at or near the ground surface or where adequate drainage cannot be provided for surface runoff.

Typical Components of the Practice

- Site Preparation
- Trench Excavation
- Installation of Drain Pipe, Bedding Material and Filter Cloth
- Backfill Installation
- Installation of Clean-Out Device
- Outlet Installation
- Stabilization
- Safety
- Construction Verification

Construction

Prior to start of construction, subsurface drains should be designed by a qualified design professional. Materials such as sand, gravel, geotextile filter cloth and pipe must be properly designed in order for the subsurface drain system to function properly. Plans and specifications should be available to field personnel.

Site Preparation

Determine exact location of underground utilities. At least 3 days prior to construction, request Alabama Line Location Center (dial 811) to mark all underground utilities within the project area.

Locate and mark the alignment of the drains as shown on the design plans.

Clear installation area of debris and obstacles, such as trees and stumps, that might hinder grading and installation of the subsurface drain.

Trench Excavation

Excavate the trench to the specified depth and grade shown in the design plan. To accommodate the gravel bedding or filter material, excavate the trench to at least 3” below the design bottom elevation of the pipe (or as shown on the design plans).

Place materials excavated from the trench on the up gradient side of the trench to prevent water from entering the trench during construction.

Grade the trench to prevent siltation into the drain.

Installation of Drain Pipe, Bedding Material and Geotextile Filter Cloth

Line trench with filter cloth (if specified), providing enough material to overlap over the top of the finished gravel bedding. This helps prevent movement of soil into the gravel.

Spread bedding material specified in the design plan, usually 3” of gravel, to fill the over-excavated bottom of the trench.

Lay pipe on the design grade and elevation avoiding reverse grade or low spots after checking to ensure the pipe meets specifications.

Cap the upper end of each drain with a standard cap made for this purpose or with concrete or other suitable material to prevent soil from entering the open end.

Place bedding material around pipe, on all sides, with the amount shown in the design plan.

Fold filter cloth over the top of the gravel bedding.

Backfill Installation

Backfill immediately after placement of the pipe and bedding. Ensure that the material does not contain rocks or other sharp objects and place it in the trench in a manner that will not damage or displace the pipe. Overfill the trench slightly to allow for settlement.

Installation of Clean-Out Device

Install clean-outs for maintenance of the subsurface drain in the locations shown on design plan.

Outlet Installation

Construct the outlet of the subsurface drain at the elevation in the design plan. The outlet section of the drain should be at least 10 feet of non-perforated corrugated metal, cast iron, steel or heavy-duty plastic pipe. Cover at least half of the pipe length with well-compacted soil. Place a suitable animal guard securely over the pipe outlet to keep out rodents.

Stabilization

Keep the settled fill over the pipe outlet slightly higher than the surrounding ground to prevent erosion, rills and gullies.

Stabilize all bare areas of the trench with temporary seeding and mulching unless construction will disturb the area within 13 days.

Safety

Narrow trenches are subject to collapse and can be a safety hazard to persons in the trench. No person should enter a trench without shoring protection or properly sloping the sides of the trench.

Construction Verification

Verify the dimensions during construction with those shown on the plans for location, length, depth and cross section of trench.

Verify the dimensions and specifications of the aggregate used in the bedding and manufactured materials such as pipe, tile or panel drain.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on-site indicate subsurface drains will not function as intended or originally designed.
- Design specifications for aggregate or manufactured products cannot be met; substitutions may be required. Unapproved substitutions could result in failure of the drain to function as intended.
- Pipe is crushed by construction traffic.

Maintenance

Check subsurface drains periodically to ensure that they are free-flowing and not clogged with sediment.

Keep outlet clean and free of debris.

Keep surface inlets open and free of sediment and other debris.

Where drains are crossed by heavy vehicles, check the pipe to ensure that it is not crushed.

Temporary Slope Drain (TSD)

Photo courtesy of CPESC, Inc.

Practice Description

A temporary slope drain is a pipe or other conduit designed to convey concentrated runoff down the face of a cut or fill slope without causing erosion. This practice applies wherever concentrated stormwater runoff must be conveyed down a steep slope.

Typical Components of the Practice

- Site Preparation
- Erosion Control
- Construction Verification

Construction

Prior to start of construction, temporary slope drains should be designed by a qualified design professional. Plans and specifications should be referred to by field personnel throughout the construction process.

Site Preparation

Determine exact location of underground utilities.

Place temporary slope drain on undisturbed soil or well-compacted fill at locations and elevations shown on the plans.

Grade the diversion channel at the top of the slope toward the temporary slope drain according to the design plan. Provide positive grade in the pipe under the ridge.

Hand tamp the soil under and around the pipe in lifts not to exceed 6".

Ensure that the fill over the drain pipe at the top of the slope is placed to the dimensions shown on the design plan.

Ensure that all slope drain connections are secure and watertight.

Ensure that all fill material is well-compacted. Securely anchor the exposed section of the drain according to the design.

Extend the drain beyond the toe of the slope and adequately protect the outlet from erosion.

Make the settled, compacted diversion ridge no less than 1 foot above the top of the pipe at every point.

Erosion Control

Compaction of earthfill around the pipe in the vicinity of the ridge is extremely important to avoid piping failure and blowouts.

Immediately stabilize all disturbed areas following construction according to the design plan (with vegetation or other appropriate means of protection).

Construction Verification

Verify that materials, elevations and installation procedures meet design specifications.

Joints should be carefully inspected for separations or looseness.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate temporary slope drains will not function as intended.

- Pipe separates or is displaced.
- Animals are going into the pipe outlet.

Maintenance

Inspect slope drains and supporting diversions once a week and after every storm event.

Check the inlet for sediment or trash accumulation; clear and restore to proper condition.

Check the fill over the pipe for settlement, cracking or piping holes; repair immediately.

Check for holes where the pipe emerges from the ridge; repair immediately.

Check the conduit for evidence of leaks or inadequate anchoring; repair immediately.

Check the outlet for erosion or sedimentation; clean and repair, or extend if necessary.

Once slopes have been stabilized, remove the temporary diversions and slope drains so that runoff water no longer concentrates but flows uniformly over the protected slope. Stabilize the diversion and slope drain areas.

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Brush/Fabric Barrier (BFB)

Practice Description

A brush/fabric barrier is a dam-like structure constructed from woody residue and faced with a non-woven geotextile fabric to provide a temporary sediment basin. This practice is applicable on sites with a small drainage area where brush and other woody debris are available from a clearing and grubbing operation.

Typical Components of the Practice

- Site Preparation
- Materials Installation
- Construction Verification

Construction

Prior to start of construction a qualified design professional should determine the location, and storage for the barrier. Typically, brush/fabric barriers are constructed where materials are readily available and at a location with adequate storage characteristics.

Site Preparation

The foundation for the barrier should be relatively smooth prior to placement of the cleared and grubbed material.

Materials Installation

Place the cleared and grubbed material in a densely compacted row, mostly on the contour with each end upturned so that excessive flows will go over the top of the barrier and not around the ends of the barrier.

Densely packed material should be placed so that the main stems of the woody debris are aligned with the length of the barrier. Small stems and limbs protruding from the bundle that could damage the fabric should be trimmed.

Generally, the barrier should be at least 3 feet tall, but no more than 6 feet tall. The width of the barrier perpendicular to the direction of flow should be at least 5 feet at its base.

Geotextile filter fabric consistent with the fabric used for silt fencing can be used to cover the face of the barrier. It is best to use wide and long rolls of the fabric so that splicing is minimized or eliminated.

The fabric should be securely buried at the bottom of an excavated trench that is at least 6" deep in front of the barrier. Prior to backfilling the trench, the fabric should be securely staked at 3 foot centers with minimum 18" long wooden stakes.

Avoid longitudinal splices of the fabric. Vertical splices must be securely fastened to each other so that flows will not short circuit through the splice. The minimum vertical splice overlap should be 3 foot.

The top edge of the fabric should be secured so that it will not sag below the designed storage elevation. The upper edge can be anchored with twine fastened to the fabric and secured to stakes behind the barrier.

Construction Verification

Check finished size, elevation, storage, and shape for compliance with standard drawings and materials list (check for compliance with specifications if included in contract specifications).

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate brush/fabric barrier will not function as intended. Change in plan will be needed.

- There is not adequate cleared woody material to construct the barrier.
- Materials specified in the plan are not available.

Maintenance

Inspect the barrier for short-circuiting of water or flow around the ends of the barrier after each significant rainfall event.

Sediment should be removed if it reaches a depth of ½ the original fabric height. If the area behind the barrier fills with sediment there is a greater likelihood that water will flow around the end of the barrier and cause the practice to fail.

Large rainfall events that overtop the structure can result in gully erosion behind the barrier. This should be repaired as needed.

Brush/fabric barriers are temporary structures and should be removed when their useful life has been completed. All accumulated sediment should be properly stabilized and the area where the barrier was located should be seeded and mulched immediately unless a different treatment is prescribed.

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Filter Strip (FS)

Practice Description

A filter strip is a wide belt of vegetation designed to provide infiltration, intercept sediment and other pollutants, and reduce stormwater flow and velocity. Filter strips are similar to grassed swales except that they are designed to accept only overland sheet flow (not channel flow). They cannot treat high velocity flows. Surface runoff must be evenly distributed across the filter strip. Vegetation may consist of existing cover that is preserved and protected or be planted to establish the strip. Once a concentrated flow channel forms in the filter strip, the filter strip is no longer effective. This practice applies on construction sites and other disturbed areas.

Typical Components of the Practice

- Preservation and Protection of Existing Vegetation
- Site Preparation
- Applying Soil Amendments
- Planting
- Mulching
- Construction Verification

Installation- preservation of existing vegetation

Prior to start of installation, filter strips should be designed by a qualified professional. Plans and specifications should be referred to by field personnel throughout the construction process.

Preserve vegetation on designated areas listed in plan and avoid surface disturbances that affect sheet flow of stormwater runoff.

At the start of development, fence off any undisturbed strips to be preserved.

Avoid storing debris from clearing and grubbing, and other construction waste material in strips during construction.

Installation-planting

Site Preparation

Prior to start of installation, filter strips should be designed by a qualified professional. Plans and specifications should be referred to by field personnel throughout the construction process. The filter strip should be installed according to planned alignment, grade and cross section.

If the upper area does not have a level edge, remove any obstructions and grade a level swale at the top edge of the filter strip. The swale should discharge to the filter strip along the level edge and serve as a level spreader to distribute runoff evenly to the filter strip.

Any rills and gullies over the filter strip area must be filled and smoothed to ensure that overland flow will discharge across the filter strip along a smooth surface.

Seedbed Preparation

Grade and loosen soil to a smooth firm surface to enhance rooting of seedlings and reduce rill erosion. If they exist, break up large clods and loosen compacted, hard or crusted soil surfaces with a disk, ripper, chisel, harrow or other tillage equipment. Avoid preparing the seedbed under excessively wet conditions.

For broadcast seeding and drilling, tillage should adequately loosen the soil to a depth of at least 6”, alleviate compaction, and smooth and firm the soil for the proper placement of seed.

For no-till drilling, the soil surface does not need to be loosened unless the site has surface compaction. If shallow compaction exists, the area should be chiseled across the slope to a depth of at least 6”. If compaction exists between 6” and 12” the area should be chiseled or subsoiled at least 12”.

Applying Soil Amendments

Liming

Follow the design plan or soil test recommendation. If a plan or soil test is not available, use 2 tons/acre of ground agricultural lime on clayey soils (approximately 90 lbs/1000 ft^2) and 1 ton/acre on sandy soils (approximately 45 lbs/1000 ft^2). Exception: If the cover is tall fescue and clover, use the 2 tons/acre rate (90 lbs/1000 ft^2) on both clayey and sandy soils.

Spread the specified amount of lime and incorporate into the top 6" of soil after applying fertilizer.

Fertilizing

Apply a complete fertilizer at rates specified in the design plan or soil test recommended. In the absence of soil tests, use the following as a guide: Grass alone: 8-24-24 or equivalent – 400 lbs/acre (9.2 lbs/1000 ft^2). When vegetation has emerged to a stand and is growing, 30 to 40 lbs/acre (0.8 lb/1000 ft^2) of additional nitrogen fertilizer should be applied.

Grass – Legume Mixture: 8-24-24 or equivalent – 400 lbs/acre (9.2 lbs/1000 ft^2). When vegetation has emerged to a stand and is growing, 30 to 40 lbs (0.8 lb/1000 ft^2) of additional nitrogen fertilizer should be applied.

Legume alone: 0-20-20 or equivalent – 500 lbs/acre (11.5 lbs/1000 ft^2).

Note: Fertilizer can be blended to meet exact fertilizer recommendations. Take soil test recommendations to local fertilizer dealer for bulk fertilizer blends. This may be more economical than bagged fertilizer.

Incorporate lime and fertilizer to a minimum depth of at least 6" or more by disking or chiseling on slopes of up to 3:1.

Planting

Plant the species specified in the plan at the rate and depth specified. In the absence of plans and specifications, plant species and seeding rates may be selected by qualified persons using Figure FS-1 and Table FS-1.

Apply seed uniformly using a cyclone seeder, drill seeder, cultipacker seeder or hydroseeder.

When using a drill seeder, plant grasses and legumes ¼" to ½" deep. Calibrate equipment in the field.

When planting by methods other than a drill seeder, cover seed by raking, or dragging a chain, brush or mat. Then firm the soil lightly with a roller. Seed can also be covered with hydro-mulched wood fiber and tackifier. Legumes require inoculation with nitrogen-fixing bacteria to ensure good growth. Purchase inoculum specific for the seed and mix with seed prior to planting.

Figure FS-1 Geographical Areas for Species Adaptation

Note: Site conditions related to soils and aspect in counties adjacent or close to county boundaries may justify adjustments in planting dates by qualified design professionals.

Mulching

Cover approximately 75% of the surface with the specified mulch materials. Crimp, tack or tie down straw mulch with netting. Mulching is extremely important for successful seeding *(See Mulching practice for more details).*

Table FS-1 Commonly Used Plants for Permanent Cover with Rates and Dates

Species	Seeding Rates/Ac PLS [1]	North	Central	South
		Seeding Dates		
Bahiagrass, Pensacola	40 lbs	--	Mar 1-July 1	Feb 1-Nov 1 [2]
Bermudagrass, Common	10 lbs	Apr 1-July 1	Mar 15-July 15	Mar 1-July 15
Bahiagrass, Pensacola **Bermudagrass, Common**	30 lbs 5 lbs	--	Mar 1-July 1	Mar 1-July 15
Bermudagrass, Hybrid (Lawn Types)	Solid Sod	Anytime	Anytime	Anytime
Bermudagrass, Hybrid (Lawn Types)	Sprigs 1/sq ft	Mar 1-Aug 1	Mar 1-Aug 1	Feb 15 - Sep 1
Fescue, Tall	40-50 lbs	Sep 1-Nov 1	Sep 1-Nov 1	--
Sericea	40-60 lbs	Mar 15-July 15	Mar 1-July 15	Feb 15 -July 15
Sericea & Common Bermudagrass	40 lbs 10 lbs	Mar 15-July 15	Mar 1-July 15	Feb 15-July 15
Switchgrass, Alamo	4 lbs	Apr 1-Jun 15	Mar 15-Jun 15	Mar 15-Jun 15

[1] PLS means pure live seed and is used to adjust seeding rates. For example, to plant 10 lbs of a species with germination of 80% and with purity of 90%, PLS = 0.8 x 0.9 = 72%, 10 PLS = 10/0.72 = 13.9 lbs.

[2] A late fall planting of Bahia should contain 45 lbs/Ac of small grain to provide cover during winter months.

Construction Verification

Check materials and installation for compliance with specifications during installation of products.

Common Problems

Consult with a qualified professional if the following occurs:

- Variations in topography on site indicate filter strip will not function as intended.
- Design specifications for seed variety, seeding dates or mulching cannot be met; substitutions may be required. Unapproved substitutions could lead to failure.
- Seeding at the wrong time of the year results in an inadequate stand. Reseed according to specifications of a qualified professional.

- Inadequate mulching results in an inadequate stand, bare spots or eroded areas; prepare seedbed, reseed, cover seed evenly and tack or tie down mulch, especially on slopes, ridges and in channels (see recommendations under Maintenance).

Maintenance

Erosion

Check for eroded channels in the filter strip after every storm event until the vegetation is well established. Eroded areas should be repaired by filling and/or smoothing, and reapplication of lime, fertilizer, seed and mulch. It is particularly important that the surface is smooth and promotes sheet flow of storm runoff. Generally, a stand of vegetation cannot be determined to be fully established until vegetative cover has been maintained for at least 1 year after planting.

Reseeding

Inspect seeding monthly for stand survival and vigor.

If stand is inadequate identify the cause of failure – choice of plant materials, lime and fertilizer quantities, poor seedbed preparation or weather – and take corrective action. If vegetation fails to grow, have the soil tested to determine whether pH is in the correct range or nutrient deficiency is a problem.

Stand conditions, particularly percent coverage, will determine the extent of remedial actions such as seedbed preparation and reseeding. A qualified professional should be consulted to advise on remedial actions. Consider drill seeding if enough residue exists.

Fertilizing

Establishment may require refertilizing the stand in the second growing season. Follow soil test recommendations or the specifications provided for establishment.

Mowing

Mow vegetation to prevent woody plants from invading.

Certain species can be weakened by mowing regimes that significantly reduce their food reserves stored for the next growing season: fescue should not be mowed closer than 4” during the summer; sericea should not be mowed closer than 4” during the growing season and it should not be mowed at all between late summer and frost.

Bermuda grass and bahiagrass are tolerant of most mowing regimes and can be mowed often and close, if so desired, during their growing season.

Floating Turbidity Barrier (FB)

Practice Description

A floating turbidity barrier consists of geotextile material (curtain) with floats on the top, weights on the bottom, and an anchorage system that minimizes sediment transport from a disturbed area that is adjacent to or within a body of water. The barrier provides sedimentation and turbidity protection for a watercourse from up-slope land disturbance activities where conventional erosion and sediment controls cannot be used or need supplemental control, or from dredging or filling operations within a watercourse. The practice can be used in non-tidal and tidal watercourses where intrusion into the watercourse by construction activities has been permitted and subsequent sediment movement is unavoidable.

Typical Components of the Practice

- Site Preparation
- Materials Installation
- Construction Verification
- Removal

Construction

Prior to the start of construction a qualified professional should determine the type of barrier to be used, location, and installation procedures for the barrier.

Site Preparation

If a floating turbidity barrier is specified in the erosion and sediment control plan, it should be installed before any land disturbing activities. Shoreline anchor points should be located according to the plans.

Materials Installation

When installing Type I barrier in the calm water of lakes or ponds it is usually sufficient to merely set the curtain end stakes or anchor points (using anchor buoys if bottom anchors are employed), then tow the curtain in the furled condition out and attach it to these stakes or anchor points. Following this, any additional stakes or buoyed anchors required to maintain the desired location of the curtain may be set and these anchor points made fast to the curtain. Only then, the furling lines should be cut to let the curtain skirt drop.

When installing Type II or III barriers in rivers or in other moving water it is important to set all the curtain anchor points. Care must be taken to ensure that anchor points are of sufficient holding power to retain the curtain under the expected current conditions, before putting the furled curtain into the water. Anchor buoys should be employed on all anchors to prevent the current from submerging the flotation at the anchor points. If the moving water into which the curtain is being installed is tidal and will subject the curtain to currents in both directions as the tide changes, it is important to provide anchors on both sides of the curtain for 2 reasons:

- Curtain movement will be minimized during tidal current reversals.
- The curtain will not overrun the anchors pulling them out when the tide reverses.

When the anchors are secure, the furled curtain should be secured to the upstream anchor point and then sequentially attached to each next downstream anchor point until the entire curtain is in position. At this point, and before unfurling, the "lay" of the curtain should be assessed and any necessary adjustments made to the anchors. Finally, when the location is ascertained to be as desired the furling lines should be cut to allow the skirt to drop.

The anchoring line attached to the flotation device on the downstream side will provide support for the curtain. Attaching the anchors to the bottom of the curtain could cause premature failure of the curtain due to the stresses imparted on the middle section of the curtain.

Construction Verification

Check the type floating turbidity barrier, installation location, and the installation and anchorage procedures for compliance with the standard drawings and materials list (check for compliance with specifications if included in contract specifications).

Removal

Care should be taken to protect the skirt from damage as the turbidity curtain is dragged from the water.

The site selected to bring the curtain ashore should be free of sharp rocks, broken cement, debris, etc. so as to minimize damage when hauling the curtain over the area.

If the curtain has a deep skirt, it can be further protected by running a small boat along its length with a crew installing furling lines before attempting to remove the curtain from the water.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate that a floating turbidity barrier will not function as intended. Change in plan will be needed.
- The specified anchorage system will not function as planned.
- Turbid water is escaping from the barrier enclosure.
- Materials specified in the plan are not available.

Maintenance

The floating turbidity barrier should be maintained for the duration of the project to ensure the continuous protection of the watercourse. Anchors, anchor lines and buoys must be regularly checked to remove debris.

If repairs to the geotextile fabric become necessary, there are normally repair kits available from the manufacturer. Follow the manufacturer's instructions to ensure the adequacy of the repair.

When the curtain is no longer required as determined by the responsible individual, the curtain and related components should be removed in such a manner as to minimize turbidity. If required by the contract or the responsible individual, sediment should be removed and the original depth (or plan elevation) restored before removing the curtain. Remaining sediment should be sufficiently settled before removing the curtain. Any spoils should be taken to an upland area and stabilized.

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Flocculant (FL)

Practice Description

Flocculation is the chemical process of causing small, suspended soil particles to be drawn together to form “flocs”. These flocs more readily settle out compared to the individual particles due to their relatively greater mass. Products that cause flocculation of suspended soil particles (flocculants) are often used to help polish, or minimize turbidity of stormwater runoff from construction sites. These products may contain both manufactured and natural polymers.

Typical Components of the Practice

- Site Preparation
- Flocculant Application
- Installation Verification

Application

Prior to the start of construction, the application of flocculants should be designed by a qualified design professional and plans and specifications should be available to field personnel.

The application should conform to the design and specifications provided in the plans.

Site Preparation

Prepare the site following design and specifications. Ensure that all erosion control practices are installed and properly functioning upstream of the flocculant application site.

Flocculant Application

Ensure that only the approved flocculant for the job is used, and only at the dosage rates and application methods approved.

The Material Safety Data Sheet for the approved flocculant should be available on the job site. Flocculants should be mixed and/or applied in accordance with all Occupational Safety and Health Administration (OSHA) Material Safety Data Sheet requirements and the manufacturer's recommendations for the specified use conforming to all federal, state and local laws, rules and regulations.

Solid form of flocculant (logs) should be installed at a location that maintains hydration and shade. It should not be placed in sediment, but should be located in turbulent flow to promote mixing.

Dry form (powder) may be applied by hand spreader or a mechanical spreader. For small applications it can be applied by hand.

Do not apply flocculants directly to streams, wetlands, or other waters of the state. If near a water body, observe the identified Buffer Zone for the job.

All flocculant applications must drain into a sediment basin or other BMP that promotes settling for final flocculation prior to discharge from the site.

Flocculants used in conjunction with a sediment basin should be introduced upstream of the basin in a turbulent flow area to ensure proper mixing.

Installation Verification

Check all components of the practice during installation to ensure that specifications are being met.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Application specifications for flocculants cannot be met; alternatives may be required. Unapproved application techniques could lead to failure.
- Visible turbidity occurs after application.

Maintenance

An operation and maintenance plan must be prepared for use by the operator responsible for flocculant application. Plan items should include the following items:

- Reapply flocculants at specified intervals or when turbidity control is no longer effective.
- Inspect flocculant logs to ensure they are properly located and hydrated.
- Deposition of sediment in sediment basins and other sediment catching BMPs may require periodic sediment removal to maintain normal functions of sediment control practices.

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Inlet Protection (IP)

Practice Description

Inlet protection is a structurally supported barrier placed around a stormwater drop inlet to create ponding which allows coarse sediment to be deposited in the pooled area. The practice does not decrease turbidity. This practice applies where early use of the storm drain system is necessary prior to stabilization of the disturbed drainage area. This practice is suitable for inlets with a drainage area of less than 1 acre. Gentler approach slopes provide for more storage. If used at a storm drain for a road, the practice could cause hazardous conditions to motorists due to ponding and should only be used when there is no public transportation allowed or when the height of ponded water is not a hazard.

Typical Components of the Practice

- Site Preparation
- Geotextile Installation
- Structure Installation
- Grading
- Stabilization
- Construction Verification

Installation

Prior to start of construction, inlet protection structures should be designed by a qualified professional. Plans and specifications should be available to field personnel.

Site Preparation

The soil around the drop inlet should be well compacted. The area around the drop inlet should be shaped, if necessary, to store the runoff on an almost level area. If runoff could bypass the protected inlet, a temporary dike should be planned and force the runoff to be trapped by the protective device.

Geotextile Installation

An 8 oz. non-woven geotextile is used as an underlayment prior to the structure placement. The geotextile should extend from the stormwater inlet to the required distance in front of the structure. The geotextile underlayment should be securely fastened to the compacted soil with staples to prevent undermining.

Structure Installation

The structure can be constructed of silt fencing materials, concrete blocks and gravel, sand bags, wattles, or premanufactured devices. The structures should be structurally sound to prevent buckling, sagging, or undermining. Check to ensure the following installation practices are followed:

Silt Fence Inlet Protection

- Use geotextile underlayment on the compacted earth surface from the inlet to at least 1 ft. beyond the silt fence. The geotextile must be securely pinned at 5-inch centers at the inlet and around the outside edge of the geotextile.
- Use steel T-posts on maximum 3 ft. centers around the inlet.
- Do not trench the silt fence. Install the wire backing tightly from the compacted earth surface to the top of the posts, and secure to the posts.
- Add 2 x 4 bracing at the top of the posts and diagonally across the corners. Drill holes to fit over T-posts once T-posts are installed to ensure a proper fit.
- Install a dewatering device to remove water from the impoundment within 48 hours. A 2 x 4 vertical board with graduated holes (smallest a bottom and largest at top) has been found to work well. The fabric should be secured to the board with staples and the geotextile punctured at each hole.
- Install the geotextile (4 oz. non-woven) Type A silt fence. The top of the geotextile shall be folded over the 2 x 4 bracing and stapled. The bottom of the geotextile shall extend about 8 inches horizontally from the bottom of the fence and secured with pins every 5 inches. The bottom of the fabric at the corners shall be cut and pinned securely to prevent water

undermining. Attach the geotextile to the wire as normally done for a silt fence.

Block and Gravel Inlet Protection

- Use geotextile underlayment on the compacted earth surface that extends from the inlet, under the blocks and at least 1 ft. beyond the blocks, and securely pinned at 5 inches centers at the inlet and around the outside edge of the geotextile. A second underlay that extends from the inlet, under the blocks, and to the top of the blocks between the blocks and gravel. Note: place geotextile vertically on the blocks surface after blocks and hardware cloth are installed.
- Use 8-inch cinder blocks no more than two blocks high. Stacked the second layer of blocks in a staggered fashion. All blocks are placed in a normal orientation with at least one block turned sideways for dewatering.
- The dewatering block(s) shall be at the lowest elevation, faced with hardware cloth, and the geotextile cut out in a three-inch-tall rectangular section for dewatering.
- Place aggregate (ALDOT no. 4 stone) in a triangular cross-section to the top of the blocks with the aggregate extending out 1 ft. at the top from the blocks before sloping down at a 1:1 ft./ft. slope.

Sand Bag Inlet Protection

- Use geotextile underlayment on the compacted earth surface that extends from the inlet to at least 1 ft. beyond the sand bags. Pin the geotextile securely at the inlet and around the edges on 5-inch centers.
- Place sand bags tight against each other around an inlet in a circular fashion with at least a 1 ft. space between the bags and the inlet.

- Orient the three layers of bags into a triangular cross-section with the first layer consisting of two bags oriented tangent to the circle, the second layer consisting of one bag perpendicular to the circle, and the third layer consisting of one bag tangent to the circle.

Wattle Inlet Protection

- Use geotextile underlayment on the compacted earth surface that extends from the inlet to at least 1 ft. beyond the wattles. Pin the geotextile securely at the inlet and around the edges on 5-inch centers.
- Use a wattle that is denser and less porous to ensure ponding occurs.
- Place the wattle in a circular fashion at least 1 ft. from the inlet. Wattle ends should be overlapped at least 18 inches and secured with grade stakes or hardwood stakes a T-Pee or A-Frame type installation method.
- Stake the wattles with T-Pee stakes at least 2 ft. on centers.
- Prevent the wattles from floating by securing with sod staples on each side of the wattle on 10-inch centers.

Premanufactured Inlet Protection Structures

Premanufactured inlet protective structures should be installed and maintained according to the manufacturer's requirements.

As a minimum, insure that the premanufactured inlet protection structure accomplishes the following:

- Is structurally supported to withstand sediment and hydrostatic loads.
- Ponds water to allow for coarse sediment to settle out of suspension.
- Does not float or undermine.
- Does not cause erosion of the soil surface between the device and the inlet.
- Has a dewatering mechanism to prevent prolonged flooding.

Grading

If needed to prevent bypass flow or ensure adequate storage, construct a temporary dike on the down slope side of the structure. Material from within the sediment pool may be used for dike construction. To be effective, the site must create the specified volume of ponding around the fabric structure.

Stabilization

Stabilize all bare areas that drain to the inlet with temporary seeding and mulching unless construction will disturb it within 13 days.

Construction Verification

Check finished grades and dimensions of fabric drop inlet protection structures.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in site conditions indicate that the practice will not function as intended; change in plan may be needed.
- Sediment not removed from pool resulting in inadequate storage volume for the next storm.
- Top of structure is too high; resulting in flow bypassing the inlet.
- Geotextile underlayment is not adjacent to the inlet exterior surface; resulting in erosion and undercutting of the structure.

Maintenance

Inspect fabric barrier after each rainfall event and make needed repairs immediately.

Remove sediment from the pool area when sediment has reached ½ the fabric height. Take care not to damage or undercut the fabric during the sediment removal.

When the contributing drainage area has been adequately stabilized, remove all materials and unstable sediment and dispose of properly. Fill the disturbed area to the grade of the drop inlet. Stabilize disturbed areas in accordance with the plans.

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Rock Filter Dam (RD)

Practice Description

A rock filter dam is a stone embankment designed to help capture sediment in natural or constructed drainageways on construction sites. This practice can be used as a fore bay to a sediment basin to help capture coarser particles of sediment. It is usually located so that it intercepts runoff primarily from disturbed areas, is accessible for periodic sediment removal and does not interfere with construction activities

Typical Components of the Practice

- Site Preparation
- Rock Placement
- Erosion and Sediment Control
- Construction Verification

Construction

Prior to start of construction, rock dams should be designed by a qualified design professional. The rock filter dam plan should include details on dam height, dam top width, dam side slopes, rock size(s), and geotextile requirements. Plans and specifications should be referred to by field personnel throughout the construction process.

Site Preparation

Determine exact location of underground utilities and avoid construction over and under utilities.

Clear and grub the area under the dam, removing and properly disposing of all root material, brush and other debris.

Divert runoff from undisturbed areas away from the rock dam and basin area. Smooth the dam foundation.

If specified, cover the foundation with geotextile fabric, making sure the upstream strips overlap the downstream strips at least 1 foot and the upslope end is embedded into the foundation at least 1 foot.

Rock Placement

Construct the dam by placing well graded, hard, angular, durable rock of the specified size over the foundation to planned dimensions and securely embed into both channel banks. Place geotextile and smaller “choking” stone on the upstream face if specified.

Once the dam is in place, clear the sediment basin area and dispose of the cleared material.

Set a marker stake to indicate the clean out elevation (i.e., point at which the basin is 50% full of sediment).

Erosion and Sediment Control

Stabilize all disturbed areas with either Temporary or Permanent Seeding.

Construction Verification

Check materials and finished elevations of the rock filter dam for compliance with specifications.

Common Problems

Consult with qualified design professional if the following occurs:

- Variations in topography on-site indicate rock filter dam will not function as intended; changes in plan may be needed.
- Materials specified in the plan are not available.

Maintenance

Inspect the rock dam and basin after each storm event.

Check the dam for rock displacement and abutments for erosion and repair immediately when repair is needed. If rock size appears too small or embankment slope is too steep, replace stone with larger size or reduce slope.

Check the drainage way at toe of dam for erosion. If erosion is occurring, a repair involving geotextile fabric (including another toe-in) and additional rock are probably needed to establish a stable outlet.

Remove sediment from the pond reservoir area when it accumulates to ½ the design volume. If the basin does not drain between storms because the filter (choking) stone (small gravel) and/or geotextile on the upstream face have become clogged, the filter system should be replaced.

Once the construction site is permanently stabilized, remove the structure and any unstable sediment. Smooth the basin site to blend with the surrounding area and stabilize. Sediment should be placed in designated disposal areas and stabilized.

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Sediment Barrier (SB)

Practice Description

A sediment barrier is a temporary structure used across a landscape mostly on the contour to reduce the quantity of sediment that is moving downslope. The most commonly used barrier is a silt fence (a geotextile fabric which is trenched into the ground and attached to supporting posts and possibly wire fence. Other barrier materials could include sand bags, wattles, and various man-made materials and devices that can be used in a similar manner as a silt fence.

This practice applies where sheet and rill erosion occurs on small disturbed areas. Barriers intercept runoff from upslope to form ponds that temporarily store runoff and allow sediment to settle out of the water and stay on the construction site. Barriers can also prevent sheet erosion by decreasing the velocity of the runoff.

Typical Components of the Practice

- Site Preparation
- Barrier Installation
- Reinforce Outlet Bypass. (Not always applicable)
- Erosion Control
- Construction Verification

Construction

Prior to start of construction, sediment barriers should be designed by a qualified professional. Plans and specifications should be referred to by field personnel throughout the construction process.

Note: Silt fence is the only barrier installation being covered in this handbook.

Site Preparation

Determine exact location of underground utilities so that locations for digging or placement of stakes can be selected where utilities will not be damaged.

Smooth the construction zone to provide a broad, nearly level area for the fence. The area should be wide enough throughout the length of the fence to provide storage of runoff and sediment behind the fence.

Silt Fence Installation

Fence should be installed generally **on the contour**, so that runoff can be intercepted as sheet flow. Ends should be flared uphill to provide temporary storage of water. Fence should be placed so that runoff from disturbed areas must pass through the fence. Fence should not be placed across concentrated flow areas such as channels or waterways unless specifically designed as a temporary check dam. When placed near the toe of a slope, the fence should be installed far enough from the slope toe to provide a broad flat area for adequate storage capacity for sediment. Dig a trench at least 6" deep along the fence alignment as shown in Figures SB-1 and SB-2 for Types A & B fences. **Please note that installation with a silt fence installation machine may permit different depths if performance is equal.**

Drive posts to the depth specified on the downslope side of the trench. Space posts a maximum of 10 feet for Type A fencing, or 6 feet for Type B fencing. **In areas where water is ponded, the fence posts may be specified at half the spacing.**

For Type A fence, fasten support wire fence to upslope side of posts, extending 6" into the trench as shown in the Figure SB-1.

Attach continuous length of fabric to upslope side of fence posts. Minimize the number of joints and when necessary to join rolls, they should be joined by rolling the ends together using the "roll joint" method illustrated in Figure SB-3 or as detailed in the specifications. Avoid joints at low points in the fence line.

Place the bottom 12" of fabric in the 6" deep (minimum) trench, lapping toward the upslope side.

Install tie backs as specified on the ends of the silt fence.

Backfill the trench with compacted earth as shown in Figures SB-1 and 2.

Provide good access in areas of heavy sedimentation for clean out and maintenance.

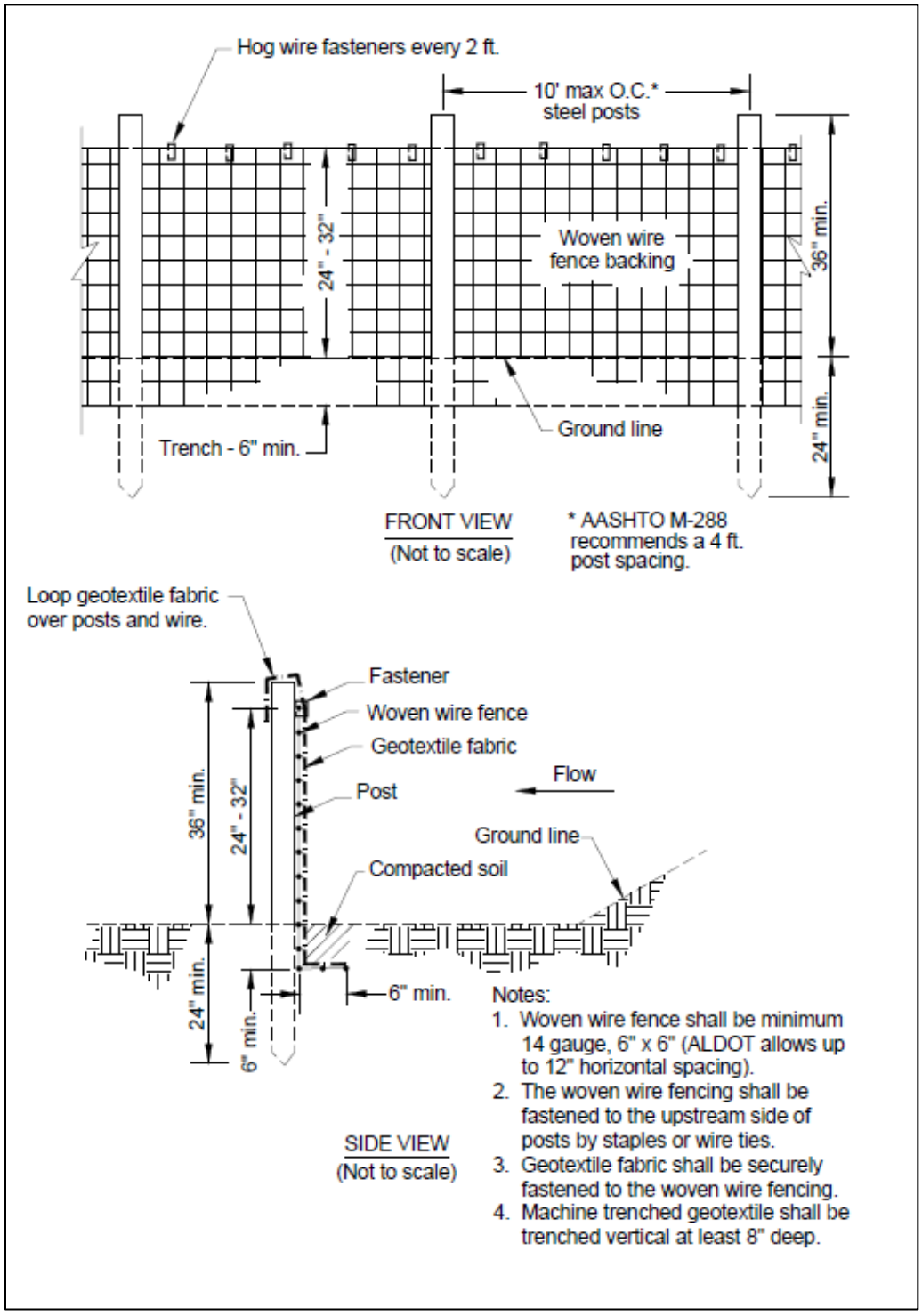

Figure SB-1 Silt Fence - Type A

(1) For post material requirements see Tables SB-2 and SB-3 (Volume I of Handbook)

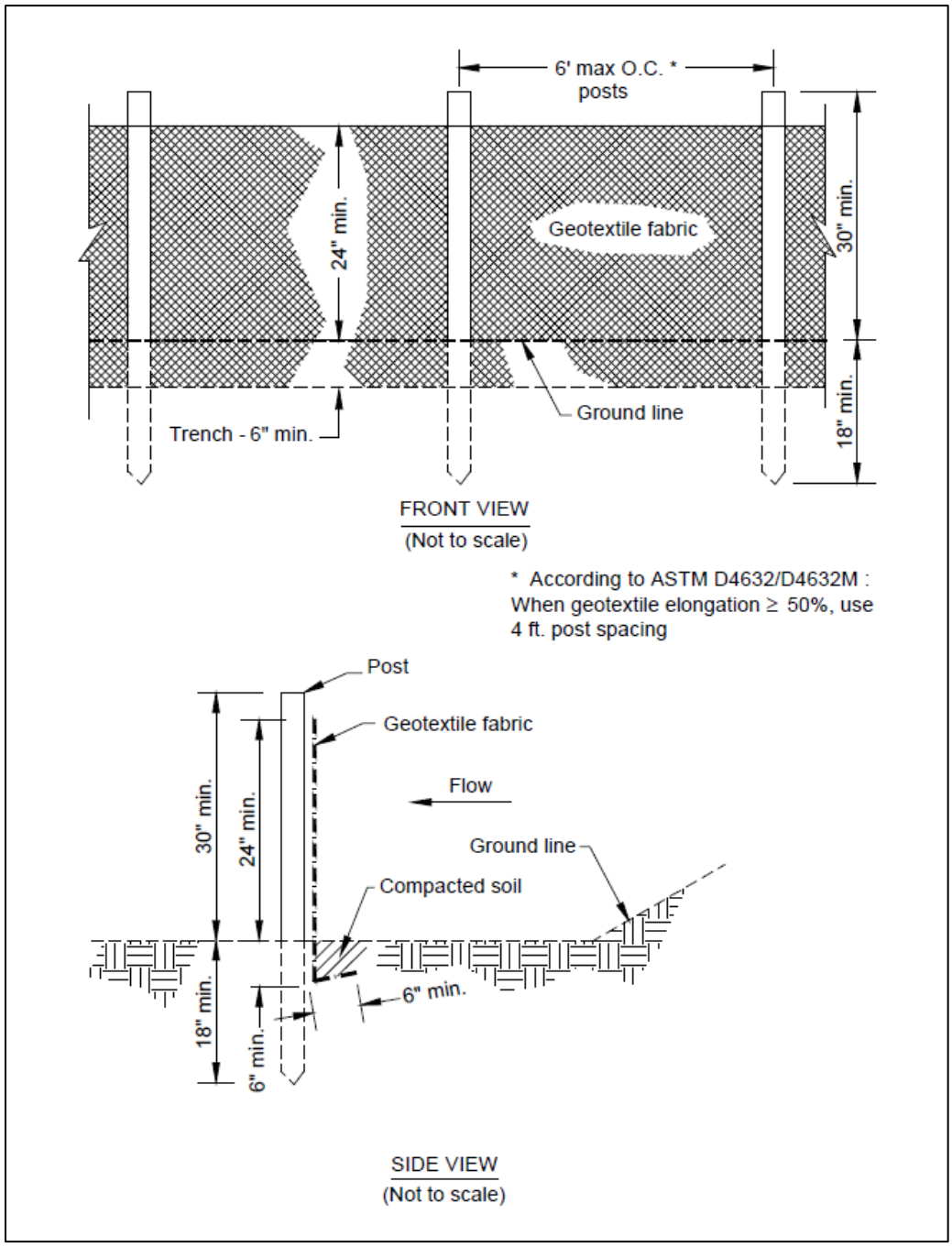

Figure SB-2 Silt Fence - Type B

(1) For post material requirements see Tables SB-2 and SB-3 (Volume I of Handbook)

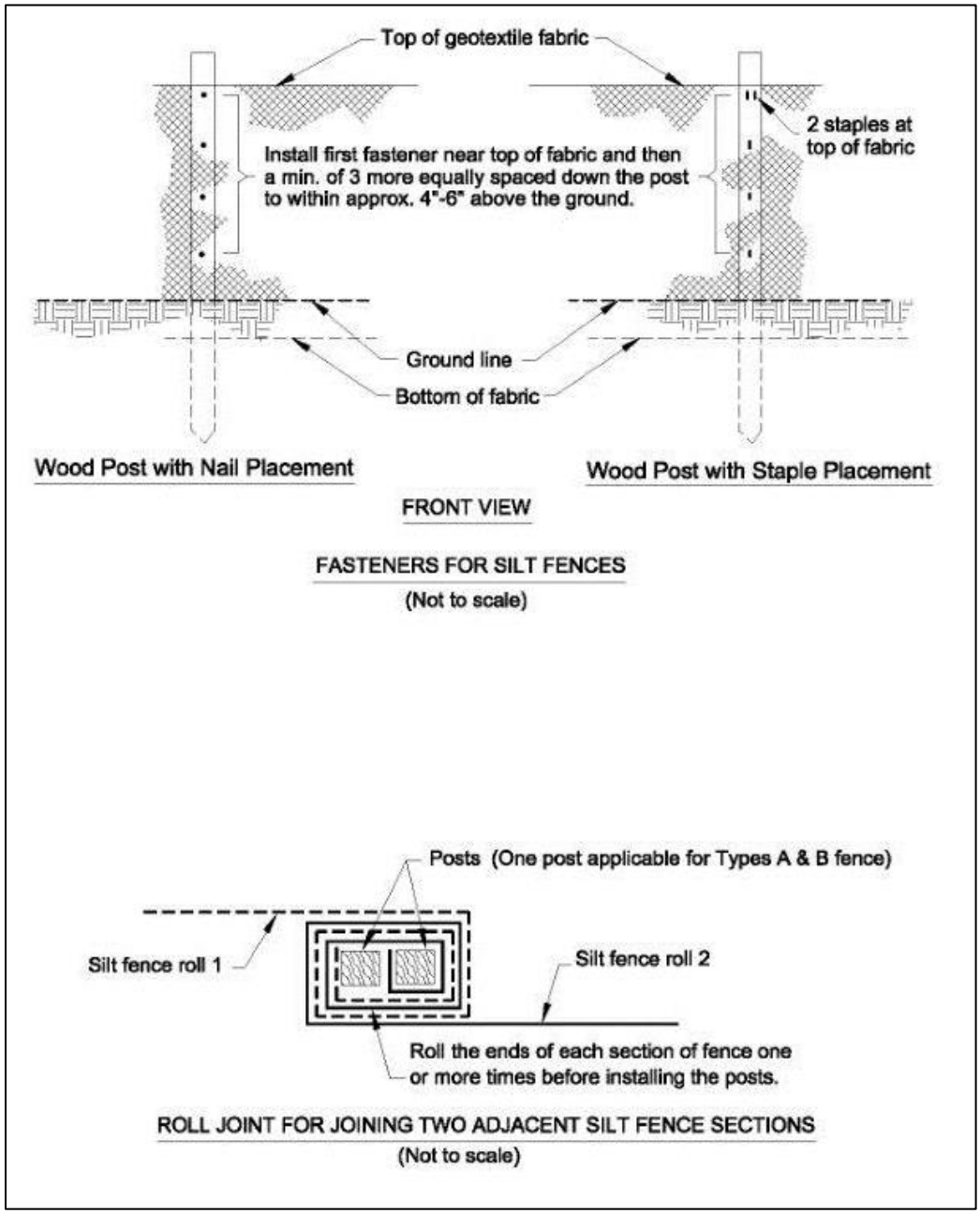

Figure SB-3 Silt Fence Installation Details

Erosion Control

Stabilize disturbed areas in accordance with vegetation plan. If no vegetation plan exists, consider planting and mulching as a part of barrier installation and select planting information from appropriate planting practice, Permanent Seeding or Temporary Seeding. Select mulching information from the Mulching practice.

Construction Verification

Check finished grades and dimensions of the sediment fence. Check materials for compliance with specifications.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography onsite indicate sediment fence will not function as intended or alignment is not on contour or fence crosses concentrated flow areas; changes in plan may be needed.
- Design specifications for filter fabric, support posts, support fence, gravel or riprap cannot be met; substitutions may be required. Unapproved substitutions could lead to failure.
- Drainage area appears to exceed ¼ acre for 100 feet of non-reinforced silt fence and ½ acre for reinforced fence.

Maintenance

Inspect silt fences at least once a week and after each significant rain event.

Make required repairs immediately.

Should the fabric of silt fence collapse, tear, decompose or become ineffective, replace it promptly.

Remove sediment deposits when they reach a depth of ½ the height of the fence as installed to provide adequate storage volume for the next rain and to reduce pressure on the fence.

After the contributing drainage area has been properly stabilized, remove all barrier materials and unstable sediment deposits, bring the area to grade and stabilize it with vegetation.

Sediment Basin (SBN)

Practice Description

An earthen embankment suitably located to capture runoff, with an emergency spillway lined to prevent spillway erosion, interior porous baffles to reduce turbulence and evenly distribute flows, and equipped with a floating skimmer or other approved surface dewatering device that removes water from the top of the basin. Flocculants are commonly used with a sediment basin to increase sediment capture.

Typical Components of the Practice

- Site Preparation
- Keyway Trench
- Skimmer or Surface Dewatering Device
- Embankment
- Emergency Spillway
- Basin and Baffles
- Erosion Control
- Flocculant
- Safety
- Construction Verification

Construction

Prior to the start of construction, sediment basins should be designed by a qualified design professional.

Plans and specifications should be referred to by field personnel throughout the construction process. The sediment basin should be built according to planned grades and dimensions. Follow all federal, state and local requirements on impoundments.

Consider the following guidance as construction proceeds.

Site Preparation

Locate all utilities at the site to ensure avoidance.

Clear, grub and strip the dam foundation and emergency spillway area, removing all woody vegetation, rocks and other objectionable material. Dispose of trees, limbs, logs and other debris in designated disposal areas.

Stockpile surface soil for use later during topsoiling.

Delay clearing the pool area until the dam is complete and then remove brush, trees, and other objectionable materials to facilitate sediment cleanout.

Specified sumps or fore bays used to capture coarse grain sediment should be installed immediately upstream of the sediment basin and completed the same time as the sediment basin.

Keyway Trench

Excavate the keyway trench along the centerline of the planned embankment to a depth determined by the qualified design professional (at least 2 feet).The trench bottom elevation should extend up both abutments to the riser crest elevation and have a bottom width of at least 8 feet and have side slopes no steeper than 1.5:1. Compaction requirements will be the same as those for the embankment.

Skimmer

Following are installation guidelines for a skimmer only:

Prevent the skimming device from settling into the mud by excavating a shallow pit under the skimmer or providing a low support under the skimmer of stone or timber (Figure SBN-1).

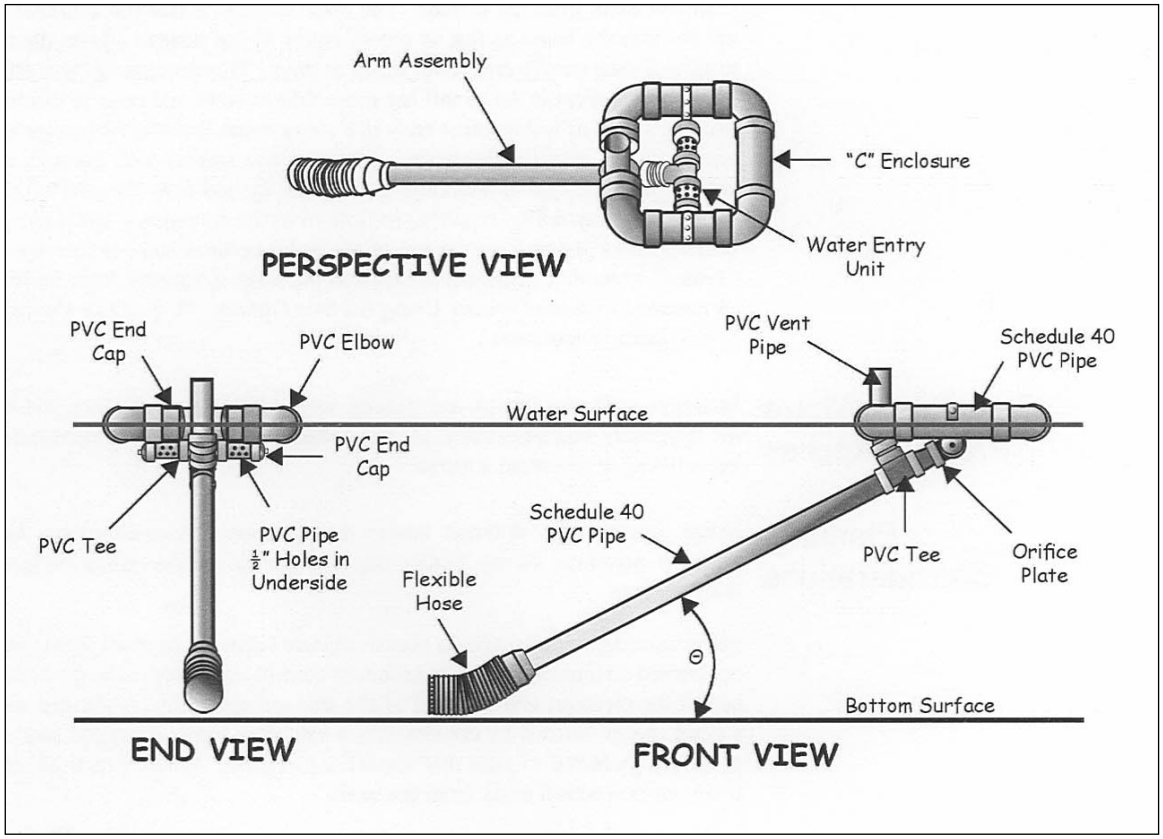

Figure SBN-1 Schematic of a skimmer.
(from Pennsylvania Erosion and Sediment Pollution Control Manual, March, 2000)

Place the barrel pipe (typically the same size as the skimmer arm) on a firm, smooth foundation of impervious soil. Do not use pervious material such as sand, gravel, or crushed stone as backfill around the pipe. Place the fill material around the pipe in 4-inch layers and manually compact it under and around the pipe to at least the same density as the adjacent embankment. Care must be taken not to raise the pipe from the firm contact with its foundation when compacting under the pipe haunches.

Construct the anti-seep collar(s) if shown on the plans.

Place a minimum depth of 2 feet of compacted backfill over the pipe before crossing it with construction equipment. In no case should the pipe conduit be installed by cutting a trench through the dam after the embankment is complete.

Assemble the skimmer following the manufacturer's instructions, or as designed.

Lay the assembled skimmer on the bottom of the basin with the flexible joint at the inlet of the barrel pipe. Attach the flexible joint to the barrel pipe and position the skimmer over the excavated pit or support. Be sure to attach a rope to the

skimmer and anchor it to the side of the basin. This will be used to pull the skimmer to the side for maintenance.

Install outlet protection as specified.

Embankment

Scarify the foundation of the dam before placing fill.

Use fill from predetermined borrow areas. It should be clean, stable soil free of roots, woody vegetation, rocks and other debris; and must be wet enough to form a ball without crumbling, yet not so wet that water can be squeezed out.

Place the most permeable soil in the downstream toe and the least permeable in the center portion of the dam.

Place the fill material in 6” to 9” continuous uncompacted layers over the length of the dam. Fill should then be compacted to a 4” to 6” thick continuous layer (One way is by routing construction equipment over the dam so that each layer is traversed by at least 4 passes of the equipment).

Protect the spillway barrel with 2 feet of fill that has been compacted with hand tampers before traversing over the pipe with equipment.

Construct and compact the dam to an elevation 10% above the design height to allow for settling. The embankment should have a minimum 8 ft. top width and 2.5:1 side slopes, but the design may specify additional width and gentler side slopes.

Place a reference stake at the sediment clean out elevation shown on the plans (50% of design storage volume).

Emergency Spillway

Construct the spillway at the site located by a qualified design professional according to the plan design (in undisturbed soil around one end of the embankment, and so that any flow will return to the receiving channel without damaging the embankment).

Basin and Baffles

Ensure the basin has a length to width ratio of at least 2:1 or more as specified. Grade the basin so that the bottom is level front to back and side to side. Discharge water into the basin in a manner to prevent erosion. The inlet into the basin should be on one end with the surface dewatering device on the opposite end of the basin. Use diversions with outlet protection to divert sediment-laden water to the upper end of the pool area to improve basin trap efficiency.

Install porous coir baffles as specified to ensure water does not flow under or around the baffles (Figure SBN-2). Baffles should be placed perpendicular to the flow and create near equal volumes within the basin.

Figure SBN-2 Example of porous baffle made of 700 g/m^2 coir erosion blanket as viewed from the inlet. (from North Carolina Erosion and Sediment Control Planning and Design Manual.)

Install posts or saw horses across the width of the sediment trap.

Steel posts should be driven to a depth of 24 inches, spaced a maximum of 4 feet apart, and installed up the sides of the basin as well. The top of the fabric should be at least the height of the required storage volume elevation.

Install at least three rows of baffles between the inlet and outlet discharge point and at the locations specified in the plans. The three rows should create four near equal volumes in the basin.

When using posts, add a support wire or rope across the top to prevent sagging.

Wrap porous coir material (700 - 900 g/m^2) over a sawhorse or the top wire. Hammer rebar into the sawhorse legs for anchoring. Attach fabric to a rope and a support structure with zip ties, wire, or staples. Each baffle should consists of 2 layers of coir fabric.

The bottom and sides of the fabric should be anchored in a trench or pinned with 8-inch erosion control matting staples.

Do not splice the fabric, but use a continuous piece across the basin.

Erosion Control

Minimize the size of all disturbed areas.

Divert runoff from undisturbed areas away from the basin.

Use temporary diversions to prevent surface water from running onto disturbed areas.

Divert sediment-laden water to the upper end of the sediment pool to improve trap effectiveness.

Vegetate and stabilize the embankment, the emergency spillway and all disturbed areas including the basin bottom and side slopes. If the basin slopes and bottom are not vegetated, cover the surface with non-woven geotextile.

Flocculant

Place the specified flocculant in a turbulent flow location upstream of the basin to ensure proper mixing.

Safety

Because sediment basins that impound water are hazardous, the following precautions should be taken:

- Fence area and post warning signs if trespassing is likely.
- Ensure that the basin does not exceed design heights.

Construction Verification

Check the finished grades and configurations for all earthworks. Check elevations and dimensions of all pipes and structures.

Common Problems

Consult with registered design professional if any of the following occurs:

- Variations in topography on-site indicate sediment basin will not function as intended.
- Seepage is encountered during construction; it may be necessary to install drains.
- Design specifications for fill, pipe, seed variety or seeding dates cannot be met; substitutions may be required. Unapproved substitutions could lead to failure.

Maintenance

Inspect the sediment basin at least weekly and after each significant storm event (½ inch or greater).

If water remains turbid in the basin, reapply flocculant as specified.

Remove and properly dispose of sediment when it accumulates to ½ the design volume.

Remove trash and other debris from the skimmer, emergency spillway and pool area.

Periodically check the embankment, emergency spillway and outlet for erosion damage, piping, settling, seepage or slumping along the toe or around the barrel and repair immediately.

Remove the basin after the drainage area has been permanently stabilized, inspected and approved. Do so by draining any water, removing the sediment to a designated disposal area, smoothing the site to blend with the surrounding area; then stabilize.

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Sediment Trap (ST)

Practice Description

A sediment trap is a temporary catch basin used for the purpose of intercepting and detaining small amounts of sediment to prevent it from leaving the construction site. This practice applies within disturbed areas with very small drainage basins that are subject to sheet erosion or in minor swales. Various materials may be used for sediment traps and include straw bales, sand bags, wattles, and various man-made materials and devices.

Typical Components of the Practice

- Site Preparation
- Installation of Straw Bales
- Erosion Control
- Construction Verification

Construction

Prior to start of construction, sediment traps should be designed by a qualified professional. Plans and specifications should be referred to by field personnel throughout the construction process. The sediment trap should be built according to planned grades and dimensions.

Note: Straw bales are the only sediment trap material covered in this handbook. Man-made products should be installed according to the design plan or, if it not detailed, installation should follow the recommendations of the manufacturer.

Site Preparation

Determine exact location of underground utilities so that locations for digging or placement of stakes can be selected where utilities will not be damaged. Smooth the construction zone to provide a broad, nearly level area for the row of bales. The area should be wide enough to provide storage of runoff and sediment behind the straw bales.

To facilitate maintenance, provide good access for cleanout of sediment during maintenance period.

Installation of Straw Bale

Excavate a trench to the dimensions shown on the drawings. The trench should be long enough that the end bales are somewhat upslope of the sediment pool to ensure that excess flows go over the bales and not around the bales.

Place each bale end to end in the trench so the bindings are oriented around the sides rather than top and bottom.

Anchor the bales by driving two 36” long 2” x 2” hardwood stakes through each bale at least 18” into the ground. Drive the first stake toward the previously laid bale to force the bales together.

Wedge loose straw into any gaps between the bales to slow the movement of sediment-laden water.

Anchor the bales in place according to the details shown on the drawings. If specific details are not shown, backfill and compact the excavated soil against the bales to ground level on the downslope side and to 4” above ground level on the upslope side.

Erosion Control

Stabilize disturbed areas in accordance with vegetation plan. If no vegetation plan exists, consider planting and mulching as part of installation and select planting information from either the permanent Seeding or Temporary Seeding practice. Select mulching information from the Mulching practice.

Construction Verification

Check finished grades and dimensions of the straw bale sediment trap. Check materials for compliance with specifications.

Common Problems

Consult with registered design professional if the following occurs:

- Variations in topography on site indicate sediment trap will not function as intended; changes in plan may be needed.
- Design specifications for materials cannot be met; substitutions may be required. Unapproved substitutions could lead to failure.

Maintenance

Inspect sediment traps after each storm event and remove sediment deposits promptly after it has accumulated to ½ of the original capacity, taking care not to undermine the entrenched bales.

Inspect periodically for deterioration or damage from construction activities. Repair damaged barrier immediately.

After the contributing drainage area has been stabilized, remove the sediment trap and sediment, bring the disturbed area to grade and stabilize it with vegetation or other materials shown in the design plan.

Straw bales may be recycled as mulch.

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Bioretention Area (BA)

Source: Source: Department of Environmental Resources, Prince George's County, MD

Practice Description

A bioretention area is a shallow, vegetated depression incorporated into a development's landscape. The purpose of bioretention is to restore, as much as possible, an area's pre-development hydrology and provide both water quantity and water quality benefits.

Stormwater is conveyed as sheet flow to the bioretention area that temporarily stores runoff. As stormwater percolates through the bioretention area, soils and plants remove pollutants. Filtered stormwater is then directed to the conveyance system or if underlying soils are appropriate, stormwater is allowed to infiltrate to the aquifer below and provide recharge.

A bioretention area is a suitable stormwater practice for commercial, transportation, industrial, and residential developments. Applications include parking lot islands, roadway medians, roadside swales, and residential gardens positioned to collect roof and parking lot runoff. Bioretention is particularly effective on sites of 1 acre or less. Bioretention is used on larger sites with multiple bioretention areas treating sub-drainages. In general, a bioretention area is a suitable stormwater management practice for residential subdivisions and high density/ultra urban sites but not for regional-scale control. [2]

Note: Only general guidance is provided for this practice. More specific information can be obtained from the Low Impact Development Handbook for the State of Alabama (www.aces.edu/lid).

Typical Components of the Practice

- Site Preparation
- Product Installation
- Erosion and Sediment Control
- Construction Verification

Construction [1, 3]

Prior to start of construction, bioretention area should be designed by a qualified design professional. Throughout the construction process, field personnel should refer to plans and specifications. Bioretention areas are generally finished last during construction to minimize sediment delivery.

Site Preparation

Install erosion and sediment control measures on adjacent areas before any site clearing, grading or excavation to prevent sediment from entering into the bioretention area.

Before the site is graded, rope off the bioretention area to prevent heavy equipment from compacting the underlying soils.

Determine the exact location of underground utilities.

If practical, redirect stormwater runoff to prevent runoff and sediment from entering the site during construction by using practices such as diversions and swales.

Stabilize any disturbed ground outside of where bioretention area is to be installed with vegetation.

Remove and stockpile the topsoil from the bioretention area.

Use earthmoving equipment with tracks or oversized tires to clear, grub and grade the site. Avoid normal rubber tires because they compact the subsoil and reduce its infiltration capabilities. Earthmoving in wet conditions should be avoided.

If curb openings exist that provide stormwater to the site they should be blocked during construction to prevent drainage onto the construction area.

Excavate the bioretention area to invert depth specified in design. Scarify remaining soil surface, taking measures not to compact underlying material.

Product Installation

Install underdrain system (including gravel diaphragm) and observation wells, if specified in design.

Backfill bioretention area with previously prepared soil mixture. See project design for specifications on soil mixture. Wet soil mixture and allow soil to settle.
Note – typically settlement will take ¼ of a day.

Add or remove soil mixture to achieve proper design grade. Leave appropriate space for mulch layer.

Install selected vegetation.

Mulch area and install area's entrance energy dissipater specified

Notes relating to Materials Installation

- Inspection of underdrain system (piping, connections, gravel bed, and any filter fabric) should be performed prior to filling in bioretention area. Gravel, pipe, and filter fabric should have manufacturer's tickets.
- If gravel diaphragm is part of underdrain system design, avoid dropping gravel into area from high levels (e.g. from a backhoe or front end loader). Gravel should be spilled directly over underdrain and spread manually.
- Allow bioretention soil to settle naturally as described above to avoid over-compaction. Do not provide any additional manual compaction. If speeding up this process is desired, pre-soak soil before placing in bioretention area.
- Soil should be overfilled above proposed surface so that post-settlement level of material will be at the proper grade. Soil materials can naturally compact up to 20% depending on soil type.

Erosion and Sediment Control

The importance of effective erosion and sediment control during and after construction should be thoroughly understood by responsible construction personnel.

Erosion and sediment control measures planned for the adjacent areas must be effective to prevent failure of the bioretention area.

Construction sequencing is vital. Construction activity in the contributing drainage area should be completed and disturbed areas stabilized before construction of bioretention area. Design drawings should specify the sequence of construction.

Construction Verification

Check the finished grades and configuration for all earthwork. Check elevations and dimensions of all pipes. Check soil additions for adherence to plan. [4]

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography or site geology indicate bioretention will not function as intended.
- Design specifications for fill, pipe, gravel, filter fabric and other material cannot be met. Unapproved substitutions could lead to failure.

Maintenance

Maintenance of bioretention areas is similar to the routine maintenance typical of any landscaped area. When plants native to the area are used, need of fertilizer, pesticide, and water is minimized.

Exercise caution during the application of fertilizers and pesticides in and around the bioretention area to prevent the possibility of surface and ground water contamination.

As plants mature in bioretention area, landscaping management requirement are lessened.

Typical aspects of bioretention maintenance include sediment and debris removal from the system, replacement of dead plant material, regulation of soil pH, repair of eroded areas, re-mulching, unclogging of underdrain, and repair of overflow structure repair.

Sediment must be kept from entering the bioretention area after construction.

An operation and maintenance checklist is helpful in ensuring that maintenance activities are scheduled appropriately. A template is available in one of the references.[5]

References

[1] Low Impact Development Handbook for the State of Alabama. Alabama Department of Environmental Management, Alabama Cooperative Extension System and Auburn University, www.aces.edu/lid

[2] Georgia Stormwater Management Manual, Volume 2 – Technical Manual. Section 3.2.3 Bioretention Areas

[3] The Bioretention Manual. Prince George's County, Maryland

[4] Templates provided by http://stormwatercenter.net
Inspection checklist available at
http://www.stormwatercenter.net/Manual_Builder/CHECKLISTS/Filters/Construction/Bioretention%20construction%20inspection%20checklists.pdf

[5] Operation and Maintenance checklist available at
http://www.stormwatercenter.net/Manual_Builder/CHECKLISTS/Filters/Operation%20and%20Maintenance/operation%20maintenance%20and%20management%20inspection%20checklists%20-%20Bioretention.pdf

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Porous Pavement (PP)

Practice Description

Porous pavement is a permeable load-bearing layer that reduces runoff by providing infiltration, and can be underlain by a stone reservoir for stormwater storage. The practice with a stone reservoir is designed to intercept storm runoff and allow it to gradually infiltrate into the subsoil. In addition, porous pavement may provide groundwater recharge, augment low flow in streams during dry periods, reduce downstream flooding and protect water quality. The practice is applicable for areas with low traffic, such as overflow parking lots and lightly used access roads that are on relatively gentle slopes and permeable soils.

Porous pavement falls into 3 different categories based on the extent of storage provide by the stone reservoir: a full exfiltration system (stores the entire design storm), a partial exfiltration system (stores a portion of the design storm) and a water quality exfiltration system (provides infiltration only or stores the first flush or some portion of a design storm and conveys the excess runoff to a conventional stormwater management facility).

Concrete grids, modular pavement, or similar products will be considered as a part of this practice.

Note: Only general guidance is provided for this practice. More specific information can be obtained from the Alabama Low Impact Development (LID) Handbook.

Typical Components of the Practice

- Site Preparation
- Product Installation
- Full Exfiltration Systems
- Partial Exfiltration Systems
- Water Quality Exfiltration Systems
- Concrete Grids & Modular Pavements
- Erosion and Sediment Control
- Construction Verification

Construction

Prior to start of construction, porous pavement should be designed by a qualified design professional. Plans and specifications should be referred to by field personnel throughout the construction process.

Consider the following guidance as construction proceeds.

Site Preparation

Before the site is graded, rope off the porous pavement area to prevent heavy equipment from compacting the underlying soils.

Determine the exact location of underground utilities.

Install Diversions to prevent runoff and sediment from entering the site during construction.

Use earthmoving equipment with tracks or oversized tires to clear, grub and grade the site. Avoid normal rubber tires because they compact the subsoil and reduce its infiltration capabilities. Earthmoving in wet conditions should be avoided.

Remove and stockpile topsoil.

Grade the site to design elevations and dimensions shown for the reservoir subgrade.

The subgrade should be reasonably smooth and free of loose rocks and clods, holes, depressions, muddy conditions or flowing water.

Product Installation

For All Products (based on the design plan)

Line the bottom and sides of the reservoir area with filter fabric, and install observation well, filler and filter stone. Typical installations include the following actions:

- using anchors to ensure the fabric is secured to the subgrade;
- installing the observation well at a designed location and elevation;
- placing stone of the specified gradation in uniform layers to the designed thickness and compacting each layer of stone lightly after it is placed;

Additional actions specific for the type of installation include the following guidelines.

Full Exfiltration System

After stone placement, install an emergency overland channel (curb or swale) to carry flows greater than the design storm.

Partial Exfiltration System

After stone placement, install perforated drainpipe and associated outlet structures at the locations and grades shown in the design plan. Drainpipes should be installed near the top of the stone reservoir.

Water Quality Exfiltration

After stone placement, install perforated drainpipe and associated outlet structures at the locations and grades shown in the design plan. Drainpipes should be installed near the top of the stone reservoir.

Concrete Grids and Modular Pavements

After stone placement, install perforated drainpipe and associated outlet structures at the locations and grades shown in the design plan. Drainpipes should be installed near the top of the stone reservoir.

Install the product and fill the open spaces within the pavement with gravel or other material according to the design plan and manufacturer's recommendations.

Notes relating to Materials Installation

- Rolling required for permeable asphalt, grid and modular pavement is critical and must be done strictly according to the design plan to prevent problems with infiltration and load bearing strength.
- After rolling is complete, all traffic should be kept out of the porous pavement area for a minimum of 1 day to allow proper hardening.

- If new utility lines are buried beneath the porous pavement site, do not construct the stone reservoir until all trench settlement has taken place.

Erosion and Sediment Control

Sediment control is critical during and after construction; therefore, erosion and sediment control measures planned for the adjacent areas must be effective to prevent loss of infiltration capacity of the porous pavement.

Vegetated filter strips should be placed around the porous pavement, concrete grids and modular pavements.

Reinforced silt fences should be placed around porous pavement, concrete grids and modular pavements while vegetation is being established.

Signs should be posted and construction personnel advised not to enter the parking lot or access area with muddy tires.

Store all construction materials and waste material well away from the porous pavement site.

Provide temporary fencing and post warning signs around the porous pavement until vegetation in the filter strip is established.

Install additional planned measures that are needed to drain and control stormwater runoff from the site.

Construction Verification

Check the finished grades and configuration for all earthwork. Check elevations and dimensions of all pipes and structures.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography or site geology indicate porous pavement will not function as intended.

- Design specifications for fill, pipe, gravel, filter fabric and asphalt paving material cannot be met. Unapproved substitutions could lead to failure.

Maintenance

Inspect the porous pavement after each storm event. Inspectors should check for ponding on the surface which might indicate local or widespread clogging.

The condition of the vegetative filter strip should be inspected.

The observation well should be checked several times in the first few months after construction. Water depth in the well should be measured at 0, 24, and 48 hour intervals after a storm.

The porous pavement site should be posted with signs indicating the nature of the surface, and warning against resurfacing the site with conventional pavement or the use of materials which could affect the infiltration capacity of the surface.

Sediment must be kept completely away from a porous pavement site after construction.

Asphalt type porous pavements should be vacuum swept at least 4 times per year, followed by high-pressure jet hosing to keep the asphalt pores open.

Potholes and cracks in asphalt porous pavement can be repaired using conventional, nonporous patching mixes as long as the cumulative area repaired does not exceed 10% of the parking lot area.

Spot clogging of the asphalt porous pavement layer can be relieved by drilling ½" holes through the porous asphalt layer every few feet. In cases where clogging occurs in a low spot in the parking lot, it may be advisable to install a drop inlet to route water into the stone reservoir.

Follow guidelines for porous pavement maintenance to maintain concrete grids and modular pavements. Where vegetation is planted in the grids, mowing, fertilizing and irrigation may be needed.

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Stormwater Detention Basin (SDB)

Practice Description

A stormwater detention basin is a dam-basin practice designed to hold stormwater runoff and release the water slowly to prevent downstream flooding and stream erosion. The practice is an extremely effective water quality and peak discharge reduction measure. Its usage is best suited to larger, more intensively developed sites. Structure life is 10 years or more. A stormwater detention basin can have a permanent pool of water or be designed to have a dry basin (typical). A detention basin can be designed to also serve as a sediment basin during the construction period.

Typical Components of the Practice

- Site Preparation
- Keyway Trench
- Principal Spillway
- Skimmer and Baffles
- Embankment
- Emergency Spillway
- Erosion Control
- Safety
- Construction Verification

Construction

Prior to start of construction, the stormwater detention ponds should be designed by a qualified design professional.

Plans and specifications should be referred to by field personnel throughout the construction process. The measure should be built according to the planned grades and dimensions and include all essential components. Follow all federal, state and local requirements on impoundments.

Consider the following guidance as construction proceeds.

Site Preparation

Locate all underground utilities to ensure avoidance.

Clear, strip, grub and excavate the dam location, removing all woody vegetation, rocks and other objectionable material, such as soft, wet, or sandy soils. Stockpile surface soils with high organic content for later use. Dispose of trees, limbs, logs and other debris in designated disposal areas.

If possible, construct the dam prior to clearing and disturbance of the pool area. Stockpile any surface soil having high amounts of organic matter for later use.

Where practical, maintain existing vegetation of at least 25 feet around the pool as a filter strip (see *Preservation of Vegetation* practice).

Keyway Trench

Excavate the keyway trench along the centerline of the planned embankment to a depth determined by the qualified design professional (at least 2 feet). The trench bottom elevation should extend up both abutments to the emergency spillway elevation and have a bottom width of at least 8 feet and have side slopes no steeper than 1.5:1 or flatter. Compaction requirements for the keyway backfill will be the same as those for the embankment.

Principal Spillway

Prepare the pipe bedding and situate the spillway barrel (pipe) and riser on a firm, even foundation.

Place around the barrel a 4” layer of moist, clayey, workable soil (not pervious material such as sand, gravel or silt), and compact with hand tampers to at least the density of the foundation soil. Do not raise the pipe from the foundation when compacting under the pipe haunches. Continue with backfill of the pipe in 4” to 6” uncompacted layers scarifying the surface between each compacted layer. All backfill material within 2 feet of the pipe (beside the pipe and above the pipe) should be compacted with hand tampers only.

Install the anti-seep collars or sand drainage diaphragm according to the design specifications.

Set the top of the riser at the elevation shown on the design drawings to allow the detention pond to store the design runoff. Install the 4 inch dewatering orifice at the designed elevation on the side of the riser pipe and complete with a trash rack device.

Embed the riser into the concrete anti-flotation block as shown on the design drawing. The concrete block should be constructed to the dimensions shown on the drawings to balance the buoyant force acting on the riser.

Install the trash rack around the riser inlet. The trash rack should have the minimum dimensions shown on the design.

At the pipe outlet, install outlet protection according to the design plan (if not specified, use a riprap apron at least 5 feet wide to a stable grade).

Skimmer and Baffles

Skimmer and baffles will be required if the stormwater detention basin is to serve as a sediment basin during the construction phase of the project.

Assemble the skimmer following the manufacturer's instructions, or as designed.

Lay the assembled skimmer on the bottom of the basin with the flexible joint connected water tight at the base of the riser pipe. Be sure to attach a rope to the skimmer and anchor it to the side of the basin. This will be used to pull the skimmer to the side for maintenance.

Prevent the skimming device from settling into the mud by excavating a shallow pit under the skimmer or providing a low support under the skimmer of stone or timber.

Install a minimum of 3 porous coir baffles as specified and ensure flows do not go under or around the baffles.

Embankment

Scarify the embankment foundation before placing fill.

Use fill from predetermined borrow areas. It should be clean, stable, mineral soil free of organic material, roots, woody vegetation, rocks and other debris; and must be wet enough to form a ball without crumbling, yet not so wet that water can be squeezed out.

Place the most permeable soil in the downstream toe and the least permeable in the center portion of the dam.

Place the fill material in 6” to 9” continuous uncompacted layers over the length of the dam. Fill should then be compacted to a 4” to 6” thick continuous layer (one way is by routing pneumatic tired construction equipment over the dam so that each layer is traversed by at least 4 passes of the equipment). Compacted layers with a slick surface should be scarified prior to the next lift being placed in order to promote bondage between the layers.

Protect the principal spillway barrel with 2 feet of hand tamped, compacted fill before traversing over the pipe with equipment.

Construct and compact the dam to an elevation 10% above the design height to allow for settling. The embankment should have a minimum 8 feet top width and 2.5:1 side slopes (3:1 for mowable slopes), but the design may specify additional width and gentler side slopes.

Place a stake marking the depth of sediment accumulation at which sediment must be cleaned out of the basin (50% of design storage volume).

Emergency Spillway

Construct the spillway at the site located, to the dimensions, and utilizing the surface treatments specified by a qualified design professional according to the design plan. In most all cases, the emergency spillway will be constructed in undisturbed soil around one end of the embankment so that any flow will return to the receiving channel without damaging the embankment.

Erosion Control

Minimize the size of all disturbed areas. At the completion of each phase of construction, stabilize the disturbed areas to minimize erosion.

Stabilize the spillway with vegetation as soon as grading is complete; or install paving material to finished grade if the spillway is not to be vegetated.

Use temporary diversions to prevent surface water from running onto disturbed areas.

Divert sediment-laden water to the upper end of the sediment pool to improve trap effectiveness.

Direct all runoff into the pond at low velocity.

Establish vegetation on all disturbed areas not previously treated including the bottom and side slopes of the basin.

Safety

Because stormwater detention basins that impound water are hazardous, the following precautions should be taken:

Provide a means of dewatering the basin between storm events.

Fence area and post with warning signs if trespassing is likely.

Construction Verification

Check the finished grades and configuration for all earthwork. Check elevations and dimensions of all pipes and structures.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate detention pond will not function as intended.
- Seepage is encountered during construction; it may be necessary to install drains.
- Design specifications for fill, pipe, seed variety or seeding dates cannot be met; substitutions may be required. Unapproved substitutions could lead to failure.

Maintenance

Inspect the stormwater detention basin after each storm event.

Remove and properly dispose of sediment when it accumulates to ½ the design volume.

Periodically check the embankment, emergency spillway and outlet for erosion damage, piping, settling, seepage or slumping along the toe or around the barrel; and repair immediately.

Remove trash and other debris from the riser, skimmer, emergency spillway and pool area. Remove nuisance vegetation on embankment.

Remove animals that burrow into the dam.

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Buffer Zone (BZ)

Practice Description

A buffer zone is a strip of plants adjacent to land-disturbing sites or bordering streams, lakes, and wetlands which provides streambank stability, reduces scour erosion, reduces storm runoff velocities and filters sediment in stormwater. This practice applies on construction sites and other disturbed areas that can support vegetation and can be particularly effective on floodplains, next to wetlands, along stream banks and on steep, unstable slopes.

Typical Components of the Practice

- Preservation and Protection of Existing Vegetation
- Site Preparation
- Soil Amendments (lime and fertilizer)
- Planting Desired Vegetation
- Mulching

Installation (Preservation)

Prior to start of construction, buffer zones should be designed by a qualified design professional. Plans and specifications should be referred to by field personnel throughout the installation process.

Preserve vegetation on designated areas shown in plan. In the absence of a plan, maintain a buffer of existing vegetation with a minimum width for shoreline or

stream bank protection of at least 35 feet. Local ordinances may require a wider buffer. Narrower buffer zones may be sufficient on steep slopes that are narrower than 35 feet.

Installation (Plantings)

Prior to start of construction, buffer zones should be designed by a qualified design professional. Plans and specifications should be referred to by field personnel throughout the installation process.

Site Preparation

Install planned measures such as silt fences and diversions before grading and seedbed preparation. In the absence of a plan and before grading and seedbed preparation, install other necessary measures which may include silt fences and diversions. Clear area of clods, rocks, etc. that would interfere with seedbed preparation; smooth the area before the soil amendments are applied and firm the soil after the soil amendments are applied.

Soil Amendments (lime and fertilizer)

Apply lime and fertilizer according to the plan or by soil test recommendations. In the absence of a plan or soil test recommendations, apply agricultural limestone at the rate of 2 tons per acre (90 lbs per 1000 ft^2.) and 10-10-10 fertilizer at the rate of 1000 lbs per acre (25 lbs per 1000 ft^2.). Apply ground agricultural limestone unless a soil test shows pH of 6.0 or greater. Incorporate amendments to a depth of 4” to 6” with a disk or chisel plow.

Planting Desired Vegetation

Plant desired vegetation according to the design plan. In the absence of a plan use installation guidelines for Permanent Seeding, Tree Planting on Disturbed Areas, Shrub, Vine and Groundcover Planting.

Mulching

Spread mulch according to guidelines in the Mulching practice.

Common Problems

Consult with qualified design professional if any of the following occur:

- Soil compaction can prevent adequate plant growth. Compaction should be addressed during site preparation.

- Design specifications for plants (variety, seeding/planting dates) and mulch cannot be met; substitutions may be required. Unapproved substitutions could lead to failure.

Problems that require remedial actions:

- Erosion, washout and poor plant establishment – repair eroded surface, reseed, reapply mulch and anchor.

- Mulch is lost to wind or stormwater runoff – reapply mulch and anchor.

Maintenance

Replant trees, grass, shrubs or vines where needed to maintain adequate cover for erosion control. Maintain grass plantings with periodic applications of fertilizer and mowing.

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Channel Stabilization (CS)

Practice Description

Channel stabilization is stabilizing a channel, either natural or artificial, in which water flows with a free surface. The purpose of this practice is to establish a non-erosive channel. This practice applies to the stabilization of open channels and existing streams or ditches with drainage areas less than one square mile. Methods of channel stabilization include rock riprap lining, concrete lining and grade stabilization structures.

Typical Components of the Practice

- Scheduling
- Site Preparation
- Installation
- Rock Riprap Lining
- Concrete Lining
- Erosion Control
- Safety
- Construction Verification

Construction

Prior to start of construction, channel stabilization should be designed by a qualified design professional. Plans and specifications should be referred to by field personnel throughout the construction process.

Consider the following guidance as construction proceeds.

Scheduling

Schedule installation during a period that includes the planting season or establishment period for the species that will be used for the adjoining Streambank Protection. In addition, use local weather forecasts to avoid installation activities during rain events that can potentially create abnormal flows and flooding.

Site Preparation

Follow all local, state and federal government regulations on stream modifications.

Determine exact location of all underground activities.

Remove trees, brush, stumps and other objectionable materials according to the design plan. Where possible, vegetation will be left standing and stumps will not be removed.

Spoil material resulting from clearing and grubbing should be disposed of according to the design plan.

The foundation for structures should be cleared of all undesirable materials prior to the installation of the structures.

Installation

Channels may be stabilized by using one or more of the following methods:

Rock Riprap Lining

Where excavation is required, channels will be excavated from one side leaving vegetation on the opposite side.

Excavation should be at the locations and grades shown on the drawings.

Spoil material resulting from channel excavation should be disposed of according to the design plan.

If required by the plans, place geotextile fabric or a granular filter as a bedding material for the riprap. Install riprap of the specified gradation to the lines and

grades shown in the design plan. Ensure that the subgrade for the filter and riprap follows the required lines and grades shown in the plan.

Riprap may be placed by equipment. Care should be taken to avoid punching or tearing of the filter cloth during placement of rock. Repair any damage by removing the riprap and placing another piece of filter cloth over the damaged area. All connecting joints should overlap a minimum of 1.5 feet so that the upstream piece of fabric lies on top of the downstream piece of fabric. If the damage is extensive, replace the entire filter cloth.

Installation usually includes some bank shaping. If bank shaping is included, follow details in the design plan and refer to the construction guidelines in Streambank Protection practice.

Concrete Lining

Where excavation is required, channels will be excavated from one side leaving vegetation on the opposite side.

Excavation should be at the locations and grades shown on the drawings.

Spoil material resulting from channel excavation should be disposed of according to the design plan.

Install concrete lining using concrete of the specified design strength according to the lines and grades in the design plan.

Installation of concrete linings usually includes some bank shaping. If bank shaping is included, follow details in the design plan and refer to the construction guidelines in Streambank Protection practice.

Place filter material and weep holes according to the plans. Place concrete according to ACI standards. Concrete on sloping surfaces should be placed from the bottom of the slope toward the top, at the required thickness, and with good vibration.

As required by the design plan, install expansion joints at the locations shown in the plan.

As required by the design plan, install welded wire fabric in the concrete forms before placing concrete.

Divert flow around the concrete lining until the concrete has reached 75% of its design strength (usually 7 days after concrete placement).

Grade Stabilization Structures

Where excavation is required, channels will be excavated from one side leaving vegetation on the opposite side.

Excavation should be at the locations and grades shown on the drawings.

Spoil material resulting from clearing, grubbing and channel excavation should be disposed of according to the design plan.

Install the structure to the lines and grades shown in the design plan.

If earthfill is required, install according to the design plan and refer to the construction guidelines for Sediment Basin embankments.

If rock riprap is required, install according to the design plan refer to the installation requirements listed earlier for Riprap-lined Swale.

Other products used, including concrete, masonry, steel, aluminum or treated wood should be installed according to details in the design plan. Installation usually includes some bank shaping. If bank shaping is included, follow details in the design plan and refer to the construction guidelines in the Streambank Protection practice.

Erosion Control

Seeding, fertilizing and mulching of the disturbed areas should be done immediately after construction and conform to the guidelines in the design plan. If vegetation establishment specifications are not included in the design plan see the appropriate practice Permanent or Temporary Seeding in Volume I for guidelines. If planting needs to be deferred until the next planting season the disturbed areas should be protected with mulch *(see Mulching practice if details are not included in the design plan).*

Safety

Store all construction materials well away from the stream. Consider weather forecasts when determining risks of damage by flooding.

Equipment used to construct channel stabilization measures should be free of leaks of fuel and hydraulic fluids to prevent contamination of surface waters. Operation of equipment in the stream should be minimized. At the completion of each workday, move all construction equipment away from the stream to prevent damage to equipment by flooding. Consider weather forecasts when determining risks of flooding.

The following precautions should be taken:

- Exercise caution on steep slopes.
- Fence area and post warning signs if trespassing is likely.

- All equipment used for practice installation should be free of leaks of gas, oil, and hydraulic fluid. Measures should be in place to prevent accidental spills from entering the stream.

- Equipment should not be operated within flowing water in the stream.

Construction Verification

Check material and finished grades to determine if job meet specifications in the design plan.

Common Problems

Variations in site conditions indicate practice will not function as intended: changes in plan may be needed.

Design specifications for materials cannot be met; substitution may be required. Unapproved substitutions could result in failure of the practice.

Maintenance

All structures should be maintained in an “as built” condition.

Check the stream channel at the construction site after each major event until the job is considered mature and a success.

Structural damage caused by storm events should be repaired as soon as possible to prevent further damage to the structure or erosion of the streambank.

Unwanted brush or excessive sediment that will impede flow should be removed in order to maintain design conditions.

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Stream Diversion Channel (SDC)

Practice Description

A stream diversion channel is a temporary practice to convey stream flow in an environmentally safe manner around a construction site while a permanent structure or conveyance is being installed in the stream channel.

Typical Components of the Practice

- Site Preparation
- Erosion and Sediment Control
- Excavation
- Lining Placement
- Stream Diversion
- Construction Verification

Construction

Prior to the start of construction, stream diversion channels are required to be designed by a qualified design engineer registered in the State of Alabama. In-stream projects of this nature are subject to the rules and regulations of the U. S. Army Corps of Engineers for in-stream modifications (Clean Water Act Section 404 permit) and if applicable, ADEM CWA Section 401 water quality certification. The stream diversion channel should be planned and installed in such a manner and time (dry season) that the impact to fisheries and the aquatic environment is minimized. A pictorial representation of a stream diversion channel is shown in Figure SDC-1. If a temporary stream crossing (TSC) is required for access, it should be constructed either up or downstream of the temporary diversion channel.

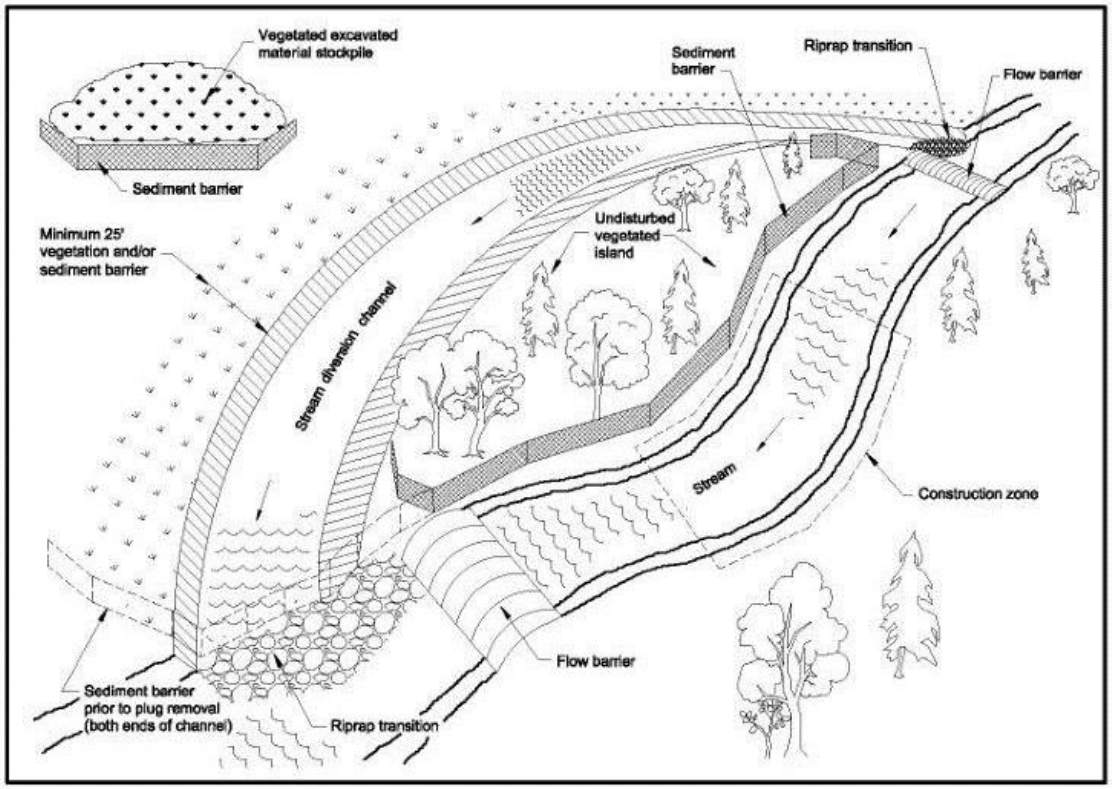

Figure SDC – 1: Typical Stream Diversion Channel Layout.

Site Preparation

Determine exact location of underground utilities.

Maintain vegetation around the stream until the stream diversion channel has been fully completed including vegetation. Clear only enough of the stream diversion channel area for the next day's work.

The centerline of the stream diversion channel should be established in the plans or by the responsible engineer. Slope and grade stakes should be established for use during excavation.

Erosion and Sediment Control

Sediment barrier or other sediment control practices to protect the stream from the construction of the diversion channel should be installed prior to any land disturbance. The stock pile for excavated material should be located well away from the work area with sediment control practices installed prior to placement of stockpiled materials. All construction areas should be seeded and mulched as soon as work is complete. Maintain a minimum 25 ft. vegetated grass filter around the stream diversion channel.

Excavation

A 25 foot undisturbed plug should be left at the exit and entrance of the stream diversion channel until the diversion channel itself has been finished. The stream diversion channel should be excavated according to the dimensions and grade shown in the construction plans beginning at the downstream end next to the plug and continue in an upstream direction. The grade of the stream diversion channel should be uniform and continuous in order to tie into the existing stream bottom elevations without any over falls that would create turbulence. Construction equipment should not be allowed to operate in flowing waters. Construction equipment should be well maintained to prevent drip/leaks of oil, hydraulic fluid, etc. Water that collects in the stream diversion channel excavation should be pumped as necessary to a settling basin prior to its discharge. The excavated material should be hauled to the stockpile location.

Lining Placement

Different lining materials can be specified for the stream diversion channel. Install the selected linings according to the construction specifications.

When rolled products like polyethylene film or geotextile fabric are specified for use as a channel lining, the product should be placed so that one width of material will cover the entire channel bottom and slopes while also providing enough material for a minimum 6 inch anchorage at the top of the bank. The upstream end of the material shall be buried at least 2 feet from top of bank to top of bank with additional trench anchorages of at least 1 ft. x 1 ft. at 50 foot intervals. Upstream sections of material shall overlap downstream sections by at least 2 feet and occur at a trench anchorage location. Polyethylene film shall be at least 6 mil thick and be capable of maintaining strength against the effects of ultraviolet light for a period of at least 60 days.

Pre-manufactured products like turf reinforcement mats (TRM), flexible concrete linings, and other similar products shall be designed and installed according to the manufacturer's recommendations.

Block sod shall be covered with erosion control netting and staked at minimal 3 ft. x 3 ft. spacing and also at the upstream edge of each piece of sod.

Generally, non-woven geotextile fabric is used underneath riprap linings. Additional protection such as riprap may be needed at the entrance and exit portion of the stream diversion channel to ensure scour does not occur in the existing stream bed or bank.

Stream Diversion

After the lining between the upstream and downstream plugs have been installed, the downstream plug should be removed first and the transition installation completed. Next, the upstream plug should be removed and the transition installation completed. Finally, the stream flow should be diverted into the stream diversion channel using an upstream flow barrier as specified in the plans and in such a manner to minimize sediment delivery into the stream. Allow time

for the stream to drain so that aquatic organisms have an opportunity to move or migrate downstream. The downstream flow barrier, if required, can then be installed so that work can commence for the installation of the permanent structure.

Construction Verification

Check finished grades and cross sections throughout the length of the stream diversion channel.

Verify the stream diversion channel cross section dimensions at several locations to confirm plan specifications.

Common Problems

Consult with a qualified design professional if any of the following occur:

- The topography of the site does not allow the practice to function as intended and changes in the plan are needed.
- The design specifications for materials cannot be met and substitutions may be necessary. Unapproved substitutions could result in an unstable diversion channel.

Maintenance

Inspect the stream diversion channel at regular intervals and especially after storm events, check for lining displacement, erosion of the lining, and erosion at the transition areas.

Repair damaged lining and erosion promptly.

Once the permanent structure has been completed, flow can be diverted into the new conveyance structure and the stream diversion channel decommissioned. The decommissioning should occur in such a manner to minimize erosion and sediment runoff into the stream system. Lining materials should be recycled or disposed of properly.

Streambank Protection (SP)

Practice Description

Streambank protection is the stabilization of the side slopes of a stream. Streambank protection can be vegetative, structural or a combined method (bioengineering) where live plant material is incorporated into a structure. Vegetative protection is the least costly and the most compatible with natural stream characteristics. Additional protection is required when hydrologic conditions have been greatly altered and stream velocities are excessively high. Streambank protection is often necessary in areas where development has occurred in the upstream watershed and full channel flow occurs several times a year.

Typical Components of the Practice

- Vegetative Measures
  - Scheduling
  - Site Preparation
  - Installation
  - Erosion Control
  - Safety
  - Inspection

- Structural Measures
  - Scheduling
  - Site Preparation
  - Installation
  - Construction Verification

Vegetative Measures – Installation

Prior to start of construction, streambank protection, for each unique channel reach, should be designed by a qualified design professional and/or an interdisciplinary team. Plans and specifications should be referred to by field personnel throughout the construction process.

Scheduling

Schedule installation during a period that includes the planting season or establishment period for the species that is to be established. In addition, use local weather forecasts to avoid installation during rain events that can potentially create wetness and flooding.

Site Preparation

Follow all local, state and federal government regulations on stream modifications. Determine exact location of all underground activities.

Stabilize the channel bottom as specified in the design plan before streambank protection measures are installed.

Installation

Plant live plant materials, cuttings or other forms of plant materials according to the planting plan.

Erosion Control

Minimize the size of all disturbed areas during site preparation and stabilize as soon as each phase of construction is complete.

Establish vegetation to stabilize all disturbed areas immediately after construction.

Safety

The following precautions should be taken:

- Exercise caution on steep slopes.
- Fence area and post warning signs if trespassing is likely.

- Store equipment, tools and materials well away from the stream during non-work periods. Consider weather forecasts when determining risks of damage to equipment, tools and materials by flooding.

- All equipment used for practice installation should be free of leaks of gas, oil, and hydraulic fluid. Measures should be in place to prevent accidental spills from entering the stream.

- Equipment should not be operated within flowing water in the stream.

Construction Verification

Check to see that planting and seeding was done in compliance with the design specifications.

Structural Measures - Construction

Prior to start of construction, streambank protection, for each unique channel reach, should be designed by a qualified design professional and/or an interdisciplinary team. Plans and specifications should be referred to by field personnel throughout the construction process.

Scheduling

Schedule installation during a period that is least likely to have flooding and that includes the planting season for the species that are to be established in association with the structural measures.

Site Preparation

Follow all local, state and federal government regulations on stream modifications. Determine exact location of all underground activities.

Stabilize the channel bottom as specified in the design plan before streambank protection measures are installed.

Remove brush and trees only if absolutely necessary to make the site suitable to install the planned measures.

Grade or excavate the areas specified in the design plan, but limit earthmoving to that absolutely necessary to make the site suitable to install the planned measures.

Installation

Riprap

Install riprap of the specified gradation to the lines and grades shown in the design plan. Installation usually includes some bank shaping.

Place geotextile fabric or a granular filter between the riprap and the natural soil and placement of the rock.

Ensure that the subgrade for the filter and riprap follows the required lines and grades shown in the plan. Low areas in the subgrade on undisturbed soil may also be filled by increasing the riprap thickness.

Riprap may be placed by equipment. Care should be taken to avoid punching or tearing of the geotextile fabric cloth during placement of rock. Repair any damage by removing the riprap and placing another piece of filter cloth over the damaged area. All connecting joints should overlap a minimum of 1.5 feet with the upstream edge over the downstream edge. If the damage is extensive, replace the entire geotextile fabric.

Gabions

Install gabions and related materials in accordance with the design plan. Use only durable crushed limestone, dolomite or granite rock. Shale, siltstone and weathered limestone should not be used.

Place geotextile fabric or a granular filter between streambank material and gabions. Install gabions and counterforts as indicated in the design plan.

Fabric Formed Revetments

Install revetments according to manufacturer's recommendations. Typically, a site must be cleared and grubbed. Next, the fabric formed revetments are sewn or zipped together at the site to form continuous coverage. Once the fabric is in place, it is pumped full of grout to form a solid, hard and impervious cover.

Reinforced Concrete

Install reinforced concrete according to the design plan. Installation usually includes some bank shaping, placing a filter fabric or a granular filter between the streambank material and the retaining wall or bulkhead, and anchoring.

Anchor the foundation for these structures to a stable, nonerodible base material such as bedrock. Also, water stops should be installed at all joints in concrete retaining walls.

Combined Methods of Streambank Protection (Soil Bioengineering)

Grid pavers, cellular confinement matrices and other appropriate structural measures used with vegetative measures should be designed and installed in accordance with manufacturer's recommendations.

Erosion Control within Soil Bioengineering Applications

Minimize the size of all disturbed areas.

Install vegetative material (stakes, wattles, etc.) according to the design plan and make seedings immediately after construction activities to stabilize all other disturbed areas needing vegetation.

Safety

Store all construction materials well away from the stream. Consider weather forecasts when determining risks of damage by flooding.

At the completion of each workday, move all construction equipment out of and away from the stream to prevent damage to equipment by flooding. Consider weather forecasts when determining risks of flooding.

The following precautions should be taken:

Exercise caution on steep slopes.

Fence area and post warning signs if trespassing is likely.

All equipment used for practice installation should be free of leaks of gas, oil, and hydraulic fluid. Measures should be in place to prevent accidental spills from entering the stream.

Equipment should not be operated within flowing water in the stream.

Construction Verification

Check cross section of the channel, thickness of structural product used and confirm the presence of filter cloth between the product and the streambank.

Check to see that planting and seeding was done in compliance with the design specifications.

Common Problems

Consult with a qualified design professional if any of the following occur:

- Variations in topography on site indicate practice will not function as intended; changes in plan may be needed.
- Design specifications for vegetative or structural protection cannot be met; substitution may be required. Unapproved substitutions could result in erosion damage to the streambank.

Maintenance

Check the streambank for rill and gully erosion after every storm event.

Repair eroded areas with appropriate plantings, structural materials or new plants.
Check the streambank for signs of voids beneath gabions, riprap and concrete. Deterioration of the filter fabric or granular material should be repaired - make needed repairs with similar material.

Protect new plantings from livestock.

Check the streambank for reduction in stream capacity; caused by overgrowth of vegetation on the streambank. Selectively remove overgrown vegetation at regular intervals to maintain capacity and to maintain desired plant communities.

Temporary Stream Crossing (TSC)

Photo courtesy of Steve Taylor, Auburn University Biosystems Engineering

Practice Description

A temporary stream crossing is a short term road crossing constructed over a stream for use by construction traffic to prevent turbidity and streambed disturbance caused by traffic. A temporary stream crossing can be a low water crossing, a culvert crossing, or a bridge with or without embankment approaches. Temporary stream crossings are applicable on construction sites where traffic must cross streams during construction.

Typical Components of the Practice

- Scheduling
- Site Preparation
- Installation and Removal Low Water Crossing
- Culvert Crossing
- Bridge
- Erosion Control
- Safety
- Construction Verification

Construction

Prior to start of construction, a temporary stream crossing should be designed by a qualified design professional. Plans and specifications should be referred to by field personnel throughout the construction process.

Scheduling

Attempt to construct temporary stream crossings during dry periods and relatively low flows to minimize stream disturbance. Use local weather forecasts to avoid installation during rain events that can potentially create turbidity.

Site Preparation

Ensure that all necessary materials are on the site before any work begins. If planned, construct a bypass channel and dewater the construction site before undertaking other work. Refer to plans.

Installation and Removal Low Water Crossing

Excavate the foundation for the temporary crossing according to the design plan and in such a manner that the final finished surface is level with the stream bed.

Excavate roadways through the abutment approaches (bank) to the crossing according to the design plan.

Place the specified type of geotextile over the width and length of the crossing subgrade and anchor it in place as specified in the plans. Next, place riprap of the specified gradation to the required thickness across the channel. Finally, place a wearing course of gravel or crushed rock of the specified gradation to the required thickness over the riprap.

Remove gravel and excess rock riprap as soon as it is no longer needed. Restore original contours to the channel, leaving rock riprap level with the streambed.

Culvert Crossing

After diverting the stream flow (if planned), excavate the foundation for the culvert. Situate the culvert on a firm, even foundation and keep the culvert parallel to the direction of flow. See Figure TSC-1.

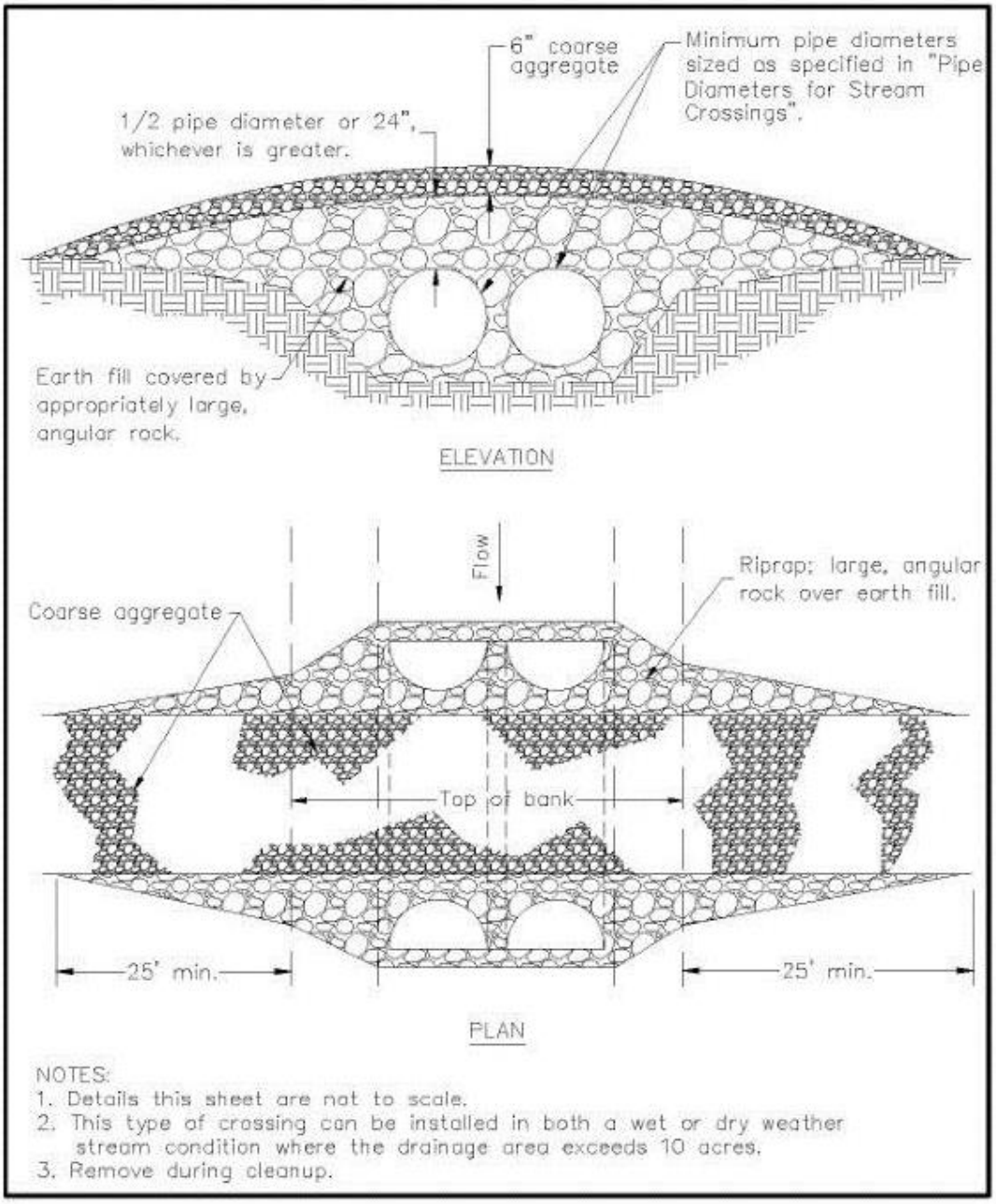

Figure TSC-1 Typical Temporary Culvert Stream Crossing

Place a 4" layer of moist, clayey, workable soil (not pervious material such as sand, gravel or silt) around the culvert. Compact by hand to at least the density of the embankment soil. (Do not raise the culvert from the foundation when compacting under the culvert haunches.) Continue with backfill of the pipe in 4" to 6" uncompacted layers scarifying the surface between each compacted layer. All backfill material within 2 foot of the pipe (beside the pipe and above the pipe) should be compacted with hand tampers only.

Extend the end of the culvert 2 feet beyond the toe of the fill slope. The outlet end of the culvert should be placed on a stable natural streambed. If this is not possible, install a riprap apron at least 5 feet wide and 10 feet long to a stable grade.

All backfill material within 2 foot of a culvert (beside the pipe and above the pipe) should be compacted with hand tampers only. Heavy equipment should not be allowed on top of the culvert until a minimum of 2 feet of hand compacted material is placed.

If an embankment is required, use fill from predetermined borrow areas. It should be clean, stable mineral soil free of roots, woody vegetation, rocks and other debris. It must be wet enough when placed to form a ball without crumbling yet not so wet that water can be squeezed out. Compact the fill material in 6" to 8" continuous layers over the length of the embankment. One way is by routing construction equipment over the embankment so that each layer is traversed by at least one wheel of the equipment. Construct and compact the culvert-crossing embankment to 10% above the design height to allow for settling.

Remove culvert as soon as it is no longer needed and restore streambed to original contour.

Bridge

Excavation

If excavation is required, excavate roadways through the abutment approaches (bank) according to the design plan.

Construct the bridge or install a prefabricated structure according to the design plan. A cable should be tied to one corner of the bridge frame with the other end fastened to a secure object to prevent flood flows from carrying the bridge downstream.

Embankment

Use fill from predetermined borrow areas. It should be clean, stable mineral soil free of roots, woody vegetation, rocks and other debris and must be wet enough to form a ball without crumbling yet not so wet that water can be squeezed out.

Compact the fill material in 6" to 8" continuous layers over the length of the embankment. One way is by routing construction equipment over the embankment so that each layer is traversed by at least one wheel of the equipment.

Construct and compact the temporary stream crossing embankment to 10% above the design height to allow for settling.

Erosion Control (all kinds of temporary stream crossings)

Minimize the size of all disturbed areas and vegetate as soon as each phase of construction is complete. Riprap or establish vegetation on the slopes of the embankment of the temporary stream crossing. Rip-rap should be placed on the entrance slope of culvert systems according to the design plan.

Direct all overland flow at low velocity to the ditches along the approach roads.

Safety

Store all construction materials well away from the stream. Consider weather forecasts when determining risks of damage by flooding.

Equipment used to construct stream crossings should be free of leaks of fuel and hydraulic fluids to prevent contamination of surface waters. Operation of equipment in the stream should be minimized. At the completion of each workday, move all construction equipment away from the stream to prevent damage to equipment by flooding. Consider weather forecasts when determining risks of flooding.

The following precautions should be taken:

- Exercise caution on steep slopes.
- Fence area and post warning signs if trespassing is likely.
- All equipment used for practice installation should be free of leaks of gas, oil, and hydraulic fluid. Measures should be in place to prevent accidental spills from entering the stream.
- Equipment should not be operated within flowing water in the stream.

Construction Verification

Check finished grade and size of culvert. Check to see if culvert is free of obstructions.

Common Problems

Consult with qualified design professional if any of the following occur:

- Variations in topography on site indicate crossing will not function as intended; changes in plan may be needed.
- Design specifications for fill or conduit cannot be met; substitution may be required. Unapproved substitutions could result in the crossing being washed out.

Maintenance

Inspect the temporary stream crossing for damage to the structure or the vegetation after each storm event.

Repair any damages found during inspections.

Remove debris, trash and other materials that restrict flow from the culvert or bridge.

Chapter 4

Inspection of Construction Sites

This chapter provides information about inspecting erosion control, sediment control and stormwater management practices during the construction period. It covers inspections using visual procedures that can be evaluated by trained individuals. It does not cover inspections that involve water sampling or testing. It does not cover the installation of the practices or measures that may be used for erosion and sediment control and stormwater management.

The information in this chapter should be considered generic with the recognition that state and local regulations may provide very specific requirements related to inspector credentials, frequency of inspections, report format, submission of reports to permitting authorities, and retention of reports.

Requirements for Inspectors

Inspections should be made by persons that understand how practices are to be properly installed, how they should perform, and how practices should be maintained. Inspectors should have enough knowledge about each practice used to determine if it is effective and whether or not it needs maintenance or repair. Inspectors should know enough about the practices to realize that there may need to be an additional practice or a different practice in a problem area. However, changes in the plan are the responsibility of the design professional.

Inspectors do not have to understand how a practice is designed, although the more a person knows about a practice the better the person will understand how the practice should be maintained. Inspectors should also know how to read site plans and understand the relationship of the erosion and sediment control practices and other stormwater management activities with the overall plan.

Inspectors need communications skills so they can explain installation and maintenance problems to the contractor or owner and anyone else that “needs to know”. Also, inspectors must provide written reports to appropriate persons for their information or follow-up actions. Actions may include maintenance, repair or a request for a qualified design professional to assist, or for reporting to meet permit requirements. In summary, both written and verbal communication skills and an understanding of report requirements are essential tools for the inspector.

The credential requirement for inspecting construction sites in Alabama is stated in the NPDES General Permit for Construction administered by the Alabama

Department of Environmental Management. Local government regulations may require that persons providing inspection services have additional credentials or training to be designated as an inspector.

How Often Should Inspections be Made

In general, inspections should be made frequently and after major rain events. Since rainfall triggers inspections on permitted sites, a rain gauge is required.

Practices that can be damaged by construction activities need to be inspected on a regular basis, at least weekly and in some cases daily so the practices will be repaired or maintained and in good condition when a major rain event occurs. During periods of major rain events, practices need inspection daily.

Practices that are not normally affected by construction activities after installation need inspecting after each major rain event and as a minimum on a monthly basis. For vegetative practices, inspections should be made during early growth stages, regardless of rainfall events, to determine if reseeding is needed to ensure an adequate vegetative cover. Newly vegetated areas damaged by rainfall events should be repaired immediately after the area is determined to need repair.

The frequency requirement for inspecting construction sites in Alabama is stated in the NPDES General Permit for Construction administered by the Alabama Department of Environmental Management. Local governments may require inspections more frequently than is required by the State General Permit.

How are Practices Inspected

Visual evaluations are made of practices to determine their condition. Also, discharge points are reviewed to determine if sediment and turbid water are leaving the construction site.

Inspectors must know enough about the practices being inspected to make sound judgments about the need for repairs and maintenance. If there is any doubt about a situation, a more knowledgeable person should be requested to assist in the determination of appropriate actions. A good example of requesting another person for expert guidance is when a permanent seeding appears borderline and there is time to reseed before the recommended planting period ends.

Inspectors and others involved in erosion and sediment control activities must understand that erosion and sediment control plans are dynamic and usually need revising if construction involves more than a large lot and the construction period extends more than a few weeks. Inspectors should be encouraged to ask for assistance of design professionals if there are any reservations that a plan needs modifying.

Suggestions for Inspectors

- Study the erosion and sediment control and stormwater management plan. Identify the practices and schedule. Participate in pre-construction and construction conferences whenever possible.

- Review the site and practices with the plan in hand according to a predetermined schedule and the predetermined triggers.

- Determine if the practices planned are installed properly and in the correct sequence.

- Determine if the practices appear in good condition (Do the practices need maintenance or repair?). This should be an objective comparison of what will be needed when major rain events occur.

- Determine if the system of practices appears to be effective for the construction site by examining discharge points. Evidence of ineffectiveness may be muddy or turbid water leaving the site or sediment deposits in the runoff conveyance system practices such as check dams and channels (swales).

- Determine if practices are effective during or immediately following a rain event. This is the best time to determine the effectiveness of the system and particularly to determine if turbid water is leaving the site.

- Determine if the site is managed to prevent a problem with debris, trash, petroleum products and chemicals (Are Groundskeeping and Spill Prevention practices used or needed?).

- Document relevant site information with photography.

- Complete or draft the appropriate inspection documents while on the site.

Discharge points should be examined objectively to determine if sediment deposits exist at adjacent off-site areas. Deposition of sediment indicates that erosion and sediment control may not be effective. An absence of deposits at discharge points (just below the outfall) where there is an opportunity for sedimentation to occur is a good indicator of an effective system. On the other hand, lack of sediment deposits at a point with high flow velocities will be less meaningful.

Inspections should be documented in a written report, log and/or checklist. Whatever format is used to document the inspection, the report should contain the site name, the date and time of inspection, the inspector and any other persons involved in the inspection, dates when key activities occurred (for example, grading the site and installing practices), comments or ratings concerning the success or failure of the practices, what corrective action(s) may be needed, what

repairs or maintenance was done since the last inspection and verbal communications with the contractor or owner that took place during the inspection. In addition, there may be other items required by the permit holder or contractor.

Photography can be used very effectively to document the findings during an inspection and becomes important in the future as site conditions change and the practice(s) is no longer used or issues arise over the impacts of the site. Developing a comprehensive file of photographs that supports inspections is a sound business!

There is a range of formats used for documenting inspections. Two examples of inspection report forms are provided (see Figure 4-1 and Figure 4-2). Figure 4-1 uses a detailed listing of practices to provide an efficient method for repeating the documentation at a site and may serve as a supplemental sheet to a more formal report form such as Figure 4-2. It is important to recognize that local and state regulations may require a specific inspection form and this must be completed in addition to other formats that are used.

There is usually a permit requirement that a responsible person (representing the permit holder) sign an inspection report to acknowledge that they have been informed and understand what is needed to meet requirements for erosion and sediment control and stormwater management at a specific construction site.

BMP INSPECTION REPORT

Client _____ Project name _____ and Reg. no. _____

Inspected By _____ Date and Time _____ Page __ of __

A. Phase of Development: Initial Site Grading __ Building and Construction __ Punch List __

B. BMPs Applied (check all that apply)	Condition of BMPs (check one) Good	Fair	Poor	Comments
○ Construction Exit	___	___	___	
○ Barrier-Class __ Silt Fence	___	___	___	
○ Check Dams	___	___	___	
○ Diversion	___	___	___	
○ Grass Swale	___	___	___	
○ Inlet Protection	___	___	___	
○ Outlet Protection	___	___	___	
○ Sediment Basin	__	___	___	
○ Temporary Seeding	___	___	___	
○ Permanent Seeding	___	___	___	
○ Groundskeeping	___	___	___	

C. Additional BMPs needed (potential practice and location):

D. Additional Comments:

E. Sampling: Instream sampling necessary to evaluate the effectiveness of BMP implementation based on evaluation of qualified credentialed professional. Yes __ No __

F. Significant rainfall events since last inspection (date and amounts):

G. Inspection report reviewed with responsible owner/operator

Inspector _____ Date _____

Responsible owner/operator _____ Date _____

ADEM NPDES CONSTRUCTION STORMWATER INSPECTION REPORT AND BMP CERTIFICATION

RESPOND WITH "N/A" AS APPROPRIATE. FORMS WITH INCOMPLETE OR INCORRECT ANSWERS, OR MISSING SIGNATURES WILL BE RETURNED AND MAY RESULT IN APPROPRIATE COMPLIANCE ACTION BY THE DEPARTMENT. IF SPACE IS INSUFFICIENT, CONTINUE ON AN ATTACHED SHEET(S) AS NECESSARY. PLEASE TYPE OR PRINT IN INK.

Item I.

Permittee Name:	Facility/Site Name:
Permit Number:	County:
Facility Entrance Latitude & Longitude:	Phone Number:
Facility Street Address or Location Description:	

Item II.

List name of current ultimate receiving water(s) (indicate if through MS4) and the number of disturbed acres which drains through each treatment system or BMP: Add additional sheet(s) if necessary.

Receiving Water	Disturbed Acres	Discharge Point #	Representative Outfall
			☐ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO

Item III.

1. ☐ YES ☐ NO Did discharges of sediment or other pollutants occur from the site? If "Yes", please list a description of the discharge(s) and their location(s):
2. ☐ YES ☐ NO Were BMPs properly implemented and maintained at the time of inspection? If "No", please provide location(s) and descriptions of BMPs that need maintenance:
3. ☐ YES ☐ NO Are BMPs needed in addition to those already present onsite at the time of inspection? If "Yes" please provide a description and location of additional BMPs that are needed:
4. ☐ YES ☐ NO Have any BMPs failed to operate as designed? If "Yes", please provide location(s) and description of BMP(s) that failed:
5. ☐ YES ☐ NO Were there BMPs required by the CBMPP that were not installed or installed in a manner not consistent with the CBMPP? If "Yes", please provide a description and location where the BMPs were not installed or installed incorrectly:

Item IV.

The Permittee shall conduct turbidity monitoring in accordance with Part V of the permit:

1. ☐ YES ☐ NO Is this facility a Priority Construction Site?
2. ☐ YES ☐ NO Has the facility disturbed greater than 10 acres?
3. ☐ YES ☐ NO Was the site discharging at the time of inspection?
4. ☐ YES ☐ NO Samples collected, if "Yes", sampling data must be attached.

Item V.

Weather Conditions:

Discharge Point #	Date, Time, and Location of Samples Collected	Sample Results	Analytical Method(s)

"Based upon the inspection of (date & time) _____ conducted by the QCP, QCI, or a qualified person (list:_____) under the direct supervision of the QCP identified below. The QCI or QCP identified below certifies that effective structural and non-structural BMPs have been fully implemented and regularly maintained to the maximum extent practicable for the prevention and minimization of all sources of pollution in stormwater and authorized related process wastewater runoff, **except for those deficiencies noted above**, in accordance with the facility's CBMPP, good sediment, erosion, and other pollution control practices, and the requirements of the permit. I certify that discharges have been tested or evaluated for the presence of non-stormwater and non-authorized process wastewaters. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I certify that this form has not been altered, and if copied or reproduced, is consistent in format and identical in content to the ADEM approved form. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations."

Name & Designation of QCI or QCP	Signature	Date

Name & Title of Permittee Responsible Official	Signature	Date

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