EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICE MANUAL

WEST VIRGINIA

DEPARTMENT OF ENVIRONMENTAL PROTECTION

DIVISION OF

WATER AND WASTE MANAGEMENT

2006

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CHAPTER 1

INTRODUCTION

CHAPTER 1

INTRODUCTION

Erosion is a natural force without which life could not be supported. Erosion forms the landscape and helps produce the soils that grow our crops. However, major problems can occur when large amounts of sediment enter our waterways. Accelerated erosion comes from man's land-altering activities such as mining, agriculture, construction, urban/suburban stream banks, logging, and oil and gas exploration.

The West Virginia Department of Environmental Protection (WVDEP) Erosion and Sediment Control Best Management Practice Manual addresses erosion and sediment control for earth disturbing activities associated with construction. The manual is designed to assist construction site developers, engineers, designers, and contractors to identify and implement the most appropriate best management practices (BMPs) for construction activities.

The purpose of this manual is to provide standardized and comprehensive erosion and sediment control management practices that can be implemented on construction projects throughout West Virginia. This manual should be used as guidance for developing sediment control plans for the General West Virginia/National Pollution Discharge Elimination System Water Pollution Control Permit for Stormwater Associated with Construction Activities. However, the use of other best management practices manuals may also be acceptable. The goal is to reduce the water quality impacts of land-disturbing activities through design and implementation of effective erosion prevention and sediment control.

West Virginia's original manual was created in 1982. While the principles of erosion prevention and sediment control have changed little, a new manual was needed to cover the advancements of the last 24 years. This manual provides updated information on erosion prevention and sediment control measures, engineering methods, and changes in the law and regulations. It should be used by the regulated community, citizens and municipalities developing their own erosion and sediment control rules and regulations.

REGULATORY REQUIREMENTS

Erosion and sediment control requirements exist at the federal, state and local levels of government. Some city and county governments have adopted site development or sediment control ordinances or regulations, usually through subdivision regulations. Developers and contractors should check with local governments to determine whether ordinances may affect their proposed activities. Over the next several years, many municipalities will be developing their own sediment control requirements to meet the provisions of the Municipal Separate Storm Sewer System (MS4) General Permit.

Federal and State Sediment Control Requirements

Congress amended the Clean Water Act (CWA) in 1987, requiring a two-phase program be implemented to regulate stormwater discharges. The U.S. Environmental Protection Agency (EPA) promulgated the Phase I regulations in 1990, which, among other things, required National Pollutant Discharge Elimination System (NPDES) permit coverage for most stormwater discharges from construction activities. EPA authorized WVDEP to administer the NPDES program in West Virginia. WV DEP issued the first NPDES General Permit for stormwater discharges from construction activities in 1992 and has issued follow up General Permits every five years since that time. In 1999, EPA issued the Phase II regulations requiring NPDES permit coverage for sites with one acre or more of land disturbance. West Virginia's current General WV/NPDES Water Pollution Control Permit for stormwater associated with construction activities covers projects with one acre or more of earth disturbance.

Construction Projects that Need a Permit for Stormwater Discharge

Any land-disturbing activity that will disturb an area of one acre or more is required to be covered under an NPDES permit for its stormwater discharge. In addition, sites that disturb less than one acre that are part of a "common plan of development or sale" may also need to be covered by this permit. A common plan of development is a contiguous construction project where multiple separate and distinct construction activities may be taking place at different times and on different schedules, but under one plan. The "plan" is broadly defined as any announcement, piece of documentation or physical demarcation indicating construction activities may occur on a specific plot; most subdivisions are included in this definition.

Construction of single family residences by the homeowner or homeowner's contractor requiring land disturbances less than three acres in size are provided coverage under the General WV/NPDES Water Pollution Control Permit and do not require application for registration. All other terms and conditions of the General Permit, except for the Notice of Termination requirement, still apply.

State Water Quality Standards

West Virginia has several water quality standards that can address runoff from earth disturbing activities. The first are numerical water quality criteria. These are numerical values set forth in the state of West Virginia's Water Quality Standards [47 CSR 2]. They specify the levels of pollutants allowed in receiving waters that are protective of the stream's designated use. Designated uses can be to protect public water supply, for protection of fish, shellfish, and wildlife, and for recreational, agricultural, industrial, and navigational purposes.

Waste assimilation and transport are not designated uses. Therefore sediment traps and basins cannot be installed in waters of the State. Also, streams cannot be used to transport sediment from a construction site to a sediment trap or basin.

The primary numeric water quality standard addressing earth disturbing activities is turbidity. Other criteria that could be violated by runoff from a construction project include pH and iron.

Turbidity is defined as an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through the sample. It is an indirect measurement of how much suspended material is in a sample of water.

In West Virginia, turbidity in the receiving stream shall not exceed 10 nephlometric turbidity units (NTU) over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase plus 10 NTU in turbidity when the background turbidity is more than 50 NTU. The points of measurement are directly above and below the point of discharge [47 CSR 2-8.32].

There are also narrative water quality criteria, listed as "Conditions Not Allowable in State Waters" [47 CSR 2-3]. Several of these are applicable to earth disturbing activities including the prohibition against the following conditions: distinctly visible floating or settleable solids, suspended solids, scum, foam or oily slicks, deposits or sludge banks. Also the discharge must not contain materials that have taste or color or have materials in concentrations that are harmful, hazardous or toxic to man, animal or aquatic life.

Compliance with Standards

Surface water discharges associated with construction activity are subject to applicable state water quality standards. The Construction Stormwater General Permit does not authorize the violation of those standards. WVDEP expects that the selection and implementation of appropriate BMPs will result in compliance with standards for surface water discharges from construction sites. Proper implementation and maintenance of these controls is critical to adequately control any adverse water quality impacts from construction activity.

Total Maximum Daily Loads (TMDLs)

If construction activities will contribute pollutants for which a specific receiving water is listed as impaired, permittees must comply with Total Maximum Daily Loads (TMDLs) set for the receiving stream. Construction sites may be designated as contributors to the impairment if a stream is listed as impaired because of sediment or iron. Section 303(d) of the CWA established the TMDL process to guide the application of state water quality standards to individual water bodies and watersheds. A TMDL defines the amount of a particular pollutant that a water body can absorb daily without violating applicable water quality standards. Once this load is established, the WVDEP allocates a portion to each source of that pollutant within a particular watershed. In the case of construction activities within an impaired watershed, the WVDEP may require the permittee to implement more stringent BMPs, apply for an individual NPDES permit, or take other necessary actions to ensure compliance with TMDL discharge requirements. To find out if there are additional TMDL-related requirements for your project, please contact the WVDEP Stormwater Program.

Local Ordinances

Local regulations, such as zoning and subdivision ordinances, may also regulate construction activities in West Virginia. Numerous cities have subdivision requirements. Some counties and most larger cities have some sort of zoning regulations. Check the phone book under county and city for "Planning Commission". If there is no Planning Commission, contact the city government and county commissions.

Each county and city in the state is required to have a floodplain ordinance in order for residents to qualify for flood insurance. The local governmental authority in charge of the program regulates projects that physically alter land within the 100-year flood zone. When there is a Planning Commission in a county, it is usually their responsibility to manage and enforce the regulations. In other counties the applicant should contact the County Commission.

Endangered Species Act

If a construction project discharges to a receiving water where a federally endangered or threatened species or its habitat is present, potential impacts to that species need to be considered. For information on Endangered Species Act implementation in West Virginia and developing project-specific compliance strategies contact the U. S Fish and Wildlife Service in Elkins at:

U.S. Fish and Wildlife Service
West Virginia Field Office
P.O. Box 1278
Elkins, WV 26241
304-636-6586

Appendix B lists water bodies where Endangered Species may be found.

Permits for In-Stream Construction and Wetland Filling

Developers proposing to conduct construction activities in waterways, including jurisdictional wetlands, may be required to obtain permits from the US Army Corps of Engineers (USACE) and/or the West Virginia Division of Natural Resources (DNR) Office of Land and Streams, as well as WVDEP depending on the project scope and location.

DNR Stream Activity Application

The Office of Land and Streams holds the title to the "waters of the state". Waters of the state "… means any and all water on or beneath the surface of the ground, whether percolating, standing, diffused or flowing, wholly or partially within this state, or bordering this state and within its jurisdiction, and includes without limiting the generality of the foregoing, natural or artificial lakes, rivers, streams, creeks, branches, brooks, ponds (except farm ponds, industrial settling basins and ponds and water treatment facilities), impounding reservoirs, springs, wells, watercourses and wetlands" [22 CSR 12-3].

A DNR Stream Activity Application is required for construction activities that occur within the normal high water mark of a stream in West Virginia. Information on this program and application forms made be obtained at:

Office of Land and Streams
Building 3, Room 643
1900 Kanawha E
Charleston, WV 25305
304-558-3225
http://www.wvdnr.gov/REM/PLC.shtm

Federal Permits

The USACE administers Section 404 of the Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act of 1899. Under these jurisdictions, the USACE have issued a number of general Nationwide Permits for certain activities or similar types of activities that have a minimal impact on navigable waters (Section 10 permits) or waters of the U.S. (Section 404 permits). For activities not covered under a Nationwide Permit, the developer will need to apply for an Individual Permit.

Section 404 of the CWA establishes a program to regulate the discharge of dredged or fill material into waters of the U.S, including jurisdictional wetlands. Construction activities covered under this program include fill for commercial site development, subdivisions and infrastructure development (such as highways, airports and utility lines).

The USACE conducts and verifies wetland determinations and has the final say on jurisdiction. The USACE also develops policy and guidance on stream and wetland issues and enforces Section 404 permits and provisions.

The ACE District offices are located in Pittsburgh and Huntington.

HUNTINGTON DISTRICT
Regulatory Branch Chief
U.S. Army Corps of Engineers,
Huntington District
502 Eighth Street
Huntington, West Virginia 25701-2070
Phone: 304-399-5710

PITTSBURGH DISTRICT
Regulatory Branch Chief
U.S. Army Corps of Engineers,
Pittsburgh District
William S. Moorhead Federal Building
1000 Liberty Avenue
Pittsburgh, Pennsylvania 15222-4186
Phone: 412-395-7152

401 Water Quality Certification

Section 401 Water Quality Certification is required for each permit or license issued by a federal agency to ensure that proposed projects will not violate the state's water quality standards or stream designated uses. States are authorized to issue Certification under Section 401 of the CWA.

The majority of certification requests are for dredge and fill operations regulated by the US Army Corps of Engineers. The US Coast Guard issues permits for bridge construction on navigable waterways. The Federal Energy Regulatory Commission is responsible for licenses related to hydropower facilities. Applicants must receive State 401 Water Quality Certification before they can receive a permit from the federal agency.

The DWWM may grant, grant with conditions, waive, or deny 401 Water Quality Certification. The decision to issue certification is based on project compliance with West Virginia Water Quality Standards. Field support for the 401 program is provided by the DNR’s Wildlife Resources Section.

Information on this program and application forms made be obtained at:

401 Certification Program
Division of Water and Waste Management
601 57th Street, SE
Charleston, WV 25304
(304) 926-0495

ACKNOWLEDGEMENTS

Development of this manual was begun in the mid-1990s and the current document has survived numerous staffing changes, agency and program reorganizations, and multiple edits and revisions. As such, it has become almost impossible to identify all who may have contributed to the manual and the exact sources of some of the information. We have attempted in the final edit to eliminate any information that could not be properly documented. The State Conservation Agency coordinated a multi-agency committee that established much of the early work on this manual. Several WVDEP staff contributed to the manual. The draft document was completed under a contract with Parsons Brinckerhoff Quade & Douglas, funded by a federal Clean Water Act grant from the US Environmental Protection Agency to the WV DEP DWWM. Final editing was completed by WVDEP Stormwater Program staff.

Technical sources:

Technical sources are noted in the document.

Corrections

Any errors or omissions are the responsibility of the WVDEP. Please report any errors or omissions to the WVDEP DWWM for correction.

Future updates

Modifications to the handbook will be necessary from time to time. The handbook has been designed to be a living document and will be updated as new information or revisions are obtained.

CHAPTER 2

HOW TO PREPARE A SEDIMENT CONTROL PLAN

How to Prepare a Sediment Control Plan

This chapter provides an overview of the important components of, and the process for, developing and implementing the sediment control plan (SCP) component of the construction stormwater pollution prevention plan (SWPPP).

Section 1 contains general guidelines with which site planners should become familiar. It describes criteria for plan format and content and ideas for improved plan effectiveness.

Section 2 outlines and describes a recommended step-by-step procedure for developing a SCP from data collection to finished product. This procedure is written in general terms to be applicable to all types of projects.

Section 3 includes a checklist for developing a SCP.

Design standards and specifications for best management practices (BMPs) referred to in this chapter are found in Chapter 3.

The SCP and SWPPP are separate stand-alone documents but should be integrated into the overall construction plan set.

Section 1

General Guidelines

What is a construction stormwater pollution prevention plan and how is it different from a sediment control plan?

The **construction stormwater pollution prevention plan** (SWPPP) is the overall document that describes the potential for pollution problems on a construction project and explains and illustrates the measures to be taken to control those problems.

A **sediment control plan** (SCP) is the document that deals exclusively with controlling erosion and sediment during the construction phase.

The SWPPP consists of several components including: the SCP, one or two groundwater protection plans, a stormwater management plan (if necessary) and a plan to control other pollutants. This manual provides practices and procedures necessary to develop a SCP.

The DEP reviews the Construction SWPPPs for compliance and adequacy in controlling erosion and sediment and other pollutants during construction. Single-family home construction projects may use the generic individual house sediment control plan.

The construction SWPPP is a separate and complete document. However, the appropriate sections (SCP in particular) should be incorporated into the contract drawings and documents. The construction SWPPP and site registration application must be located on the construction site for examination by DEP inspection personnel. As site work progresses, the plan must be modified to reflect changing site conditions that affect sediment and erosion control practices. These changes are subject to the permit modification procedures for the state.

What is in a sediment control plan?

The SCP for projects that disturb more than one acre must contain sufficient information to satisfy the state that the pollution problems have been adequately addressed for the proposed project. An adequate SCP includes both a narrative and drawings. The narrative is a written statement to explain the pollution prevention decisions made for a particular project. The narrative contains information about existing site conditions, proposed site conditions, construction schedules and sequence of events, design and calculations and other pertinent items. The drawings and notes describe where and when the various BMPs should be installed and the construction drawings and details of each practice mentioned in the narrative.

On construction sites the primary concern in the preparation of the SCP is impacts to surface water and groundwater. Each of the elements found in the following section should be included in the SCP unless an element is determined not to be applicable to the project.

Best management practice guidelines and specifications

Chapter 3 contains guidelines and specifications for the BMPs referred to in this chapter.

The guidelines and specifications in Chapter 3 of this volume are not intended to limit any innovative or creative effort to effectively control erosion and sedimentation. In those instances where appropriate BMPs are not in this chapter, experimental practices can be considered. Some modifications to guideline practices may also be employed. However, the DEP must approve

such practices before they may be used. All experimental practices and modified guideline practices are required to achieve the same or better performance of the BMPs listed in Chapter 3.

General principles

The following general principles should be applied to the development of the SCP:

• The duff layer, native topsoil, and natural vegetation should be retained in an undisturbed state to the maximum extent practicable.

• Prevent pollutant release. Select source control BMPs as a first line of defense. Erosion prevention can be easier than treating turbid runoff.

• Select BMPs depending on site characteristics (topography, drainage, soil type, ground cover, and critical areas) and the construction plan.

• Divert runoff away from exposed areas wherever possible. Keep clean water clean.

• Limit the extent of clearing operations and phase construction operations.

• If topsoil is not available, amend all soils with appropriate lime and fertilizer prior to seeding.

• Maintain and protect natural drainage features whenever possible.

• Minimize slope length and steepness.

• Control water through the use of diversions and slope drains.

• Reduce runoff velocities to prevent channel erosion.

• Prevent the tracking of sediment offsite.

• Control pollutants other than sediment.

• Anticipate rain. View the project controls as if there will be a significant rain event at some point during construction. Determine where runoff will drain to at each stage of the project and make sure there will be an appropriate sediment control device there to intercept it.

• Remember that the ground won't dry out as fast during the winter as it does in the summer.

• Be realistic about the limitations of controls that you specify and the operation and maintenance of those controls. Anticipate what can go wrong, how you can prevent it from happening, and what will need to be done to fix it.

Section 2
Step-By-Step Procedures

There are three basic steps in producing a sediment control plan:

Step 1 - Data collection

Step 2 - Data analysis

Step 3 - SCP development and implementation

Steps 1 and 2 described below are intended for projects that disturb one acre or more. Single-family home construction projects that are part of common plan of development or sale may use the simpler generic individual house sediment control plan.

Step 1 - Data collection

Evaluate existing site conditions and gather information that will help develop the most effective SCP. The information gathered should be explained in the narrative and shown on the drawings.

• Topography - Prepare a topographic drawing of the site to show the existing contour elevations at intervals of at most five feet depending upon the slope of the terrain.

• Drainage - Locate and clearly mark existing drainage swales and patterns on the drawing, including existing storm drainpipe systems.

• Soils - Identify and label soil type(s) and erodibility (low, medium, high, or an index value from the NRCS manual) on the drawing. Soils information can be obtained from a soil survey if one has been published for the county. If a soil survey is not available, a request can be made to a local Natural Resource Conservation Service office.

Soils must be characterized for permeability, percent organic matter, and effective depth by a qualified soil professional or engineer. These qualities should be expressed in averaged or nominal terms for the subject site or project.

• Ground cover - Label existing vegetation on the drawing. Such features as tree clusters, grassy areas, and unique or sensitive vegetation should be shown. Unique vegetation may include existing trees above a given diameter. Local requirements regarding tree preservation should be investigated. In addition, existing denuded or exposed soil areas should be indicated.

• Critical areas - Delineate critical areas adjacent to or within the site on the drawing. Such features as steep slopes, streams, floodplains, lakes, and wetlands should be shown. Delineate setbacks and buffer limits for these features on the drawings. Other related jurisdictional boundaries such as the Federal Emergency Management Agency (FEMA) base floodplain should also be shown on the drawings.

• Adjacent areas - Identify existing buildings, roads, and facilities adjacent to or within the project site on the drawings. Identify existing and proposed utility locations, construction clearing limits, and erosion and sediment control BMPs on the drawings.

• Existing encumbrances - Identify wells, existing and abandoned septic drain fields, utilities, easements, and site constraints.

• Precipitation records - Determine the average monthly rainfall and rainfall intensity for the required design storm events.

Step 2 - Data analysis

Consider the data collected in Step 1 to visualize potential problems and limitations of the site. Determine those areas that have critical erosion hazards. The following are some important factors to consider in data analysis:

• Topography - The primary topographic considerations are slope steepness and slope length. The longer and steeper the slope, the greater the erosion potential.

• Drainage - Natural drainage patterns should be maintained as much as possible in the developed site. Care should also be taken to ensure that increased runoff from the site will not erode or flood the existing natural drainage system. Possible sites for temporary surface water retention and detention should be considered at this point.

Direct construction away from areas of saturated soil - areas where ground water may be encountered - and critical areas where drainage will concentrate. Preserve natural drainage patterns on the site.

• Soils - Evaluate soil properties such as surface and subsurface runoff characteristics, depth to impermeable layer, depth to seasonal ground water table, permeability, shrink-swell potential, texture, settleability, and erodibility. Develop the SCP based on known soil characteristics.

• Ground cover – Preserving ground cover is the most important factor in terms of preventing erosion. Existing vegetation that can be saved will prevent erosion better than constructed BMPs. Trees and other vegetation protect the soil structure. If the existing vegetation cannot be saved, consider such practices as phasing construction, temporary seeding, and mulching. Phasing of construction involves stabilizing one part of the site before disturbing another. In this way, the entire site is not disturbed at once.

• Critical areas - Critical areas may include flood hazard areas, mine hazard areas, slide prone areas, sole source aquifers, wetlands, stream banks, streams, and other water bodies. Any critical areas within or adjacent to the development should exert a strong influence on land development decisions. Critical areas and their buffers shall be delineated on the drawings and clearly flagged in the field. Orange plastic fencing may be more useful than flagging to assure that equipment operators stay out of critical areas. Only unavoidable work should take place within critical areas and their buffers. Such unavoidable work may require special BMPs, permit restrictions, and mitigation plans.

• Adjacent areas - An analysis of adjacent properties should focus on areas upslope and down slope from the construction project. Waterbodies that will receive direct runoff from the site are a major concern. The types, values, and sensitivities of and risks to downstream resources, such as private property, surface water facilities, public infrastructure, or aquatic systems, should be evaluated. Care must be taken where upslope diversions will exit the property.

Erosion and sediment controls should be selected accordingly.

• Timing of the project - An important consideration in selecting BMPs is the timing and duration of the project. Projects that will proceed during the winter or that will last through several seasons must take precautions to remain in compliance with the SWPPP and General Permit. Requirements for some practices, especially seeding and mulching, can change according to the season they are implemented.

Step 3 - SCP development and implementation

After collecting and analyzing the data to determine the site limitations, the planner can then develop a SCP. Each of the 12 elements below must be considered and included in the SCP unless site conditions render the element unnecessary.

12 Basic Sediment Control Plan Elements

Element #1: Mark clearing limits

• Prior to beginning land disturbing activities, clearly mark all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area. These shall be clearly marked, both in the field and on the plans, to prevent damage and offsite impacts.

• Plastic, metal, or stake wire fence may be used to mark the clearing limits.

• Suggested BMPs:

- Preserving natural vegetation
- Buffer zones
- Safety fence

Element #2: Establish construction access

• Construction vehicle access and exit should be limited to one route if possible.

• Access points shall be stabilized with crushed aggregate to minimize the tracking of sediment onto public and private roads.

• Wheel wash or tire baths should be located on site, if applicable.

• No sediment tracking on the roadway is allowed. In the event that sediment is inadvertently tracked onto the road, the road shall be cleaned thoroughly by the end of each day. Sediment shall be removed from roads by shoveling or pickup sweeping and shall be transported to a controlled sediment disposal area. Street washing of sediments to the storm drain system is not allowed. If street wash wastewater can be controlled from entering the storm drainage system, then it shall be pumped back onto the site, contained, and disposed of properly.

• Construction access restoration shall be equal to or better than the pre-construction condition.

• Suggested BMPs:

- Stabilized construction entrance
- Construction road/parking area stabilization

Element #3: Install sediment controls

• The duff layer, native topsoil, and natural vegetation shall be retained in an undisturbed state to the maximum extent practicable.

• Prior to leaving a construction site, surface water runoff from disturbed areas shall pass through a sediment basin/trap or other appropriate and approved sediment removal BMP.

• BMPs intended to trap sediment on site shall be constructed as one of the first steps in grading. These BMPs shall be functional before other land disturbing activities take place.

• Earthen structures such as dams, dikes, and diversions shall be seeded and mulched according to the timing indicated in Element #5.

• Suggested BMPs:

- Sediment trap
- Temporary sediment basin
- Silt fence
- Super silt fence

- ī Drop inlet protection
- ī Vegetated strip
- ī Wattles

Element #4: Stabilize soils

• Exposed and unworked soils shall be stabilized by application of effective BMPs that protect the soil from the erosive forces of raindrops, flowing water, and wind. The General Permit requires that all graded areas that are at final grade must be seeded and mulched within 7 days and areas that will not be worked again for 21 days or more must be seeded and mulched within 7 days.

• Applicable practices include, but are not limited to, temporary and permanent seeding, sodding, mulching, erosion control fabrics and matting, soil application of polyacrylamide (PAM), the early application of gravel base on areas to be paved, and dust control.

• Selected soil stabilization measures shall be appropriate for the time of year, site conditions, and estimated duration of use.

• Soil stockpiles must be stabilized and protected with sediment trapping measures.

• Linear construction activities such as right-of-way and easement clearing, roadway development, pipelines, and trenching for utilities, shall be conducted to meet the soil stabilization timeframe requirements. Contractors shall install the bedding materials, roadbeds, structures, pipelines, or utilities and re-stabilize the disturbed soils so that the 7-day requirements are met:

• Suggested BMPs:

- _Temporary seeding
- _Permanent seeding
- _Mulching
- _Rolled erosion control products
- _Sodding
- _Topsoiling
- _Polyacrylamide for soil erosion protection
- _Surface roughening
- _Surface water control
- _Dust control

Element #5: Protect slopes

• The General Permit prohibits upslope runoff from flowing down fill slopes. Contain fill runoff with temporary berms and in pipes, slope drains, or stabilized channels.

• Design, construct, and phase cut and fill slopes in a manner that will minimize erosion.

• Consider soil type and its potential for erosion.

• Reduce slope runoff velocities by reducing continuous length of slope with benches and diversions, reduce slope steepness, and roughen slope surface.

• Divert upslope drainage and run-on waters with interceptors at top of slope. Surface water from offsite should be handled separately from surface water generated on the site. Diversion of offsite surface water around the site may be a viable option. Diverted flows must be redirected to the natural drainage location at or before the property boundary.

• Provide drainage to remove ground water intersecting the slope surface of exposed soil areas.

• Excavated material shall be placed on the uphill side of trenches, consistent with safety and space considerations.

• Stabilize soils on slopes, as specified in Element #4.

• Suggested BMPs:

_Temporary seeding
_Permanent seeding
_Surface roughening
_Temporary diversions
_Temporary berms
_Pipe slope drains
_Level lip spreader
_Rock check dams
_Commercial check dams

Element #6: Protect drain inlets

• Storm drain inlets operable during construction shall be protected so that surface water runoff does not enter the conveyance system without first being filtered or treated to remove sediment.

• Approach roads shall be kept clean.

• Inlets should be inspected weekly at a minimum and daily during storm events. Inlet protection devices should be cleaned or removed and replaced before six inches of sediment can accumulate.

• Suggested BMPs:

_Drop inlet protection

Element #7: Convey stormwater in a non-erosive manner

• Points of discharge and receiving streams shall be protected from erosion due to increases in the volume, velocity, and peak flow rate of surface water runoff from the project site.

• Design and stabilize any stormwater conveyance for expected flows.

• Consider any local government requirements for stormwater management.

• Suggested BMPs:

ī Outlet protection

_Level lip spreader

_Riprap

_Rock check dams

_Surface water controls

_Rolled erosion control products

Element #8: Control other pollutants

• All pollutants, including waste materials and demolition debris, that occur on site during construction shall be handled and disposed of in a manner that does not cause contamination of surface water. Woody debris may be chopped and spread on site.

• Cover, containment, and protection from vandalism shall be provided for all chemicals, liquid products, petroleum products, and non-inert wastes present on the site.

• Maintenance and repair of heavy equipment and vehicles involving oil changes, hydraulic system drain down, solvent and de-greasing cleaning operations, fuel tank drain down and removal, and other activities which may result in discharge or spillage of pollutants to the ground or into surface water runoff must be conducted using spill prevention measures, such as drip pans. Contaminated surfaces shall be cleaned immediately following any discharge or spill incident. Emergency repairs may be performed on-site using temporary plastic placed beneath and, if raining, over the vehicle.

• Wheel wash or tire bath wastewater shall be discharged to a separate on-site treatment system or to the sanitary sewer.

• Application of agricultural chemicals including fertilizers and pesticides shall be conducted in a manner and at application rates that will not result in loss of chemical to surface water runoff. Manufacturers' recommendations for application rates and procedures shall be followed.

• BMPs shall be used to prevent or treat contamination of surface water runoff by pH modifying sources. These sources include bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, and concrete pumping and mixer washout waters.

Element #9: Control dewatering

• Foundation, vault, and trench dewatering water shall be discharged into a controlled conveyance system prior to discharge to a sediment pond. Channels must be stabilized, as specified in Element #8.

• Clean, non-turbid dewatering water, such as well-point ground water, can be discharged to systems tributary to state surface waters, as specified in Element #7, provided the dewatering flow does not cause erosion or flooding of receiving waters. These clean waters should not be routed through surface water sediment ponds.

• Highly turbid or contaminated dewatering water from construction equipment operation, work inside a cofferdam shall be handled separately from surface water.

• Other disposal options, depending on site constraints, may include:

1. Infiltration;
2. Transport off-site in vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters;
3. On-site treatment using chemical treatment or other suitable treatment technologies;
4. Sanitary sewer discharge with local sewer utility approval; or
5. Use of a dewatering bag with outfall to a ditch or swale for small volumes of localized dewatering.

Element #10: Maintain BMPs

• Temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure continued performance of their intended function. Maintenance and repair shall be conducted in accordance with BMPs.

• Sediment control BMPs shall be inspected weekly or after each storm of 0.5 inches or more.

• Temporary erosion and sediment control BMPs should be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil resulting from removal of BMPs or vegetation shall be permanently stabilized.

• Maintenance should be included as a separate bid item for each BMP, where applicable.

Element #11: Manage the project

• Phasing of Construction - Development projects shall be phased in order to prevent the transport of sediment from the development site during construction, unless the project engineer can demonstrate that construction phasing is infeasible. Revegetation of exposed areas and maintenance of that vegetation shall be an integral part of the clearing activities for any phase.

Clearing and grading activities for developments shall be permitted only if conducted pursuant to an approved site development plan (e.g., subdivision approval) that establishes areas of clearing, grading, cutting, and filling. When establishing clearing and grading areas, consideration should be given to minimizing removal of existing trees and disturbance and compaction of native soils. Any areas required to preserve critical or sensitive areas, and buffers, shall be delineated on both the plans and the site.

• Coordination with Utilities and Other Contractors - The primary project manager shall evaluate, with input from utilities and other contractors, the surface water management requirements for the entire project, including the utilities, when preparing the SCP.

• Inspection and Monitoring - All BMPs shall be inspected, maintained, and repaired as needed to assure continued performance of their intended function.

Whenever inspection and/or monitoring reveals that the BMPs identified in the SCP are inadequate, the SCP shall be modified, as appropriate, in a timely manner.

• Reporting - Report spillage or discharge of pollutants within 24-hours.

• Equipment Maintenance - Maintenance and repair of heavy equipment and vehicles involving oil changes, hydraulic system drain down, solvent and de-greasing cleaning operations, fuel tank drain down and removal, and other activities which may result in discharge or spillage of pollutants to the ground or into surface water runoff must be conducted using spill prevention measures, such as drip pans. Contaminated surfaces shall be cleaned immediately following any discharge or spill incident. Contaminated soil must be disposed of properly. Emergency repairs may be performed on-site using temporary plastic placed beneath and, if raining, over the vehicle.

• Maintenance of the SCP - The SCP shall be retained on-site. The SCP shall be modified whenever there is a significant change in the design, construction, operation, or maintenance of any BMP. The DEP must be notified of any changes to the Construction SWPP. Depending on the significance of the revision, a permit modification may need to be submitted to the DEP.

Element #12: Stabilization

The construction site should be stabilized as soon as possible after completion. Establishment of final cover must be initiated no later than 7 days after reaching final grade. A Notice of Termination must be filed with the DEP when the site reaches final stabilization. Final stabilization means that all soil-disturbing activities are completed, and that either a permanent vegetative cover with a density of 70% or greater has been established or that the surface has been stabilized by hard cover such as pavement or buildings... It should be noted that the 70% requirement refers to the total area vegetated and not just a percent of the site.

Section 3
Checklists for Sediment Control Plans

The SCP typically consists of two parts: a narrative and the drawings. The following two sections describe in general terms the contents of the narrative and the drawings. For more specific information to comply with the General Permit see the instructions to complete a site Registration application form following this section.

Several checklists are included in this manual that can be used as a quick reference to determine if all the major items are included in the SCP.

Narrative

The following topic headings are guideline to be used when preparing the SCP narrative.

• Project description – Describe the nature and purpose of the construction project. Include the size of the project area, any increase in existing impervious area, the area disturbed, and the volumes of grading cut and fill that are proposed.

• Existing site conditions – Describe the existing topography, vegetation, and drainage. Include a description of any structures or development on the parcel including the area of existing impervious surfaces.

• Adjacent areas – Describe adjacent areas, including streams, lakes, wetlands, residential areas, and roads that might be affected by the construction project. Provide a description of the downstream drainage leading from the site to the receiving body of water.

• Critical areas – Describe areas on or adjacent to the site that are classified as critical areas. Describe special requirements for working near or within these areas.

• Soil – Describe the soils on the site, giving such information as soil names, mapping unit, erodibility, settleability, permeability, depth, texture, and soil structure.

• Potential erosion problem areas – Describe areas on the site that have potential erosion problems.

• Twelve (12) elements – Describe how the SCP addresses each of the 12 required elements. Include the type and location of BMPs used to satisfy the each element. If a sediment basin or trap of the required volume cannot be constructed provide a written justification and explain in detail what other sediment and erosion controls will be used in its place.

• Construction phasing – Describe the construction sequence of events and proposed construction phasing.

• Construction schedule – Provide a relative construction schedule. It is not necessary to provide exact dates but rather describe in relative terms when each construction phase will take place and how and where each planned sediment and erosion control device or practice will be installed.

• Engineering calculations – Attach any calculations made for the design of such items as sediment ponds, diversions, and waterways, as well as calculations for runoff and surface water detention design (if applicable). Engineering calculations for permanent structures must bear the signature and stamp of an Engineer licensed in the State of West Virginia. References shall be provided for all variables used.

Drawings

Because contractors seldom will see the SWPPP, the Contract Drawings should include all of the critical provisions of the SWPPP.

Each set of Contract Drawings should have at a minimum the following information.

• Name of the project and owner, address; Parcel Number or other identifying mark; and scale.

• Vicinity Map – Provide a map locating the site in relation to the surrounding area and roads.

• Number of sheets with index.

• **Site map** – Provide a site map(s) showing the following features. The site map requirements may be met using multiple plan sheets for ease of legibility.

1. Standard notes that summarize the critical portions of the SCP. Notes addressing construction sequencing and scheduling must be included on the drawings.
2. Show project limits.
3. The direction of north in relation to the site.
4. Existing structures and roads, if present.
5. The boundaries of and label the different soil types.
6. Areas of potential erosion problems.
7. Any on-site and adjacent critical areas, their buffers, and FEMA base flood boundaries.
8. Existing contours and drainage basins and the direction of flow for the different drainage areas.
9. Final grade contours and developed condition flow paths and drainage basins.
10. Areas that are to be cleared and graded.
11. Existing unique or valuable vegetation and the vegetation that is to be preserved.
12. Cut and fill slopes indicating top and bottom of slope.
13. Stockpile, waste storage, and vehicle storage/maintenance areas.
14. Total cut and fill quantities and the disposal method and location of excess material. All existing and proposed utilities and any associated easements.
15. Proposed permanent structures including roads and parking areas.

• **Conveyance systems** – Show on the site map(s) the following temporary and permanent onsite and offsite conveyance features:

1. Locations for existing and permanent swales, diversions, or ditches.
2. Drainage pipes, berms, ditches, or diversions associated with erosion and sediment control and surface water management.
3. Temporary and permanent pipe inverts and minimum slopes.
4. Grades, dimensions, and direction of flow in all ditches and swales, culverts, and pipes.
5. Details for bypassing offsite runoff around disturbed areas.
6. Locations and outlets of any dewatering systems.

• **Location of stormwater management structures** – Show on the site map the locations of any stormwater management structures.

• **Erosion and sediment control practices** – Show on the site map the following erosion and sediment control practices:

1. The location of sediment basins/trap(s), pipes and structures.

2. Dimension basin berm widths and inside and outside pond slopes.
3. The trap/pond storage required and the depth, length, and width dimensions.
4. Typical section views through pond and outlet structure.
5. Typical details of riser and other outlet devices.
6. Stabilization technique details for basin inlets and outlets.
7. Temporary and permanent seeding and mulching specifications. Seeding timeframes.
8. Temporary stabilization methods and timeframe for berms, diversions and slopes.
9. Rock specifications and detail for outlet protection, rock check dam, and any other device used.
10. Construction drawings for each sediment and erosion control device used on the project. Include construction specifications for each device used.
11. The construction entrance location and a stabilization detail.

• Other non-traditional practices--Any structural practices used that are not referenced in this manual should be explained and illustrated with detailed drawings.

• Other pollutant BMPs--Indicate on the site map the location of BMPs to be used for the control of pollutants other than sediment.

Construction Sediment Control Plan Checklist

Project Name:_____

Address:_____

Section I – SCP Narrative

1. Project Description

___ A. Total Project Area
___ B. Total proposed impervious area.
___ C. Total proposed area to be disturbed.
___ D. Total volumes of proposed cuts/fill.

2. Existing Site Conditions

___ A. Description of the existing topography.
___ B. Description of the existing vegetation.
___ C. Description of the existing drainage.

3. Adjacent Areas

___ A. Description of adjacent areas which may be affected by site disturbance
- ___ 1. Streams
- ___ 2. Lakes
- ___ 3. Wetlands
- ___ 4. Residential areas
- ___ 5. Roads
- ___ 6. Ditches, pipes, culverts
- ___ 7. Other

___ B. Description of the downstream drainage path leading from the site to the receiving body of water. (Minimum distance of 1/4 mile.)

4. Critical Areas

___ A. Description of critical areas that are on or adjacent to the site.
___ B. Description of special requirements for working in or near critical areas.

5. Soils

___ A. Description of on-site soils.
- ___ 1. Soil name(s)
- ___ 2. Soil mapping unit
- ___ 3. Erodibility
- ___ 4. Settleability
- ___ 5. Permeability
- ___ 6. Depth
- ___ 7. Texture

___ 8. Soil structure

6. Erosion Problem Areas

___ A. Description of potential erosion problems on site.

7. Construction Stormwater Pollution Prevention Elements

___ A. Describe how each of the Construction Stormwater Pollution Prevention Elements has been addressed though the SCP.
___ B. Identify the type and location of BMPs used to satisfy the required element.
___ C. Written justification identifying the reason an element is not applicable to the proposal.

12 Required Elements - Construction Stormwater Pollution Prevention Plan:
___ 1. Mark Clearing Limits
___ 2. Establish Construction Access
___ 3. Install Sediment Controls
___ 4. Stabilize Soils
___ 5. Protect Slopes
___ 6. Protect Drain Inlets
___ 7. Convey stormwater in a non-erosive manner
___ 8. Control Other Pollutants
___ 9. Control Dewatering
___ 10. Maintain BMPs
___ 11. Manage the Project
___12. Stabilization

8. Construction Phasing

___ A. Construction sequence
___ B. Construction phasing (if proposed)

9. Construction Schedule

___ A. Provide a proposed construction schedule.

___ B. Wet Season Construction Activities

___ 1. Proposed wet season construction activities.
___ 2. Proposed wet season construction restraints for environmentally sensitive/critical areas.

11. Engineering Calculations

___ A. Provide Design Calculations.

___ 1. Sediment ponds/traps
___ 2. Diversions
___ 3. Waterways
___ 4. Runoff/stormwater calculations

Section II - Erosion and Sediment Control Plans

1. General

___ A. Vicinity Map
___ B. Address, Parcel # and Street names labels
___ C. Erosion and Sediment Control Notes

2. Site Plan

___ A. Legal description of subject property.
___ B. North Arrow
___ C. Indicate boundaries of existing vegetation, e.g. tree lines, pasture areas, etc.
___ D. Identify and label areas of potential erosion problems.
___ E. Identify any on-site or adjacent critical areas and associated buffers.
___ F. Identify FEMA base flood boundaries
___ G. Show existing and proposed contours.
___ H. Indicate drainage basins and direction of flow for individual drainage areas.
___ I. Label final grade contours and identify developed condition drainage basins.
___ J. Delineate areas that are to be cleared and graded.
___ K. Show all cut and fill slopes indicating top and bottom .

3. Conveyance Systems

___ A. Designate locations for swales, interceptor trenches, or ditches.
___ B. Show all temporary and permanent drainage pipes, ditches, or cut-off trenches required for erosion and sediment control.
___ C. Provide minimum slope and cover for all temporary pipes or call out pipe inverts.
___ D. Show grades, dimensions, and direction of flow in all ditches, swales, culverts and pipes.
___ E. Provide details for bypassing offsite runoff around disturbed areas.
___ F. Indicate locations and outlets of any dewatering systems.

4. Location of Stormwater Management Structures

___ A. Identify location of any stormwater management structures.

5. Erosion and Sediment Control Measures

___ A. Show the locations of sediment trap(s), pond(s), pipes and structures.
___ B. Dimension pond berm widths and inside and outside pond slopes.
___ C. Indicate the trap/pond storage required and the depth, length, and width dimensions.
___ D. Provide typical section views through pond and outlet structure.
___ E. Provide typical details of gravel cone and standpipe, and/or other filtering devices.
___ F. Detail stabilization techniques for outlet/inlet.
___ G. Detail control/restrictor device location and details.
___ H. Specify mulch and/or recommended cover of berms and slopes.
___ I. Provide rock specifications and detail for rock check dam(s), if applicable.
___ J. Specify spacing for rock check dams as required.

___ K. Provide front and side sections of typical rock check dams.
___ L. Indicate the locations and provide details and specifications for silt fabric.
___ M. Locate the construction entrance and provide a detail.

6. Detailed Drawings

___ A. Any structural practices used that are not referenced in the Manual should be explained and illustrated with detailed drawings.

7. Other Pollutant BMPs

___ A. Indicate on the site plan the location of BMPs to be used for the control of pollutants other than sediment, e.g. concrete wash water.

8. Monitoring

___ A. Describe inspection reporting responsibility, documentation, and filing.

CHAPTER 3

STANDARD GUIDELINES AND SPECIFICATIONS

3.01 - PRESERVING EXISTING VEGETATION

Introduction

This practice is to preserve the existing natural vegetation thereby reducing erosion wherever practicable. Limiting the amount of disturbance on a construction site is the single most effective method for reducing erosion. For example, trees can hold up to about 50 percent of all rain that falls during a storm. Up to 20-30 percent of this rain may never reach the ground but is taken up by the tree or evaporates. Raindrop erosion is also prevented. Vegetation cools the ground and reduces soil evaporation. Removing natural vegetation and destroying the existing soil profile is one of the greatest causes of increased runoff and subsequent flooding. In urbanizing areas such as the Eastern Panhandle, preserving existing vegetation can be one the most important practice contributing to clean water.

Natural vegetation should be preserved as much as possible but especially on critical areas such as: steep slopes, areas adjacent to perennial and intermittent watercourses or swales or wetlands, and on building sites in wooded areas.

It doesn't make sense to destroy all the trees in a subdivision and then name one of the new streets Shady Oak Lane.

Design and Installation Specifications

Natural vegetation can be preserved in natural clumps or as individual trees, shrubs and vines.

The preservation of individual plants is more difficult because heavy equipment is generally used to remove unwanted vegetation. The points to remember when attempting to save individual plants are:

- Is the plant worth saving? Consider the location, species, size, age, vigor, and the work involved. Check you're your local government. They may have ordinances to save natural vegetation and trees.

- Fence or clearly mark areas around trees that are to be saved. It is preferable to keep all disturbances away from the trees at least as far out as the drip line. (see drawing)

Plants need protection from three kinds of injuries:

Construction Equipment - This injury can be above or below the ground level. Damage results from scarring, cutting of roots, and

compaction of the soil. Placing a fenced buffer zone around plants to be saved prior to construction can prevent construction equipment injuries.

Grade Changes - Changing the natural ground level will alter grades, which affects the plant's ability to obtain the necessary air, water, and minerals. Minor fills usually do not cause problems although sensitivity between species does vary and should be checked. Trees can tolerate fill of 6 inches or less. For shrubs and other plants, the fill should be less.

When there are major changes in grade, it may become necessary to supply air to the roots of plants. If fill has to be placed over the root system, place a layer of gravel and a tile system over the roots before the fill is made. The tile system should be laid out on the original grade leading from a dry well around the tree trunk. The system should then be covered with small stones to allow air to circulate over the root area.

Lowering the natural ground level can also seriously damage trees and shrubs. The highest percentage of the plant roots are in the upper 12 inches of the soil and cuts of only 2-3 inches can cause serious injury. To protect the roots it may be necessary to terrace the immediate area around the plants to be saved. If roots are exposed, construction of retaining walls may be needed to keep the soil in place. Plants can also be preserved by leaving them on an undisturbed, gently sloping mound. To increase the chances for survival, it is best to limit grade changes and other soil disturbances to areas outside the drip line of the plant.

Excavations - Protect trees and other plants when excavating for drainfields, power, water, and sewer lines. Where possible, the trenches should be routed around trees and large shrubs. When this is not possible, it is best to tunnel under them. This can be done with hand tools or with power augers. If it is not possible to route the trench around plants to be saved, then the following should be observed:

- Cut as few roots as possible. When you have to cut, cut clean. Paint cut root ends with a wood dressing like asphalt base paint.

- Backfill the trench as soon as possible.

- Tunnel beneath root systems as close to the center of the main trunk to preserve the important feeder roots.

Trees damaged or stressed by construction my die slowly or become more susceptible to attack from disease or insects. Failure to properly protect trees may result in expensive removal costs post construction.

Problem trees: The following trees are more susceptible to damage than others: beech, yellow poplar, Dogwood, hickory, birch, some oaks, most maples, and all conifers. These trees do not readily adjust to changes in the immediate environment and special care should be taken to protect these trees.

Maples and willows have water-seeking roots. These can cause trouble in sewer lines and infiltration fields. On the other hand, they thrive in high moisture conditions that other trees would not.

Minimum Tree Protection Measures

Active tree protection shall consist of, at a minimum, establishing a tree protection zone around each tree or grouping of trees by the installation of fencing at the outer edges of the critical root zone. Protecting the roots of a tree is the most important aspect of tree preservation on a construction project. This root zone can extend two to three times the radius of the drip line.

Despite this the tree protection zone is usually placed along the drip line. Some experts recommend a tree protection root zone calculated as one foot to one and half feet of radius for each inch of tree diameter at breast height. While this is a significant amount of space, if the tree is valuable, the root protection zone should extend to the edge all of the roots. If you want to protect the lower branches, the barrier must be just outside the drip line.

Tree protection fencing and tree protection area signs shall be installed prior to any land disturbance activity or building activity. Tree protection fencing should be at least four feet high and should be installed with either sturdy wooden or metal fence posts around the tree protection zone. Tree protection fencing must remain in good condition throughout the development and construction processes and should only be removed after construction has ceased.

Tree roots need oxygen so it is important to limit compaction around trees. If there is ANY disturbance with the root zone, the tree protection area should be mulched with a minimum of three inches and not more than eight inches of organic mulch such as pine straw, wood chips, tree leaves, or compost.

Allow NO storage, NO heavy equipment, NO machinery, NO trenching, NO digging, NO driving, NO lounging of workers in this area. The area within the protection zone must be off limits to ALL activity.

The Engineer or owner may require the installation of additional tree protection measures to insure survivability of conserved trees.

Materials

1. Protective fencing should be installed anytime existing natural vegetation is to be preserved.
2. Protective fencing is designated as the materials used to protect the root zones of trees. Three basic types of protective fencing materials can be used. Type A and Type B are typical applications and shall be installed where damage potential to a tree root system is high, while Type C shall be installed where damage potential is minimal.

3. The specific type of protective fencing for the work shall be as indicated on the Drawings.
4. Type C fencing shall be replaced by Type A or Type B fencing as directed by the Engineer or designated representative if it fails to perform the necessary function.

    a. Type A Chain Link fence (Typical Application-high potential damage)

    Type A protective fencing shall be installed in accordance with the Division of Highways Standard for Chain Link Fence and shall consist of a minimum five-foot high chain link fencing with tubular steel support poles or "T" posts.

    b. Type B Wood Fence (Typical Application-high potential damage)

    Type B protective fencing shall consist of any vertical planking attached to 2x4-inch horizontal stringers that are supported by 2x4-inch intermediate vertical supports and a 4x4-inch at every fourth vertical support.

    c. Type C Other Materials (Minimal potential damage)

    The following materials may be permitted as alternates for limited or temporary applications and where tree damage potential is minimal:

    (1) High visibility plastic construction fencing. The Standard for SAFETY FENCE in this manual can be used for this specification.
    (2) Other approved equivalent restraining material.

    The fencing materials, identified in (1) and (2) above, shall be supported by steel pipe, tee posts, U posts or 2" x 4" timber posts that are a minimum of 5-1/2 feet in height and spaced no more than 8 feet on centers. The fabric shall be secured to post by bands or wire ties.

Maintenance

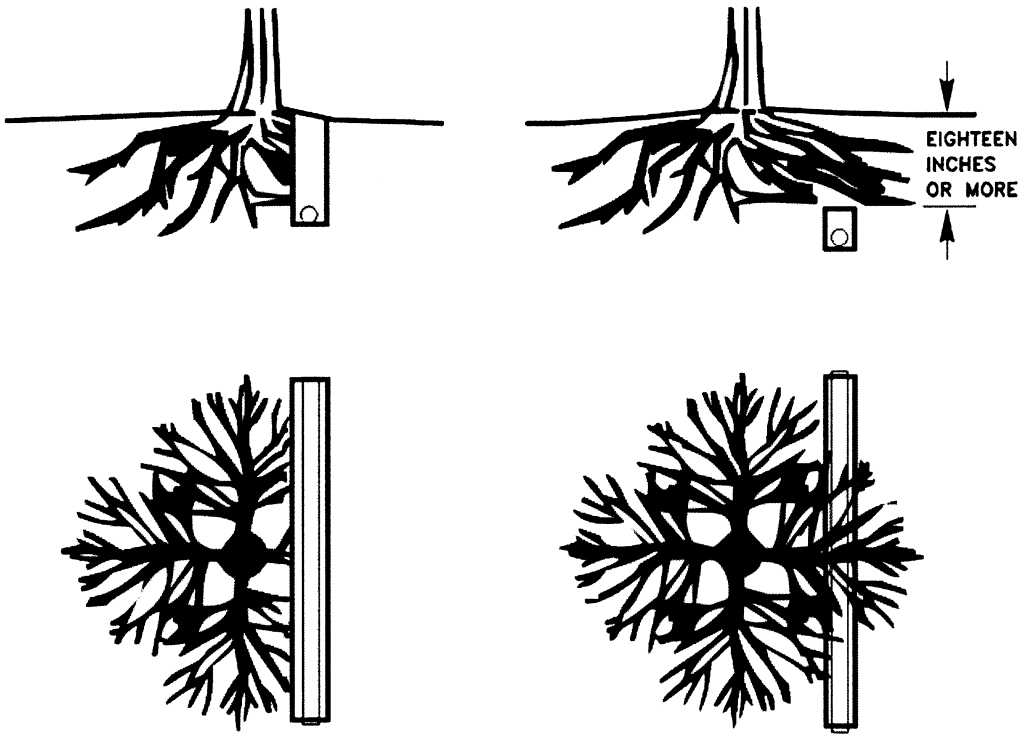
Inspect flagged and/or fenced areas regularly to make sure flagging or fencing has not been removed or damaged. If the flagging or fencing has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.

If tree roots have been exposed or injured, “prune” cleanly with an appropriate pruning saw or loppers directly above the damaged roots and recover with native soils. Treatment of sap flowing trees (pine, soft maples) is not advised as sap forms a natural healing barrier.

FIGURE 3.01.1

PRESERVING NATURAL VEGETATION

TRENCHING VS TUNNELING



DESTRUCTION OF FEEDER ROOTS
WILL PROBABLY KILL THE TREE

TUNNELING UNDER THE TREE WILL
PRESERVE ANY FEEDER ROOTS

SOURCE: US ACOE

FIGURE 3.01.2

TREE PROTECTION ZONES

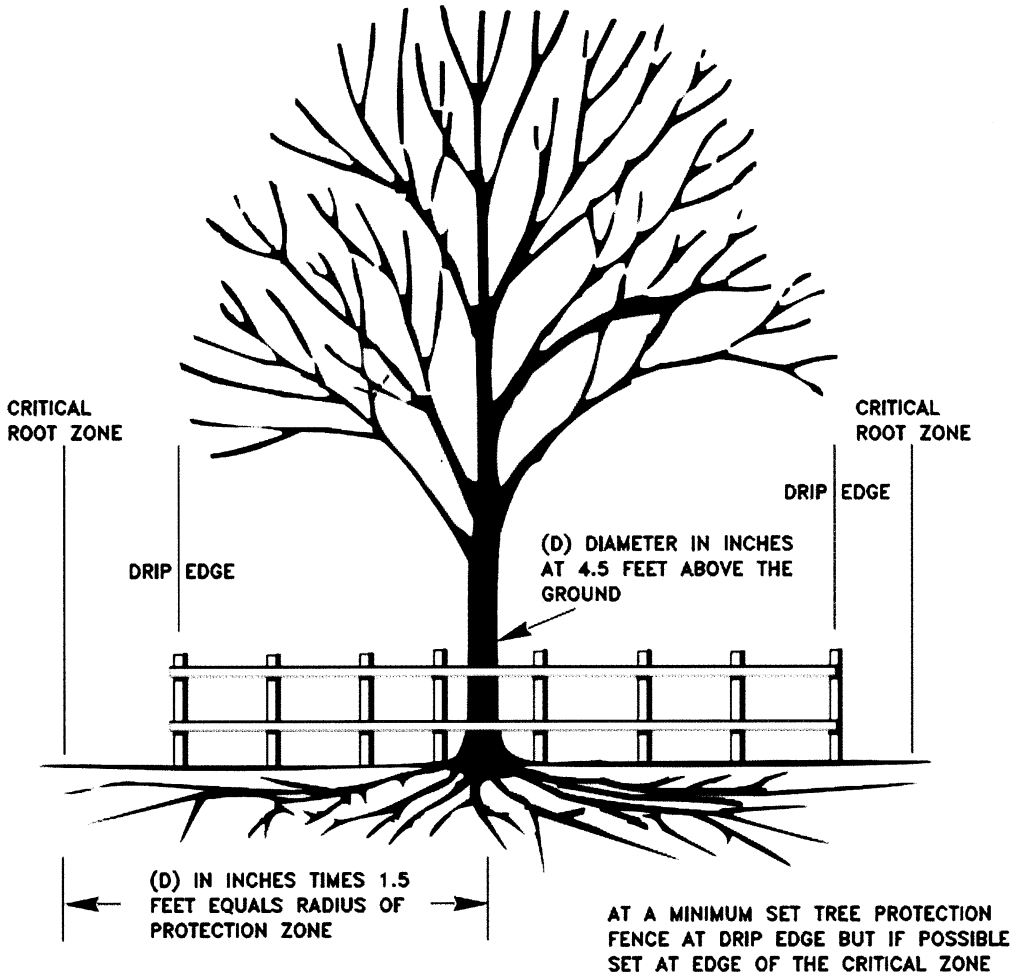
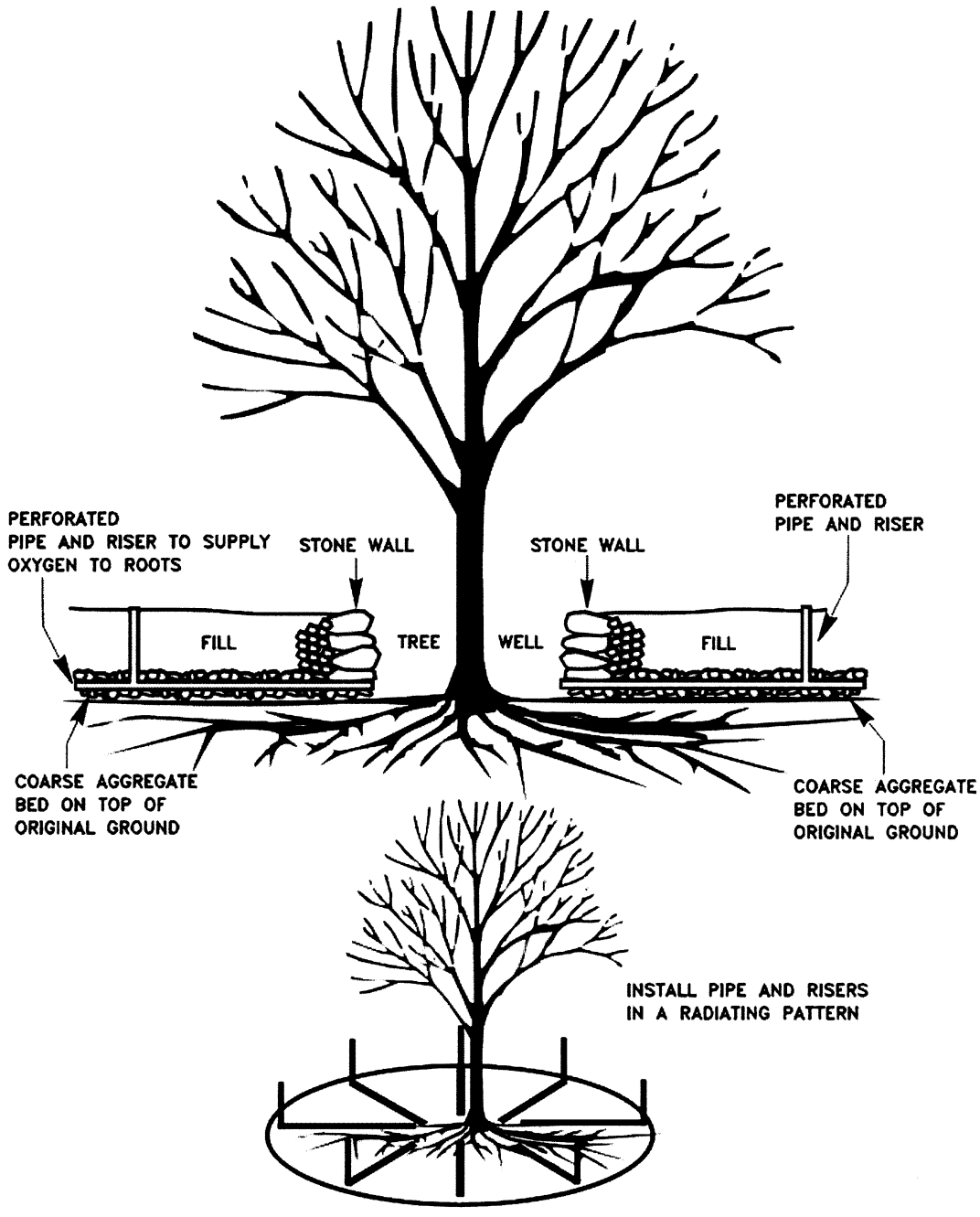


FIGURE 3.01.3

TREE WELL WHEN FILLING OVER TREE ROOTS



3.02 - STABILIZED CONSTRUCTION ENTRANCE

Introduction

Large quantities of mud can be tracked onto public and private roads causing dangerous driving conditions and muddy runoff when it rains. Construction entrances are stabilized to reduce the amount of sediment transported onto paved roads by vehicles or equipment by constructing a stabilized pad of stone at entrances to construction sites.

Conditions Where Practice Applies

Stabilized Construction Entrances shall be installed wherever construction traffic enters and leaves a site.

Design Criteria

1. Use 2-4 inch stone for low volume entrances, larger stone (4-6 inch) for heavy use or material delivery entrances.
2. Length is as required, but not less than 70 feet (except on a single residence lot where a 30 foot minimum length would apply).
3. Thickness should be not less than 6 inches.
4. The width shall be a minimum of 10 feet, but not less than the full width at points where ingress or egress occurs.
5. Geotextile fabric shall be placed over the entire area prior to the placing of stone.
6. All surface water flowing or diverted toward construction entrances shall be piped across the entrance. If a culvert is impractical, a mountable berm with 5:1 slopes shall be used.
7. If necessary, divert any water running down access road to a sediment trap located on either side of the Stabilized Construction Entrance.

Maintenance

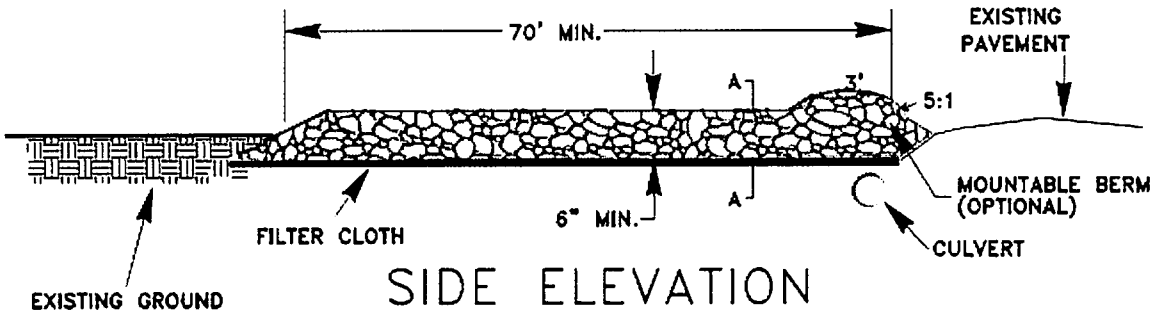
The entrance shall be maintained in a condition that will prevent tracking or flowing of sediment onto public rights-of-way. This may require periodic top dressing with additional stone as conditions demand and repair and/or cleanout of any measures used to trap sediment. All sediment spilled, dropped, washed or tracked onto public rights-of-way must be removed immediately.

Wheels on all vehicles shall be cleaned to remove sediment prior to entrance onto public rights-of-way. If washing is required, it shall be done on an area stabilized with stone and which drains into approved sediment trapping device. If the street is washed precautions must be taken to prevent muddy water from running into waterways or storm sewers.

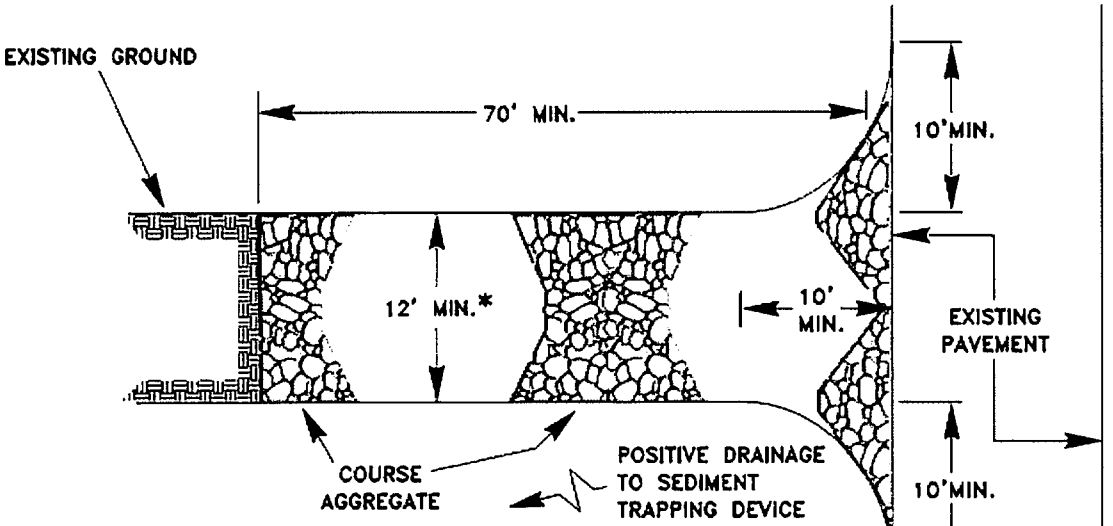
Inspection and needed maintenance should be provided daily but at a minimum every seven days and after every rain of 0.5 inch or greater.

FIGURE 3.02.1

STONE CONSTRUCTION ENTRANCE

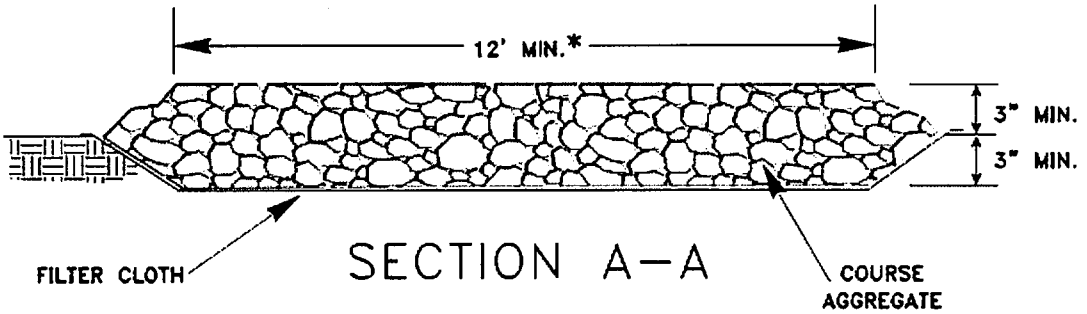


SIDE ELEVATION



*MUST EXTEND FULL WIDTH OF INGRESS AND EGRESS OPERATION

PLAN VIEW



SECTION A–A

SOURCE: ADAPTED from 1983 Maryland Standards for Soil Erosion and Sediment Control and Va. DSWC

3.03 - TEMPORARY CONSTRUCTION ROAD, WORK AND PARKING AREA STABILIZATION

Introduction

The temporary stabilization of access roads, haul roads, parking areas, laydown, material storage and other onsite vehicle transportation routes with stone immediately after grading. This practice is used to reduce the erosion and subsequent regrading of temporary and permanent roadbeds, work areas and parking areas rutted by construction traffic during wet weather. Provides easier access in all weather and reduces tracking mud onto public roads.

Conditions Where Practice Applies

All temporary work areas on a construction site where vehicular traffic will occur.

Construction Specifications

1. Temporary roads shall follow the contour of the natural terrain to the extent possible. Slopes should not exceed 15 percent.
2. Temporary parking areas should be located on naturally flat areas to minimize grading. Grades should be sufficient to provide drainage but should not exceed 4 percent.
3. Roadbeds should be at least 14 feet wide for one-way traffic and 20 feet wide for two-way traffic. Haul roads should be a least 30 feet wide.
4. All cuts and fills should be 2:1 or flatter.
5. Drainage ditches and culverts shall be provided as needed.
6. The roadbed or parking surface shall be cleared of all vegetation, roots and other objectionable material.
7. A 6-inch course of crushed aggregate shall be applied immediately after grading. Geotextile fabric should be applied to the roadbed for additional stability. In heavy duty traffic situations, stone should be placed at an 8 to10 inch depth to avoid excessive maintenance.
8. Stabilize disturbed areas not covered with stone immediately after installation with appropriate temporary or permanent vegetation according to the applicable standards and specifications contained in this manual.
9. Also see, access road section, for water control practices.

Maintenance

Inspect and perform needed maintenance at a minimum once every seven

calendar days and within 24 hours after any storm event greater than 0.5 inches of rain per 24 hour period.

Both temporary and permanent roads, laydown and work areas and parking areas may require periodic top dressing with new gravel.

Seeded areas adjacent to the roads and parking areas should be checked periodically to ensure that a vigorous stand of vegetation is maintained.

Roadside ditches and other drainage structures should be checked regularly to ensure that they do not become clogged with silt or other debris.

3.04 - SAFETY FENCE

Introduction

Protective fencing should be installed to prevent access to potentially hazardous areas of a construction site.

Conditions Where Practice Applies

Applicable to any control measure or series of measures, which can be considered unsafe by virtue of potential for access by the public. The designer, developer, and contractor should always be sure that the most appropriate type of fence is utilized for a particular need.

Construction Specifications

1. Safety fences should be located so as to create a formidable barrier to undesired access, while allowing for the continuation of necessary construction operations.
2. Safety fences are most applicable to the construction of traps and dams. In use with those structures, safety fences should be located far enough beyond the outer toe of the embankment to allow for the passage of maintenance vehicles. Fences should not be installed across the slope of a dam or dike.
3. Signs noting potential hazards such as "DANGER" or "HAZARDOUS AREA --KEEP OUT" should be posted and easily seen by anyone approaching the protected area.
4. Plastic (polyethylene) fence may be used as safety fencing, primarily in situations where the need is for a temporary barrier. The fence should meet the physical requirements noted in Table 3.04.1.

Table 3.04.1 Physical properties of plastic safety fence

Physical property	Test	Requirements
Recommended color	N/A	International Orange
Tensile yield	ASTM D638	Average 2,000 lbs.
Ultimate tensile strength	ASTM D638	Average 2,900 lbs. per 4 ft. width
Elongation at break(%)	ASTM D638	Greater than 1000%
Chemical resistance	N/A	Inert to most chemicals/acids

5. Safety fences should be installed prior to the sediment control measure becoming accessible.
6. Applicable warning signs noting hazardous conditions must be installed immediately upon installation of safety fence.

7. Chain link fence should be used for permanent structures (greater than one year).

Maintenance

Safety fence shall be checked regularly for weather-related or other damage. Any necessary repairs must be made immediately.

Care should be taken to secure all access points (gates) at the end of each working day. All locking devices must be repaired or replaced as necessary.

3.05 - ROCK CHECK DAMS

Introduction

Small temporary stone dams can be constructed across a waterway to reduce the velocity of stormwater flows, thereby reducing erosion of the channel and trapping sediment. This practice is the replacement for the traditionally misused hay/straw bales and silt fence ditch checks. Constructing a small dugout trap upstream of the structure can enhance the sediment trapping efficiency.

Conditions Where Practice Applies

This practice, utilizing a combination of stone sizes, is limited to use in small open channels that drain 5 acres or less. It is never used in live streams. Check dams can be useful in the following instances:

1. Temporary ditches or swales
2. Temporary or permanent ditches and swales which need protection during the establishment of grass linings.
3. This practice is not a substitute for major perimeter trapping measures such as a sediment trap or a sediment basin.

Construction Specifications

No formal design is required for a check dam, however, the following conditions should be adhered to:

1. The drainage area of the ditch or swale being protected shall not exceed 2 acres when 2 to 4 inch aggregate is used alone; and shall not exceed 5 acres when a combination of 4 to 8 inch aggregate (added for stability) and the smaller aggregate is used. Refer to Figure 3.05.1 for orientation of stone and a cross-sectional view of the measure. An effort should be made to extend the stone to the top of channel banks.
2. The maximum height of the dam should be 3 feet.
3. The center of the check dam must be at least 6 inches lower than the outer edges. This is the single most important aspect in the proper installation of the rock check dam. High flows must go over the center of the dam, not around the edges where severe erosion can occur.
4. The maximum spacing between the dams should be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam. The maximum distance between rock check dams is 300 feet.
5. When using a small trap in front of the check dam, ensure the minimum transition from the ditch into the trap is at least 5:1.

Commercial Products

There are several commercially available products on the market now that are viable alternatives to the rock check dam. See commercial silt dike section

Maintenance

1. Inspect each check dam at a minimum once every seven calendar days and within 24 hours after any storm event greater than 0.5 inches of rain per 24 hour period. Check to see if water has flowed around the edges of the structure.
2. Replace stone and repair dams as necessary to maintain the correct height and configuration.

3. Sediment should be removed from behind the check dams when it has accumulated to one half of the original height of the dam. Dispose of the sediment in an appropriate place.

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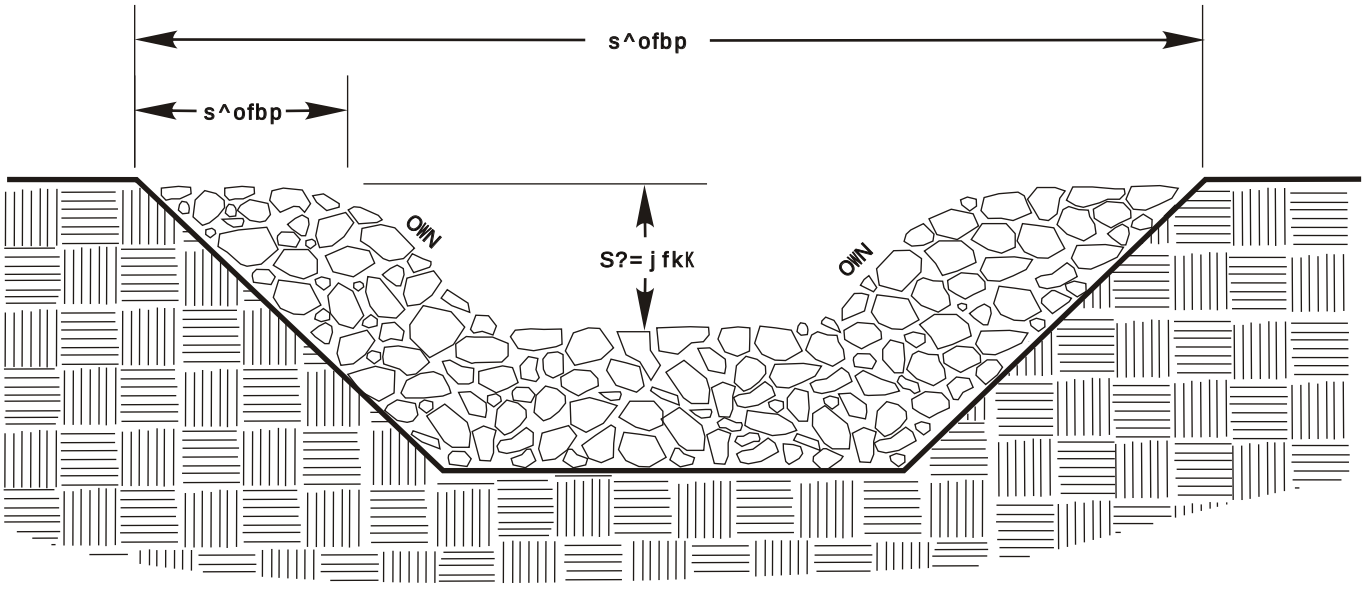

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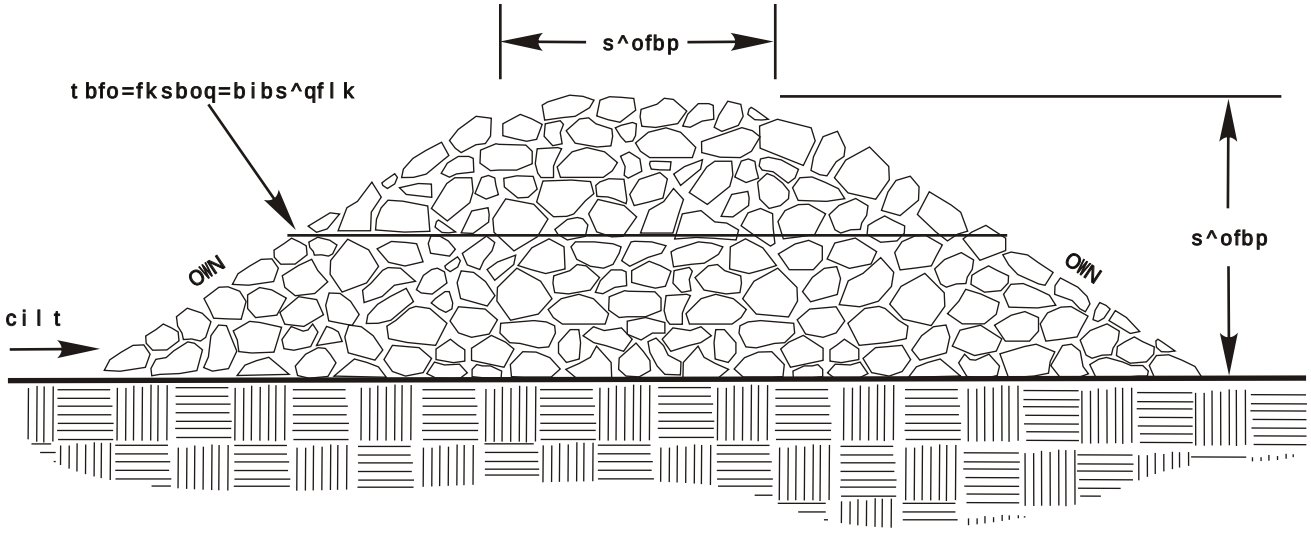

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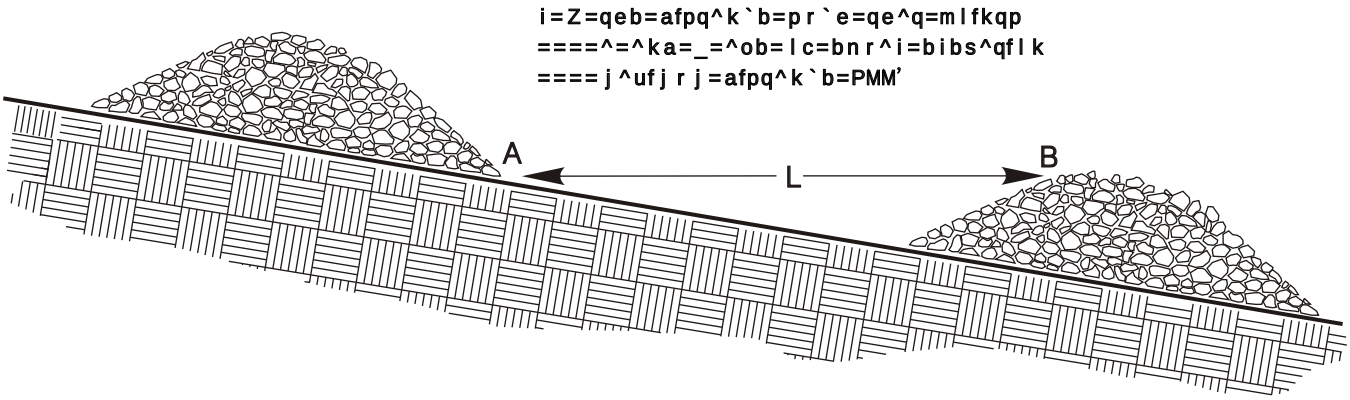

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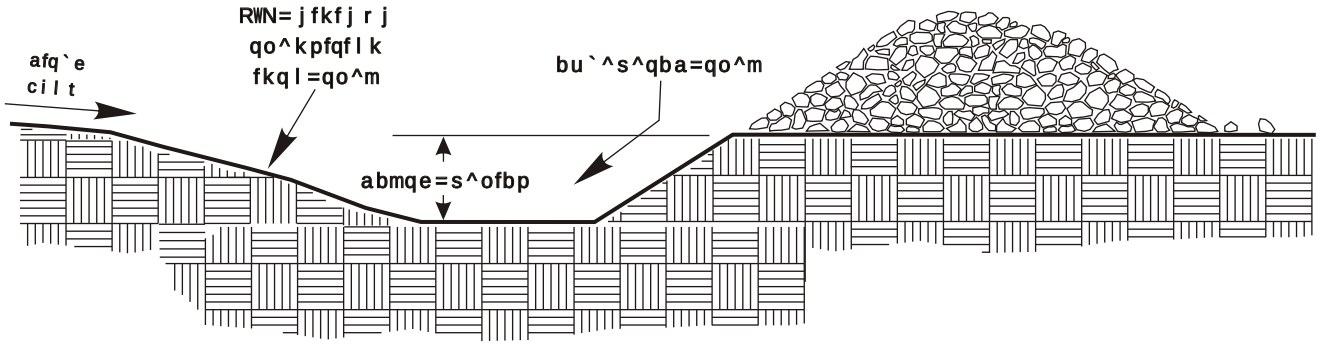

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3.06 - WATTLES

Introduction

Wattles are erosion and sediment control barriers consisting of straw or other organic materials wrapped in biodegradable tubular plastic or similar encasing material. Sometimes called Fiber Rolls. Wattles may reduce the velocity and theoretically spread the flow of rill and sheet runoff, and can capture and retain sediment. Wattles are typically 8 to 20 inches in diameter and 10 to 30 feet in length. The wattles are placed in shallow trenches and staked along the contour of disturbed or newly constructed slopes or in low flow ditches where they can function as check dams.

Wattles reduce slope length, and are intended to capture and keep sediment on the slopes. Wattles are useful to temporarily stabilize slopes by reducing soil creep, and sheet and rill erosion until permanent vegetation can be established. Wattles can catch soil that is moved down the slope by the freeze/thaw processes. Organic matter and seeds are trapped behind the rolls, which provide a stable medium for germination. Rolls trap topsoil and retain moisture from rainfall, which aids in growth of seedlings planted upslope of the rolls.

Conditions Where Practice Applies

1. Install on disturbed areas that require immediate erosion protection.
2. Use on slopes requiring stabilization until permanent vegetation can be established.
3. Can be used along the perimeter of a project, as a check dam in unlined ditches and around temporary stockpiles
4. Wattles can be staked to the ground using willow cuttings for added revegetation
5. Erosion can occur beneath and between wattles if not properly entrenched, allowing water to pass below and between wattles. It is therefore very important to install wattles correctly.
6. They can replace sediment fence on steep slopes.
7. Rolls are a short-term solution to help establish native vegetation
8. Rolls store moisture for vegetation planted immediately upslope.
9. Plastic netting will eventually photo-degrade, eliminating the need for retrieval of materials after the fiber or straw has broken down.

Construction Specifications

1. It is critical that wattles are installed perpendicular to the flow direction and parallel to the slope contour.
2. Narrow trenches should be dug across the slope, on contour, to a depth of 3 to 5 inches on clay soils and soils with gradual slopes. On loose soils, steep slopes, and during high rainfall events, the trenches should be dug to a depth of 5 to 7 inches, or ½ to 2/3 of the thickness of the wattle.

3. Start construction of trenches and installing wattles from the base of the slope and work uphill. Excavated material should be spread evenly along the uphill slope and compacted using hand tamping or other method. Construct trenches at contour intervals of 3 to 30 feet apart depending on the steepness of the slope, soil type, and rainfall. The steeper the slope the closer together the trenches should be constructed.
4. Install the wattles snugly into the trenches and abut tightly end to end. Do not overlap the ends.
5. Install stakes at each end of the wattle, and at 4-foot centers along the entire length of the wattle.
6. If required, install pilot holes for the stakes using a straight bar to drive holes through the wattle and into the soil.
7. At a minimum, wooden stakes should be approximately ¾ x ¾ x 24 inches. Willow cuttings or 3/8-inch rebar can also be used for stakes.
8. Stakes should be driven through the middle of the wattle, leaving 2 to 3 inches of the stake protruding above the wattle.

Maintenance

Inspect wattles at least once a week and after each rain event greater than 0.5 inch.

Repair or replace split, torn, raveling, or slumping wattles.

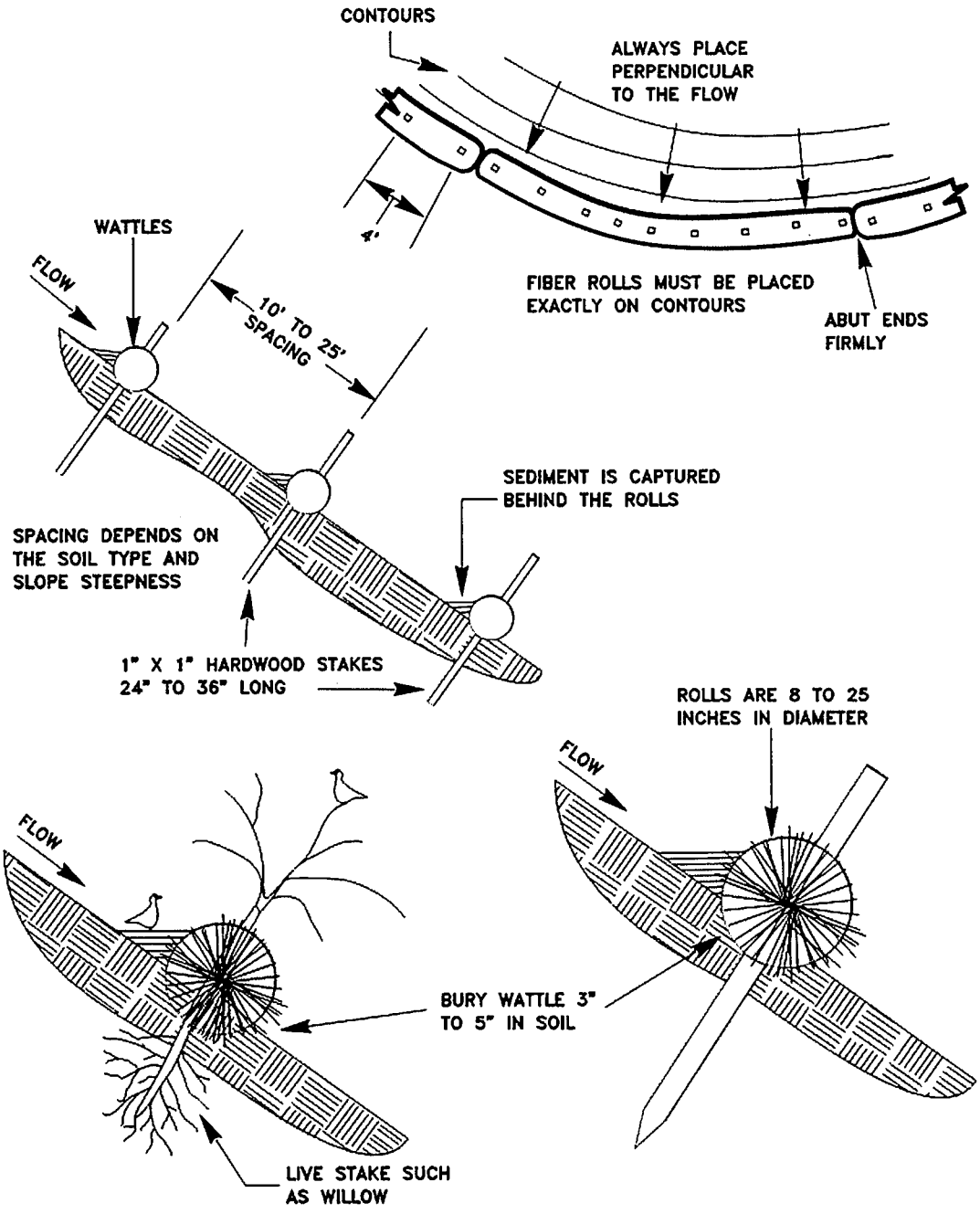
Remove sediment accumulations when exceeding ½ the height between the top of the wattle and the ground surface.

Repair any rills or gullies promptly.

Reseed or replant vegetation if necessary until the slope is stabilized

FIGURE 3.06.1

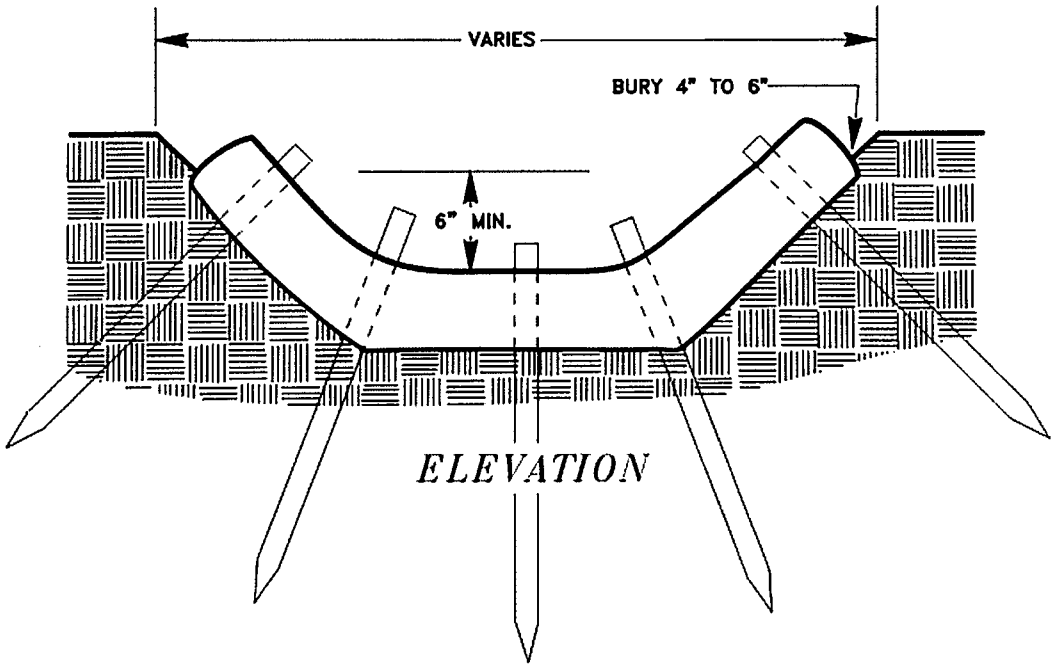
WATTLES



ADAPTED FROM JOHN MCCULLAGH, SALIX AND OREGON DEQ

FIGURE 3.06.2

STRAW WATTLE DITCH CHECK



ELEVATION

3.07 - COMMERCIAL SILT DIKES

Introduction

Rock check dams are the most commonly used practice to protect ditchlines from erosion and to trap small amounts of sediment. There are now several commercially available replacements for rock check dams. These new check dams are made from a variety of lightweight materials. One of these is made from foam rubber surrounded by a geotextile filter fabric. Others are made from plastic or a combination of synthetics and natural materials. They can be used as check dams, perimeter protection, drop inlet protection, or as a temporary interceptor dike.

Commercial silt dikes work on the same principle as rock check dams; they intercept and pond sediment-laden runoff. Ponding the water reduces the velocity of any incoming flow and allows some of the suspended sediment to settle. Water exits some commercial silt dikes by flowing over the top and others by flowing through with higher flows going over the top. The apron on the downstream side of the dike helps prevent scour caused by this flowing water.

Conditions Where Practice Applies

1. In place of rock check dams in ditches, especially in locations where hauling the rock would be difficult or in ditches with shallow soils underlain by rock.
2. May be used on soil with staples or on pavement with adhesive.
3. Commercial silt dikes can be used creatively to build temporary sediment traps, diversion ditches, concrete washout facilities, curbing, water bars, level spreaders, and berms.

Construction Specifications

1. Commercial silt dikes are made of urethane foam sewn into a woven geosynthetic fabric, permeable plastic or wattles.
2. Commercial silt dikes come in various shapes, sizes and materials and must be used as detailed in this practice and as the manufacturer states. The connection between individual pieces must be continuous.
3. Install commercial silt dikes perpendicular to the flow of the water except when used as diversions.
4. The commercial silt dikes should extend far enough so that the bottoms of the end dikes are higher than the top of the lowest center dike. This prevents water from flowing around the commercial silt dikes.
5. Attach the commercial silt dikes and their flaps to the ground with wire staples. Wire staples must be No. 11 gauge wire or stronger and shall be 6 to 12 inches in length. Follow the manufacturer’s recommendation for installation.
6. When multiple units are installed, the sleeve of fabric at the end of the unit shall overlap the abutting unit and be stapled.

7. Commercial silt dikes must be located and installed as soon as construction will allow.
8. When used as check dams, the leading edge must be secured with rocks, sandbags, or a small key slot and staples.
9. Space dikes apart as shown for rock check dams.
10. Commercial silt dikes can be removed when the grass channel lining has matured sufficiently to protect the ditch or the ditch is stabilized with some sort of permanent lining such as riprap. The soil beneath the commercial silt dikes check dams shall be seeded and mulched immediately after dam removal.

Maintenance

Inspect at a minimum once every seven calendar days and within 24 hours after any storm event greater than 0.5 inches of rain per 24 hour period. Sediment shall be removed when it reaches one half the height of the silt dike.

Anticipate submergence and deposition above the dike and erosion from high flows around the edges of the dike/dam. Immediately repair any damage or any undercutting of the dike/dam.

3.08 - SURFACE ROUGHENING

Introduction

Surface roughening means providing a rough soil surface with horizontal depressions created by operating a tillage or other suitable implement on the contour, or by leaving slopes in a roughened condition by not fine-grading them. This will aid in establishment of vegetative cover with seed, reduce runoff velocity, and increase infiltration, and reduce erosion and provide for sediment trapping. Surface roughening is also a way to prepare the seedbed.

Conditions Where Practice Applies

1. All slopes steeper than 3:1 require surface roughening, either stair-step grading, grooving, furrowing, or tracking if they are to be stabilized with vegetation.
2. Areas with grades less steep than 3:1 should have the soil surface lightly roughened and loose to a depth of 2 to 4 inches prior to seeding.
3. Slopes with a stable rock face do not require roughening or stabilization.

Planning Considerations

It is difficult to establish vegetation on graded areas with smooth, hard surfaces due to reduced water infiltration and the potential for erosion. Rough slope surfaces with uneven soil and rocks left in place may appear unattractive or unfinished at first, but encourage water infiltration, speed the establishment of vegetation, and decrease runoff velocity.

Rough loose soil surfaces give lime, fertilizer and seed some natural coverage. Niches in the surface provide microclimates that generally provide a cooler and more favorable moisture level than hard flat surfaces; this aids seed germination.

There are different methods for achieving a roughened soil surface on a slope, and the selection of an appropriate method depends upon the type of slope. Roughening methods include stair-step grading, grooving, and tracking. Factors to be considered in choosing a method are slope steepness, mowing requirements, and whether the slope is formed by cutting or filling.

Cut Slope Applications For Areas Which Will Not Be Mowed

Cut slopes with a gradient steeper than 3:1 should be stair-step graded or grooved.

1. Stair-step grading may be carried out on any material soft enough to be ripped with a bulldozer. Slopes consisting of soft rock with some subsoil are particularly suited to stair-step grading.

   The ratio of the vertical cut distance to the horizontal distance shall be less than 1:1 and the horizontal portion of the "step" shall slope toward the vertical wall.

   Individual vertical cuts shall not be more than 30 inches on soft soil materials and not more than 40 inches in rocky materials.

2. Grooving consists of using machinery to create a series of ridges and depressions that run perpendicular to the slope (on the contour). Grooves may be made with any appropriate implement which can be safely operated on the slope and which will not cause undue compaction. Suggested implements include disks, tillers, spring harrows, and the teeth on a front-end loader bucket. These grooves should not be less than 3 inches deep nor further than 15 inches apart.

Fill Slope Applications For Areas Which Will Not Be Mowed

Fill slopes with a gradient steeper than 3:1 shall be grooved or allowed to remain rough as they are constructed. The methods below may be used:

1. Groove according to #2 above.
2. As lifts of the fill are constructed, soil and rock materials may be allowed to fall naturally onto the slope surface.

At no time shall slopes be bladed or scraped to produce a smooth, shiny, hard surface.

Cuts, Fills, and Graded Areas Which Will Be Mowed

Mowed slopes should not be steeper than 3:1. Excessive roughness is undesirable where mowing is planned. These areas may be roughened with shallow grooves such as remain after tilling, disking, harrowing, raking, or use of a cultipacker-seeder. The final pass of any such tillage implement shall be on the contour (perpendicular to the slope).

Grooves formed by such implements shall be not less than 1-inch deep and not further than 12-inches apart. Fill slopes that are left rough as constructed may be smoothed with a dragline or pick chain to facilitate mowing.

Roughening With Tracked Machinery

Roughening with tracked machinery on clayey soils is not recommended unless no alternatives are available. Undue compaction of surface soil results from this practice. Sandy and rocky soils do not compact severely, and may be tracked. In no case is tracking as effective as the other roughening methods described.

When tracking is the chosen surface roughening technique, it shall be done by operating tracked machinery up and down the slope to leave horizontal depressions in the soil. As few passes of the machinery should be made as possible to minimize compaction.

Seeding

Roughened areas shall be seeded and mulched as soon as possible to obtain optimum seed germination and seedling growth but at a minimum within seven days of reaching final grade or within seven days if no additional activity is anticipated for 21 days or more.

3.09 - TOPSOILING

Introduction

Topsoiling is the spreading of topsoil of a suitable quality over an area to be stabilized by establishing vegetation. Topsoil is the surface layer of the soil profile, generally characterized as darker than the subsoil due to the enrichment with organic matter. It is the major zone of root development and biological activity. Microorganisms that enhance plant growth thrive in this layer. Topsoil can usually be differentiated from subsoil by texture as well as color. Clay content usually increases in the subsoil. Where subsoils are high in clay, the topsoil layer may be significantly coarser in texture. The depth of natural topsoil may be quite variable. On severely eroded sites it may be gone entirely.

Advantages of topsoil include its higher organic matter content, friable consistence (soil aggregates can be easily crushed with only moderate pressure), its available water holding capacity, and its nutrient content. Most often it is superior to subsoil in these characteristics. The texture and friability of topsoil are usually much more conducive to seed germination, emergence, and root growth.

In addition to being a better growth medium, topsoil is often less erodible than subsoil, and the coarser texture of topsoil increases infiltration capacity and reduces runoff.

Vegetative growth is more rapid on sites with at least 4 inches of topsoil, and the health and quality of the vegetation is better than on sites with little or no topsoil.

Conditions Where Practice Applies

Where the preservation or importation of topsoil is determined to be the most effective method of providing a suitable growth medium.

Where the subsoil or existing soil present any or all of the following problems:

1. The texture, bulk density, pH, or nutrient balance of the available soil cannot be modified by a reasonable means to provide an adequate growth medium for the desired vegetation.
2. The soil is too shallow to provide adequate rooting depth or will not supply necessary moisture and nutrients for growth of desired vegetation.
3. The soil contains substances toxic or potentially toxic to the desired vegetation.
4. Where high-quality turf or ornamental plants are desired.

Design Considerations

Determine if sufficient quantities of suitable topsoil is available at the site or nearby. Topsoil shall be spread at a lightly compacted depth of 2

to 4 inches. Depths of 4 inches or greater are recommended where fine-textured (clayey) subsoil or other root limiting factors are present.

If topsoil is to be stockpiled at the site, select a location so that it will not erode, block drainage, or interfere with work on the site.

During construction of the project, soil stockpiles shall be stabilized by temporary seeding and mulching and protected with sediment trapping measures such as silt fence. Perimeter controls shall be placed around the stockpile immediately; seeding and mulching of stockpiles shall be completed within seven days of formation of the stockpile if it is to remain in place for longer than 21 days.

If the topsoil is not properly bonded to the existing soil, water will not infiltrate evenly, and it will be difficult to establish vegetation.

Care must be taken not to apply topsoil to an existing soil surface if the two have contrasting textures. Clayey topsoil over sandy subsoil is a particularly poor combination, as water creeps along the junction between the two soil layers and may cause the topsoil to slough.

Do not apply topsoil to slopes greater than 2:1 to avoid slippage. Topsoiling of steep slopes should be discouraged unless good bonding of the soils can be achieved.

Construction Specifications

The plans and specifications for installing topsoil shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. At a minimum include the following items:

1. Topsoil source.
2. Stockpile location and method of stabilization prior to its use.
3. Topsoil/subsoil bonding procedures.
4. Site preparation plans and method of application, distribution and compaction.

Site preparation- Before spreading topsoil, assure that all necessary erosion and sediment control practices such as diversions, berms, dikes, waterways, and sediment basins are in place and functioning properly. These practices must be maintained until the site is permanently stabilized.

Grading- Maintain grades on the areas to be topsoiled according to the approved plan and do not alter them by adding topsoil.

Liming of subsoil- Where the pH of the existing subsoil is 6.0 or less, or the soil is composed of heavy clays, incorporate agricultural limestone in amounts recommended by soil tests or specified for the seeding mixture to be used. Incorporate lime to a depth of at least 2 inches by disking.

Roughening- Immediately prior to spreading the topsoil, loosen the subgrade by disking or scarifying to a depth of at least 4 inches, to ensure bonding of the topsoil and subsoil. If no amendments have been incorporated, loosen the soil to a depth of at least 6 inches before spreading the topsoil.

Spreading topsoil- Uniformly distribute topsoil to a minimum compacted depth of 2 inches on 3:1 slopes and 4 inches on flatter slopes.

Topsoil shall not be spread while it is frozen or saturated or when the subsoil is frozen or saturated.

Irregularities in the surface that result from topsoiling or other operations shall be corrected to prevent the formation of depressions or ponding of water.

Compact the topsoil enough to ensure good contact with the underlying soil, but avoid excessive compaction, as it increases runoff and inhibits seed germination and seedling growth. Light packing with a roller is recommended where high-maintenance turf is to be established.

In areas that are not going to be mowed, the surface can be left rough.

Maintenance

After topsoil application, follow procedures for seedbed preparation. Take care to avoid excessive mixing of topsoil into the subsoil. Permanently stabilize the site following appropriate practice standards as quickly as practicable. Periodically inspect the site until permanent stabilization is achieved. Make necessary repairs to eroded areas or areas of light vegetative cover.

3.10 - TEMPORARY SEEDING

Introduction

Temporary erosion control measures consist of seeding and mulching, or matting used to produce a quick ground cover to reduce erosion on exposed soils that may be redisturbed or permanently stabilized at a later date.

Conditions Where Practice Applies

Use this method where exposed soil surfaces are not to be fine-graded for periods longer than 21 days. Such areas include denuded areas, soil stockpiles, dikes, dams, sides of sediment basins, temporary road banks, etc. A permanent vegetative cover shall be applied to areas that will be left unworked for a period of more than six months.

Planning Considerations

Sheet erosion, caused by the impact of rain on bare soil, is the source of most fine particles in sediment. To reduce this sediment load in runoff, the soil surface itself should be protected. The most efficient and economical means of controlling sheet and rill erosion is to establish vegetative cover. Annual plants that sprout rapidly and survive for only one growing season are suitable for establishing temporary vegetative cover. Temporary seeding is encouraged whenever possible to aid in controlling erosion on construction sites.

Temporary seeding also reduces costly maintenance operations on sediment control systems. For example, sediment basin/trap clean-outs can be reduced if its drainage area is vegetated when grading is not taking place. Perimeter dikes are more effective if not choked with sediment. Silt fence does not need to be cleaned as often.

Temporary seeding is essential to preserve the integrity of earthen structures used to control erosion and sediment, such as dikes, diversions, and the banks and dams of sediment basins/traps. If the design life of the basin or trap is more than one year, permanent seeding should be used.

Proper seedbed preparation and the use of quality seed are important in this practice just as in permanent seeding. Failure to carefully follow sound agronomic recommendations will often result in an inadequate stand of vegetation that provides little or no erosion control.

Construction Specifications

Prior to seeding, install necessary erosion control practices such as dikes, waterways, and basins.

Plant Selection

Select plants appropriate to the season and site conditions.

Seedbed Preparation

To control erosion on bare soil surfaces, plants must be able to germinate and grow. Seedbed preparation is essential. If the area has been recently

loosened or disturbed, no further roughening is required. When the area is compacted, crusted, or hardened, the soil surface must be loosened by disking, raking, harrowing, or other acceptable means (see surface roughening section).

Seeding

Seed shall be evenly applied with a broadcast seeder, drill, cultipacker seeder or hydroseeder. Small grains shall be planted no more than 1.5 inches deep. Small seeds, such as annual rye, shall be planted no more than quarter inch deep. Other grasses and legumes shall be planted no more than half inch deep.

Mulching

Temporary seeding conducted in fall for winter cover and during hot and dry summer months shall be mulched with straw or hay according to the standard for mulching. Hydromulches (fiber mulch) may not provide adequate temperature and moisture control.

Maintenance

Areas that fail to establish a vegetative cover adequate to prevent rill erosion should be re-seeded as soon as such areas are identified.

Table 3.10.1 Temporary seed chart

PLANT NAMES		PLANTING DATES	APPLICATION RATE LBS/ACRE
COMMON	**SCIENTIFIC**		
Annual Ryegrass	*Lolium multiflorum*	2/16 – 5/15 8/1 – 11/1	40
Field Bromegrass	*Bromus ciliatus*	3/1 – 6/15 8/1 – 9/15	40
Spring Oats	*Avena sativa*	3/1 –6/15	100
Winter Rye	*Secale cereale*	8/15 –2/28	170
Winter Wheat	*Triticum aestivum*	8/15 – 2/28	180
Japanese Millet	*Echinochloa crusgalli*	5/15 – 8/15	30
Redtop	*Agrostis alba*	3/1 – 6/15	10
Annual Ryegrass and Spring Oats	*Lolium multiflorum* *Avena sativa*	3/1 – 6/15	30 70
German/Foxtail Millet	*Setaria italica*	5/1 – 8/1	40
Hairy Vetch	*Vicia villosa*	8/15 – 4/1	60

*Inoculation is required. If a hydroseeder is utilized, the application rate is 5 times the recommended rate.

3.11 - PERMANENT SEEDING

Introduction

Permanent seeding is the establishment of perennial vegetative cover on disturbed areas by planting seed.

Purpose

1. To reduce erosion and decrease sediment yield from disturbed areas.
2. To permanently stabilize disturbed areas in a manner that is economical, adaptable to site conditions and allows selection of the most appropriate plant materials.

Conditions Where Practice Applies

1. Disturbed areas where permanent, long-lived vegetative cover is needed to stabilize the soil.
2. Rough-graded areas that will not be brought to final grade for six months or more.

Planning Considerations

Vegetation controls erosion by reducing the velocity and the volume (by increasing infiltration) of overland flows, protecting the bare soil surface from raindrop impact and binding the soil particles together by the roots and rhizomes.

Advantages of seeding over other means of establishing plants include the small initial establishment cost, the wide variety of grasses and legumes available, low labor requirement and ease of establishment in difficult areas.

Disadvantages include the potential for erosion during the establishment stage, a need to reseed areas that fail to establish, limited periods during the year suitable for seeding, the potential need for weed control during the establishment phase, and a need for water and appropriate micro-climatic conditions during germination.

There are so many variables in plant growth that an end product cannot be guaranteed. Much can be done in the planning stages to increase the chances for successful seeding. Selection of the right plants for the site, good seedbed preparation, proper timing and conscientious maintenance are important. By meeting the requirement to seed and mulch your site within seven days, the seedbed preparation and timing components are easily met.

Selecting Plants

The factors affecting plant growth are climate, soils and topography. In West Virginia, there are three major physiographic regions that reflect changes in soil and topography. In selecting appropriate plant materials, one should take into account the characteristics of the physiographic region in which the project is located.

Physiographic Regions

Western Plateau- Characterized by steep slopes and narrow valleys drained by dendritic low gradient streams. Soils are highly variable and on the acidic side. Erosion can be catastrophic and almost impossible to control, especially in the western sections of the state. Clays and silty-clays predominate with rich well-drained soils in the major river valleys. Rainfall averages 40 inches a year and is spread evenly throughout the year. Rain events average every four days. Soil moisture is optimal in the spring and fall. Droughts of short duration can occur every summer. Both cool and warm season grasses will grow.

Ridge and Valley Region- This region is divided into plateaus, mountains, narrow valleys and wide fertile valleys near the major stems of the Potomac River. Streams have medium gradient. Soils tend to be shallow and acid, and may erode rapidly on steep slopes. The significant shalely slopes are often unstable and droughty. This area is significantly drier than the rest of the state; however, storm events are significantly greater. The rugged topography makes plant establishment difficult. Cool season grasses are normally specified in this region.

Mountains-This region consists of high mountains (up to 4,860 feet) and plateaus, deep, steep valleys, short summers and cold snowy winters, and fast flowing, steep gradient streams. Rainfall averages 50 to 60 inches with up to 240 inches of snow each winter in the highest elevations. Soil depths range from bedrock along areas of the Allegheny Front, to thin to moderate. The range of soil fertility is large and many are acidic. Erodibility ranges from low in the shalely soils common to the Ridge and Valley, to very high in the soils formed from the Mauch Chunk sandstones. Erosion can be a problem because of the extreme steepness of the slopes. Because of the shortness of the growing season, the timeliness of seeding is of utmost importance. However, summer drought is unusual.

Soils

Soils in West Virginia usually require some nitrogen fertilization along with phosphorus and potassium to establish plants. Except for shallow limestone soils in Greenbrier, Pocahontas, Jefferson and Berkeley counties, and some small pockets elsewhere, lime is universally needed.

Microclimates, or localized climate conditions, affect plant growth. A south-facing slope is drier and hotter than a north-facing slope, and may require drought-tolerant plants. Shaded areas require shade-tolerant plants; the windward side of a ridge will be drier than the leeward, etc. Shaley soils are droughty.

The addition of lime is equally as important as applying fertilizer. Lime is best known as a pH or acidity modifier, but it also supplies calcium and magnesium, which are plant nutrients. More importantly, the correct pH frees up nutrients to the plant. Soils with a pH that is too low will not allow a plant to utilize nitrogen and phosphorus properly. Raising the pH can also prevent aluminum toxicity by making aluminum less soluble in the soil. Many soils in West Virginia are high in aluminum, which can stunt the growth of plant roots. Also remember that rainfall is acidic, compounding the low pH problem in the soil.

Once the soil temperature is correct, the two key limiting factors of seed germination are pH and moisture. If you control these two factors, your chances of success are greatly enhanced.

Seed Mixtures

As previously noted, the establishment of high quality turf frequently involves planting one single species. However, in seedings for erosion control purposes, the inclusion of more than one species should always be considered. Mixtures need not be excessive in poundage or seed count. The addition of a quick-growing annual

provides early protection and facilitates establishment of one or two perennials in a mix. More complex mixtures might include a quick-growing annual, one or two legumes and more than one perennial grass. The addition of a nurse crop (quick-growing annuals added to permanent mixtures) is a sound practice for soil stabilization, particularly on difficult sites - those with steep slopes, poor, rocky, erosive soils, those seeded outside of the optimum seeding periods or in any situation where the permanent cover development is likely to be slow. The nurse crop germinates and grows rapidly, holding the soil until the slower-growing perennial (permanent) seedlings become established.

Maintenance

Even with careful, well-planned seeding operations, failures occur. When it is clear that plants have not germinated on an area or have died, these areas must be prepared and reseeded immediately to prevent erosion damage. It is extremely important to determine why germination did not take place and make any necessary corrective actions. **Healthy vegetation is the most effective erosion control available**. Some highly acidic soils (especially around various coal seams in the coalfields) will resist the best efforts to revegetate them. In these cases, topsoling will be the only way to establish vegetation.

Table 3.11.1 Permanent seeding

SEED MIX	PLANT NAMES		APPLICATION RATE LBS/ACRE
	COMMON	SCIENTIFIC	
A	Kentucky 31 Fescue Red Fescue Birdsfoot Trefoil	*Festuca arundinacea* *Festuca rubra* *Lotus corniculatus*	65 20 5
B	Switchgrass Perennial Ryegrass Redtop Birdsfoot Trefoil	*Panicum virgatum* *Lolium perenne* *Agrostis alba* *Lotus corniculatus*	15 20 5 15
C	Red Fescue Kentucky Bluegrass Merion Bluegrass	*Festuca rubra* *Poa pratensis* *Poa pratensis*	20 40 30
D	Kentucky 31 Fescue Red Fescue Kentucky Bluegrass White Dutch Clover	*Festuca arundinacea* *Festuca rubra* *Poa pratensis* *Trifolium repens*	45 20 25 5
E	Perennial Ryegrass Switchgrass Crownvetch or Perennial Pea	*Lolium perenne* *Panicum virgatum* *Coronilla varia* *Lathyrus latifolius*	30 15 20 30
F	Orchardgrass Ladino Clover Redtop	*Dactylis glomerata* *Trifolium repens* *Agrostis alba*	20 5 5
G	Birdsfoot Trefoil Weeping Lovegrass Perennial Ryegrass	*Lotus corniculatus* *Eragrostis curvula* *Lolium perenne*	15 45 10
H	Crownvetch Orchardgrass	*Coronilla varia* *Dactylis glomerata*	25 40
I	Crownvetch Perennial Ryegrass	*Coronilla varia* *Lolium perenne*	25 30
J	Perennial Pea Orchardgrass	*Lathyrus latifolius* *Dactylis glomerata*	30 30
K	Deertongue Birdsfoot Trefoil Weeping Lovegrass	*Panicum clandestinum* *Lotus corniculatus* *Eragrostis curvula*	30 15 5
L	Orchardgrass Serecia Lespedeza Ladino Clover	*Dactylis glomerata* *Lespedeza cunata* *Trifolium repens*	30 40 5
M	Perennial Ryegrass Ladino Clover Redtop	*Lolium perenne* *Trifolium repens* *Agrostis alba*	50 5 5
N	Crownvetch Orchardgrass Redtop	*Coronilla varia* *Dactylis glomerata* *Agrostis alba*	15 30 5

O	Perennial Ryegrass Birdsfoot Trefoil Redtop	*Lolium perenne* *Lotus corniculatus* *Agrostis alba*	40 15 5
P	Serecia Lespedeza Orchardgrass Redtop	*Lespedeza cunata* *Dactylis glomerata* *Agrostis alba*	40 30 5
Q	Orchardgrass Reed Canarygrass[1] Redtop Ladino Clover	*Dactylis glomerata* *Phalaris arundinacea* *Agrostis alba* *Trifolium repens*	25 30 5 5
R	Kentucky Bluegrass Redtop White Clover or Birdsfoot Trefoil	*Poa pratensis* *Agrostis alba* *Trifolium repens* *Lotus corniculatus*	30 5 5 15
S	Reed Canarygrass[1] Weeping Lovegrass	*Phalaris arundinacea* *Eragrostis curvula*	40 5
T	Perennial Ryegrass Reed Canarygrass[1] Birdsfoot Trefoil	*Lolium perenne* *Phalaris arundinacea* *Lotus corniculatus*	30 15 5
U	Timothy Alfalfa	*Phluem pratense* *Medicago sativa*	10 18
V	Timothy Birdsfoot Trefoil	*Phluem pratense* *Lotus corniculatus*	10 15
W	Redtop Perennial Ryegrass Orchardgrass	*Agrostis alba* *Lolium perenne* *Dactylis glomerata*	5 30 25
X	Reed Canarygrass[1] Birdsfoot Trefoil Redtop	*Phalaris arundinacea* *Lotus corniculatus* *Agrostis alba*	30 20 5
Y	Switchgrass Birdsfoot Trefoil	*Panicum virgatum* *Lotus corniculatus*	30 20
Z	Switchgrass Serecia Lespedeza	*Panicum virgatum* *Lespedeza cunata*	15 30
A-1	Orchardgrass Red Clover	*Dactylis glomerata* *Trifolium pratense*	30 10
A-2	Switchgrass Big Bluestem Indiangrass Little Bluestem Sideoats Grama[2]	*Panicum virgatum* *Andropogon gerardi* *Sorghastrum nutans* *Andropogon scoparius* *Bouteloua curtipendula*	15 5 5 5 5
A-3	Switchgrass Eastern Gamagrass[3]	*Panicum virgatum* *Tripsacum dactyloides*	20 15

NOTE: When utilizing a properly prepared seedbed, the rates of application can be reduced by 30 percent except for seed mixes A-2 & A-3.

[1] Reed Canarygrass shall not be used east of I-79 and/or south of Charleston.
[2] Use north and east of I-64 and I-79.
[3] Use south and west of I-64 and I-79.

Table 3.11.2 Nurse crops

PLANT NAMES		PLANTING DATES	APPLICATION RATE LBS/ACRE
COMMON	SCIENTIFIC		
Annual Ryegrass	*Lolium multiflorum*	2/16 – 5/15 8/1 – 11/1	25
Field Bromegrass	*Bromus ciliatus*	3/1 – 6/15 8/1 – 9/15	20
Spring Oats	*Avena sativa*	3/1 –6/15	50
Winter Rye	*Secale cereale*	8/15 –2/28	85
Winter Wheat	*Triticum aestivum*	8/15 – 2/28	90
Japanese Millet	*Echinochloa crusgalli*	5/15 – 8/15	15
Redtop	*Agrostis alba*	3/1 – 6/15	10
Annual Ryegrass and Spring Oats	*Lolium multiflorum* *Avena sativa*	3/1 – 6/15	15 35
German/Foxtail Millet	*Setaria italica*	5/1 – 8/1	25
Hairy Vetch*	*Vicia villosa*	8/15 – 4/1	30

* Inoculation is required. If a hydroseeder is utilized, the application rate is five times the recommended rate.

Table 3.11.3 Permanent seeding requirements

SEED MIX	FINE LAWN	COARSE LAWN	LOW MAINT.	NO MAINT.	PASTURE	SENSITIVE NATURAL AREAS	pH RANGE	DRAINAGE	SHADE TOLERANCE	PREFERRED PLANTING DATES			
										3/1 -6/15	6/16 -8/14	8/15 - 9/15	9/16 - 2/28
A			✓ 1				6.0 – 7.5	MOD. - WELL	FULL SUN	✓	♦	✓	♦
B				✓			5.0 – 7.5	MOD. – WELL	FULL SUN	✓	♦	✓	♦
C	✓ 1						6.0 – 7.5	MOD. – WELL	FULL SUN	✓		✓	
D		✓ 1					6.0 – 7.5	MOD. – WELL	FULL SUN	✓		✓	
E				✓ 1			6.0 – 7.5	MOD. – WELL	FULL SUN	✓	♦	✓	♦
F			✓	✓	✓		5.5 – 7.5	MOD. – WELL	TOLERANT	✓	♦	✓	♦
G				✓	✓		5.0 – 7.5	MOD. – WELL	FULL SUN	✓	♦	✓	♦
H			✓	✓ 1	✓		5.0 – 7.5	MOD. – WELL	TOLERANT	✓	♦	✓	♦
I			✓	✓ 1	✓		5.0 – 7.5	MOD. – WELL	FULL SUN	✓	♦	✓	♦
J			✓	✓ 1	✓		4.0 – 8.0	MOD. – WELL	TOLERANT	✓	♦	✓	♦
K				✓			4.0 – 7.0	MOD. – WELL	FULL SUN	✓	♦	✓	♦
L				✓	✓		4.5 – 7.5	MOD. – WELL	TOLERANT	✓	♦	✓	♦
M			✓	✓	✓		5.0 – 7.5	MOD. – WELL	TOLERANT	✓	♦	✓	♦
N			✓	✓ 1	✓		5.0 – 7.5	MOD. – WELL	TOLERANT	✓	♦	✓	♦
O			✓	✓	✓		5.0 – 7.5	MOD. – WELL	FULL SUN	✓	♦	✓	♦
P			✓	✓	✓		4.5 – 7.5	MOD. – WELL	TOLERANT	✓	♦	✓	♦
Q			✓	✓	✓		4.5 – 7.5	POOR - WELL	TOLERANT	✓	♦	✓	♦
R			✓	✓	✓		5.5 – 7.5	MOD. – WELL	FULL SUN	✓	♦	✓	♦
S			✓	✓	✓		4.5 – 7.5	POOR – WELL	FULL SUN	✓	♦	✓	♦
T					✓		5.5 – 7.5	POOR – WELL	FULL SUN	✓	♦	✓	♦
U					✓		6.5 – 8.0	MOD. – WELL	FULL SUN	✓	♦	✓	♦
V					✓		5.5 – 7.5	POOR – WELL	FULL SUN	✓	♦	✓	♦
W			✓	✓	✓		5.0 – 7.5	MOD. – WELL	TOLERANT	✓	♦	✓	♦
X					✓		5.5 – 7.5	POOR – WELL	FULL SUN	✓	♦	✓	♦
Y			✓	✓	✓		5.0 – 7.5	MOD. – WELL	FULL SUN	✓	♦	✓	♦
Z			✓	✓	✓		5.0 – 7.5	MOD. – WELL	FULL SUN	✓	♦	✓	♦
A-1					✓		4.5 – 7.5	MOD. – WELL	TOLERANT	✓	♦	✓	♦
A-2				✓	✓	✓	5.0 – 7.5	MOD. – WELL	FULL SUN	✓	♦	✓	♦
A-3				✓		✓	5.0 – 7.5	POOR - WELL	FULL SUN	✓	♦	✓	♦

♦ Nurse crop required – See Table B

1 Urban areas only

Seedbed Requirements

Vegetation should not be established on slopes that are unsuitable due to inappropriate soil texture, poor internal structure or internal drainage, volume of overland flow, or excessive steepness until measures have been taken to correct these problems.

To maintain a good stand of vegetation, the soil must meet certain minimum requirements as a growth medium.

The soil should have these characteristics:

1. Enough fine-grained material to maintain adequate moisture and nutrient supply.
2. Sufficient pore space to permit root penetration. A fine granular or crumb-like structure is favorable.
3. Sufficient depth of soil to provide an adequate root zone. The depth to rock or impermeable layers such as hardpans should be 12 inches or more, except on slopes steeper than 2:1 where the addition of soil is not feasible.
4. A favorable pH range for plant growth.
5. Freedom from toxic amounts of materials harmful to plant growth.
6. Freedom from excessive quantities of roots, branches, large stones, large clods of earth or trash of any kind.

Appropriate structural erosion control practices, such as berms, waterways, diversions, pipe slope drains, water bars or right of way diversions, needed to control overland flow to protect the seedbed should be installed prior to seeding.

Surfaces will be roughened in accordance with surface roughening section contained within this manual.

Soil Conditioners

In order to modify the texture, structure, or drainage characteristics of a soil, the following materials may be added to the soil:

1. Peat is a very costly conditioner, but works well. If added, it shall be sphagnum moss peat, hypnum moss peat, reed-sedge peat or peat humus, from freshwater sources.
2. Sand shall be clean and free of toxic materials. If this practice is considered, consult a professional authority to ensure that it is done properly.
3. Vermiculite shall be horticultural grade and free of toxic substances.
4. Manure, including poultry litter, in its composted form, is a viable soil conditioner. The use of manure should be based on site-specific recommendations offered by a professional in this field such as an agriculture extension agent or USDA employee.
5. Thoroughly rotted sawdust shall have six pounds of nitrogen added to each cubic yard and shall be free of stones, sticks, and toxic substances.
6. When composted, treated sewage sludge offers an alternative soil amendment. This practice should be thoroughly evaluated by a professional and used in accordance with any local, state, and federal regulations.

Lime and Fertilizer

Lime and fertilizer needs should be determined by soil tests. Soil tests may be performed by the WVU Extension Service soil testing laboratory or by a reputable commercial laboratory. Information concerning the WVU soil testing laboratory is available from county extension agents.

Under unusual conditions where it is not possible to obtain a soil test, the following soil amendments will be applied:

Lime

Two tons/acre (90 lbs./1,000 ft.^{2}) pulverized agricultural grade limestone.

Note: An agricultural grade of limestone should always be used except in inaccessible areas; lime may have to be applied separately in pelletized or liquid form.

Fertilizer

Mixed grasses and legumes: 1,000 lbs./acre nutrients (23 lbs./1,000 ft.^{2}) 10-20-10 or equivalent.

Legume stands only: 1,000 lbs./acre (23 lbs./ 1,000 ft.^{2}) 5-20-10 is preferred; however, 1,000 lbs./acre of 10-20-10 or equivalent may be used.

Grass stands only: 1,000 lbs./acre (23 lbs./1,000 ft.^{2})10-20-10 or equivalent nutrients.

Other fertilizer formulations, including slow-release sources of nitrogen (preferred from a water quality standpoint), may be used provided they can supply the same amounts and proportions of plant nutrients.

Lime and fertilizer shall be incorporated into the top 4 to 6 inches of the soil by disking or other means whenever possible. When applying lime and fertilizer with a hydroseeder, apply to a rough, loose surface.

Seeding

1. Appropriately labeled seed will be used for all permanent seeding whenever possible. Labeled seed is inspected by the West Virginia Department of Agriculture. The seed must be appropriately labeled or tagged as defined in the West Virginia Seed Law, Chapter 19 Article 16.
2. Legume seed should be inoculated appropriate to the species. Seed of the lespedezas, the clovers and crownvetch should be scarified to promote uniform germination.
3. Apply seed uniformly with a broadcast seeder, drill, culti-packer seeder or hydroseeder. See Seedbed Requirement above for seedbed preparation. Seeding depth should be a quarter to half inch.
4. To avoid poor germination rates as a result of seed damage during hydroseeding, it is recommended that if a machinery breakdown of 30

minutes to two hours occurs, 50 percent more seed be added to the tank, based on the proportion of the slurry remaining in the tank. Beyond two hours, a full rate of new seed may be necessary.

5. Surface roughening is particularly important when hydroseeding, as a roughened slope will provide some natural coverage for lime, fertilizer and seed.

Legume inoculants should be applied at five times the recommended rate when the inoculant is included in the hydroseeder slurry.

Mulching

All permanent seeding must be mulched immediately upon completion of seed application. Refer to the mulching section contained within this manual.

Irrigation

The newly seeded area should be supplied with adequate moisture. Supply water as needed, especially late in the season, in abnormally hot or dry weather, or on adverse sites. Water application rates should be controlled to prevent excessive runoff. Inadequate amounts of water may be more harmful than no water by causing the seedlings roots to curve towards the surface of the ground looking for moisture.

Reseeding

Inspect seeded areas for failure (less than 70 percent coverage) and make necessary repairs and reseeding within the same growing season, if possible.

a. If vegetative cover is inadequate to prevent rill erosion, overseed and fertilize in accordance with soil test results. If rills are large enough it may be necessary to regrade the rills out and reestablish a seedbed.

b. If a stand has less than 70 percent coverage, reevaluate choice of plant materials and quantities of lime and fertilizer. The soil must be tested to determine if acidity or nutrient imbalances are responsible. Reestablish the stand following seedbed preparation and seeding recommendations.

Fertilization

Cool season grasses should be fertilized 90 days after planting to ensure proper stand and density. Warm season grasses should be fertilized 30 days after planting.

Apply maintenance levels of fertilizer as determined by soil test. In the absence of a soil test, fertilization should be as follows:

Cool Season Grasses

Apply 4 lbs. nitrogen, 1 lb. phosphorus, 2 lbs. potassium per 1,000 $ft.^2$ per year. Seventy-five percent of the total requirements should be applied between September 1 and December 31. The balance should be applied prior to May 1 the following year. More than 1 lb. of soluble nitrogen per 1,000 $ft.^2$ should not be applied at any one time.

Warm Season Grasses

Apply 4 to 5 lbs. nitrogen between May 1 and August 15 per 1,000 $ft.^2$ per year. Phosphorus and Potassium should only be applied according to soil test.

Note: The use of slow-release fertilizer formulations for maintenance of turf is encouraged to reduce the number of applications and the impact on

groundwater.

Note: The permanent seeding section is not meant to be an all-inclusive list of possible seeding mixtures. There may be other purposes such as wildlife habitat or natural beauty that would require alternative mixtures. The DEP encourages the submission of enhanced vegetation plans for other purposes with your NPDES permit application.

3.12 – MULCHING INCLUDING FLEXIBLE GROWTH MEDIUM AND BONDED FIBER MATRIX

Introduction

The application of straw, hay or other suitable materials to the soil surface used to:

1. Prevent erosion by protecting the soil surface from raindrop impact and reducing the velocity of overland flow.
2. Foster the growth of vegetation by increasing available moisture and providing insulation against extreme heat and cold. Mulching increases the window of opportunity for seeding by moderating temperature and moisture extremes. This is important because the general permit does not define specific seeding dates and requires only that areas be seeded within seven days of reaching final grade.

Conditions Where Practice Applies

1. Areas that have been temporarily or permanently seeded should be mulched immediately following seeding.
2. Areas that cannot be seeded because of the season should be mulched to provide some protection to the soil surface. An organic mulch should be used, and the area then seeded as soon as weather or seasonal conditions permit. Do not use fiber mulch (cellulose-hydroseed) alone for this practice; at normal application rates it will not give the protection that is achieved by using other types of mulch.
3. Mulch may be used together with plantings of trees, shrubs, or other ground covers that do not provide adequate soil stabilization by themselves.

Planning Considerations

Mulches are applied to the soil surface to conserve desirable soil properties or to promote plant growth. Mulching can be an effective means of controlling runoff and erosion on disturbed land.

Mulches increase the infiltration rate of the soil, reduce soil moisture loss by evaporation, prevent crusting and sealing of the soil surface, modify soil temperatures and provide a suitable microclimate for seed germination.

Organic mulch materials such as straw and hay are the most effective, followed by wood chips, bark and fiber.

At this time chemical soil stabilizers or soil binders should not be used alone for mulch. These materials are useful to bind organic mulches together to prevent displacement.

A variety of manufactured rolled erosion control products have been developed for erosion control in recent years. See standard for erosion control matting for alternatives to mulching. Some of these products can be used as mulches, particularly in critical areas such as waterways, steep slopes and windy ridges. They also may be used to hold other mulches to the soil surface.

The choice of materials for mulching will be based on the type of soil to be protected, site conditions, season and economics. It is especially important to mulch liberally in mid-summer and prior to winter, and on cut slopes and southern slope exposures.

Organic mulches

Straw- The mulch most commonly used in conjunction with seeding. The straw should come from wheat or oats (free of troublesome weed seeds) and may be spread by hand or machine. Straw can be windblown and should be anchored down by an acceptable method. Straw's attributes such as its hollow core (provides insulation), rigidity (does not easily compress) and general lack of weeds makes it the best mulch available

Hay- May be used in lieu of straw where incompatible vegetation will not present a problem, and may be spread by hand or machine. Hay can be windblown and should be anchored or tacked down.

Additionally, when hay or straw mulch decomposes it adds valuable organic material to the soil.

Wood cellulose fiber mulch- Used in hydroseeding operations and applied as part of the slurry. It creates the best seed-soil contact when applied over top of (as a separate operation) newly seeded areas. These mulches do not require tacking, although tacking agents or binders are sometimes used in conjunction with the application of fiber mulch. Fiber mulch does not provide sufficient protection on highly erodible soils or during less favorable growing conditions. **Fiber mulch should not be used alone during the dry summer months or for late fall mulch cover**. Use straw/hay mulch during these periods. Fiber mulch may be used to tack (anchor) straw/hay mulch. Fiber mulch is well suited for steep slopes, critical areas, and areas susceptible to wind.

Chemical mulches, soil binders and tackifiers

A wide range of synthetic spray-on materials is marketed to stabilize and protect the soil surface. These are emulsions or dispersions of petroleum distillates, emulsions of copolymer acrylates, latexes, and polyvinyl acetates, clay colloids, and dry powered vegetable gums derived from guar, psyllium, and sodium alginase, which are mixed with water and sprayed over the mulch and to the soil. They may be used alone in some cases as temporary stabilizers, or in conjunction with fiber mulch, hay or

straw. The DEP does not recommend the use of asphalt emulsion as a binder.

Unlike organic mulches, most chemical mulches do not insulate the soil or retain soil moisture when used alone. They may also be easily damaged by traffic. Application of these mulches is usually more expensive than organic mulching, and the mulches decompose quickly.

The industry is continually improving alternative soil binders/mulches and the permittee is encouraged to investigate these new products for use on the site.

Always follow the manufacturer's recommendations when applying any of the above products.

Construction Specifications

Organic mulches

Organic mulches may be used in any area where mulch is required, subject to the restrictions noted in Table 3.12.1.

Select mulch material based on site requirements, availability of materials and availability of labor and equipment. Table 3.12.1 lists the most commonly used organic mulches.

Prior to mulching, complete the required grading and install needed sediment control practices.

Lime and fertilizer should be incorporated and surface roughening accomplished as needed. Seed should be applied prior to mulching except in the following cases:

1. Where seed is to be applied as part of a hydroseeder slurry containing wood cellulose fiber mulch (DEP recommends that the seed be spread prior to the spraying of the fiber mulch if at all possible).
2. Where seed is to be applied following a temporary mulch spread during winter months.

Mulch materials shall be spread uniformly, by hand or machine. When spreading straw mulch by hand, divide the area to be mulched into approximately 1,000 sq. ft. sections and place 70-90 lbs. (1½ to 2 bales) of straw in each section to facilitate uniform distribution.

Straw and hay mulch should be anchored immediately after spreading to prevent displacement. Other organic mulches listed in Table 3.12.1 should not require anchoring. The following methods of anchoring straw and hay may be used:

1. **Mulch anchoring tool (often referred to as a krimper or krimper tool) -** A tractor-drawn implement designed to punch mulch into the soil surface. This method provides good erosion control with straw. It is limited to use on slopes where the equipment can operate safely. Machinery shall be operated on the contour.
2. **Wood cellulose fiber mulch-** Apply fiber mulch by means of a hydroseeder at a rate of 500-750 lbs./acre over top of straw mulch or hay. It has an added benefit of providing additional mulch to the newly seeded area.
3. **Liquid mulch binders-** Application of liquid mulch binders and tackifiers should be heaviest at edges of areas and at crests of ridges and banks, to prevent displacement. The remainder of the area should have binder applied uniformly. Binders may be applied after mulch is spread or may be sprayed into the mulch as it is being blown onto the soil.
4. **Synthetic binders-** Formulated binders or organically formulated products may be used as recommended by the manufacturer to anchor mulch.
5. **Mulch netting-** Lightweight plastic, cotton and coir nets may be stapled over the mulch according to manufacturer's recommendations (See rolled erosion control products section).

Chemical mulches

Chemical mulches* may be used alone only in the following situations:

1. Where no other mulching material is available.
2. From March 15 to May 1 and August 15 to September 30, provided that they are used on areas with slopes no steeper than 4:1, which have been roughened in accordance with surface roughing standards. If rill erosion occurs, another mulch material shall be applied immediately.

* Note: Some chemical mulches may be used to bind other mulches or with fiber mulch in a hydroseeded slurry. Manufacturer's recommendations for application of chemical mulches shall be followed.

Maintenance

All mulches and soil coverings should be inspected periodically (particularly after rainstorms and high winds) to check for erosion and displacement. Where erosion is observed in mulched areas, additional mulch should be applied and erosion repaired if necessary. Nets and mats should be inspected after rainstorms for dislocation or failure. If washouts or breakage occur, reinstall netting or matting as necessary after regrading to repair damage to the slope or ditch. Inspections should take place up until grasses are firmly established or the area is redisturbed.

Table 3.12.1 Organic mulch materials and application rates

Mulches:	Rates:		Notes:
	Per acre	Per 1,000 ft^2.	
Straw or hay	1½ - 2 tons (minimum 2 tons for winter cover)	70 - 90 lbs.	Free from weeds and coarse matter. Must be anchored. Spread with mulch blower or by hand.
Fiber mulch	Minimum 1,500 lbs.	35 lbs.	Do not use as mulch for winter cover or during hot, dry periods.* Apply as slurry.
Cornstalks	4 - 6 tons	185 - 275 lbs.	Cut or shredded in 4-6" lengths. Air-dried. Do not use in fine turf areas. Apply with mulch blower or by hand.
Wood chips	4 - 6 tons	185 - 275 lbs.	Free of coarse matter. Air-dried. Treat with 12 lbs. nitrogen per ton. Do not use in fine turf areas. Apply with mulch blower, chip handler, or by hand.
Bark chips or Shredded bark	50 - 70 cu. yds.	1-2 cu. yds.	Free of coarse matter. Air-dried. Do not use in fine turf areas. Apply with mulch blower, chip handler, or by hand.

* When fiber mulch is the only available mulch during periods when straw should be used, apply at a minimum rate of 2,000 lbs./ac. or 45 lbs./1,000 sq. ft.

From VA DSWC

3.13 - ROLLED EROSION CONTROL PRODUCTS

Introduction

Rolled Erosion Control Products (RECPs) are temporary or permanent erosion control nets, blankets and three-dimensional matrixes made from a wide variety of natural (such as jute, coir and straw) and manmade materials alone or in combination. There are numerous commercially available products so great care must be used to choose the correct product for the application.

RECPs help prevent erosion in several ways. They can be a direct replacement for straw or hay mulch and provide uniform protection from raindrop erosion, moderating temperature and moisture extremes and preventing detachment of the soil by sheet flow. They can hold seed and mulch in place on slopes and in channels so that vegetation can become established. And they can be used to permanently reinforce turf to protect channels and stream banks in high flows conditions.

Conditions Where Practice Applies

Temporary Rolled Erosion Control Products

Temporary rolled erosion control products (RECPs) consist of prefabricated blankets or netting that are formed from both natural and synthetic materials. Temporary RECPs are used as a temporary surface stabilizing measure and to aid in the establishment of vegetation. They are typically used on steep slopes and to help establish grass in low velocity vegetated channels.

Temporary RECPs consist of netting or blanket materials that are used to stabilize disturbed surfaces and promote the establishment of vegetation. RECPs may also be used to stabilize the surface of channels where the flows are low to moderate until vegetation can be established.

They are manufactured from a wide variety of different materials including coconut fiber (coir), jute, nylon, polypropylene, PVC, straw, hay, or wood excelsior. These materials may be used individually, or in combination to form nets or blankets.

The products function by protecting the ground surface from the impact of raindrops and stabilize the surface until vegetation can be established. RECPs also promote the growth of vegetation by helping to keep seed in place, and by maintaining a consistent temperature and moisture content in the soil.

RECPs are not intended to provide long-term or permanent stabilization of slopes or channels. Their role is to protect the surface until the vegetation can establish itself and become the permanent stabilizing

feature. In fact, most RECPs are either biodegradable or photodegradable and will decompose over a period of time.

Jute matting must be used in conjunction with mulch. Excelsior, woven straw blankets and coir (coconut fiber) blankets may be installed without mulch. There are many other types of erosion control nets and blankets on the market that may be appropriate in certain circumstances.

In general, most nets (e.g., jute matting) require mulch in order to prevent erosion because they have a fairly open structure. Blankets typically do not require mulch because they usually provide complete protection of the surface.

The temporary rolled erosion control product shall conform to one of the following specifications and corresponding properties found in Table 3.13.1

Permanent Rolled Erosion Control Products

Permanent RECPs or Turf Reinforcement Mats (TRMs) are similar to the Temporary RECPs but they usually are intended for reinforcing grass-lined channels and stream banks and can be useful when underlying soil boundaries may subside or shift slightly after installation They are composed of ultraviolet (UV) stabilized polymeric fibers, filaments, nettings and/or wire mesh, integrating together to form a three-dimensional matrix. The types of polymer include polypropylene, polyethylene, polyamides, and polyvinyl chloride. Often TRMs are combined with organic material such as coir to aide vegetation establishment and provide the initial temporary erosion control necessary to resist the forces of running water until the vegetation can become established. Typical vegetation includes grasses that can withstand inundation.

TRMs can be installed after applying seed to the prepared soil surface or deployed first, and then seeded following infilling with soil. The former method allows the roots and shoots to grow through and interlock with the geosynthetic matrix.

For applications where natural vegetation alone will not sustain expected flow conditions and/or provide sufficient long-term erosion protection a permanent rolled erosion control product will be required The permanent RECP must have the necessary performance properties to effectively control erosion and reinforce vegetation under the expected long-term site conditions.

The permanent erosion control product shall conform to one of the specifications and corresponding properties found in Table 3.13.2.

Rolled erosion control products are designated as follows:

1. Mulch control netting. (MCN) A planar woven natural fiber or extruded geosynthetic mesh used as a temporary degradable rolled erosion control product to anchor loose fiber mulches.
2. Open weave textile. (OWT) A temporary degradable rolled erosion control product composed of processed natural or polymer yarns woven into a matrix, used to provide erosion control and facilitate vegetation establishment. Can replace straw or hay mulch.
3. Erosion control blanket. (ECP) A temporary degradable rolled erosion control product composed of processed natural or polymer fibers mechanically, structurally or chemically bound together to form a continuous matrix to provide erosion control and facilitate vegetation establishment. Can replace straw or hay mulch.
4. Turf reinforcement mat. (TRM) A rolled erosion control product composed of non-degradable synthetic fibers, filaments, nets, wire mesh and/or other elements, processed into a permanent, three-dimensional matrix of sufficient thickness. TRMs, which may be supplemented with degradable components, are designed to impart immediate erosion protection, enhance vegetation establishment and provide long-term functionality by permanently reinforcing vegetation during and after maturation. Note: TRMs are typically used in hydraulic applications, such as high flow ditches and channels, steep slopes, stream banks, and shorelines, where erosive forces may exceed the limits of natural, un-reinforced vegetation or in areas where limited vegetation establishment is anticipated.

Design Considerations for degradable RECPs

Given the wide variety of RECPs available, it is impossible to cover the design considerations for each type of product herein. Therefore, it is recommended that the designer contact a manufacturer to obtain the appropriate information. Many manufacturers provide design software and/or a RECP product selection guide through their company website. Also, the Erosion Control Technology Council (ECTC) is an organization representing suppliers and manufacturers of rolled erosion control products. (www.ectc.org) The construction specifications that follow are from that organization.

Tables 1 and 2 provide guidance on the selection of appropriate RECPs for various situations.

For channel applications, the final permanent grass lining planned for the channel should be analyzed for the 10-year storm in the permanent vegetated state. The RECP should also be analyzed for shear stress. This analysis should be for the unvegetated state, representing the situation immediately after installation. Since it is considered a temporary measure, stabilizing the channel only until vegetation is established, the RECP does not need to be analyzed for a 10-year event as the vegetation

does. Analyses of the RECP's shear strength for a 2-year event is adequate.

Design Considerations for TRMs

There is also a wide variety of TRMs available so it is impossible to cover the specific design considerations of each product. However, most TRM products are designed, tested, and rated for resistance to shear stress. As with all permanent channels use the peak flows from a 10-year/24-hour storm event.

Shear stress in channels lined with TRMs is calculated in the same manner as for grass channels. If the channel is to be vegetated, a variable Manning coefficient will need to be calculated. If the channel is being analyzed for performance with the TRM alone, a constant Manning coefficient, provided by the manufacturer, may be used..

After calculating the shear stress in the channel, an appropriate TRM able to withstand the anticipated shear stress can be selected. Most TRM manufacturers have software available to aid in the calculation of shear stress and the selection of an appropriate TRM. This software may be available through the manufacturer's website or local product representative.

TRMs should always be installed in accordance with the manufacturer's recommendations.

Construction Specifications

This specification is intended to provide general guidelines for the installation of RECPs and does not supersede manufacture's guidelines. The following sections summarize the general, accepted procedures for installation of RECPs and provide basic guidance for slope and channel installations. Detailed design/installation information should be obtained from the manufacturer.

General Procedure. Prepare a stable and firm soil surface free of rocks and other obstructions. Apply soil amendments as necessary to prepare seedbed. Apply seed and fertilizer in accordance with the Permanent Seeding Specification. Typically, RECPs are unrolled parallel to the primary direction of flow. Ensure the product maintains intimate contact with the soil surface over the entirety of the installation. Do not stretch or allow material to bridge over surface inconsistencies. Staple/stake RECPs to soil such that each staple/stake is flush with underlying soil. Install anchor trenches, seams and terminal ends as specified.

Install RECPs after application of seed, fertilizer, mulches (if necessary) and other necessary soil amendments, unless soil in-filling of the TRM is required. For TRMs if soil in-filling, install TRM, apply seed, and other soil amendments lightly brush or rake 0.3 to 0.7 in. of topsoil into TRM matrix to fill the product thickness. If in-filling with a hydraulically-

applied matrix or medium is required; install TRM, then install hydraulically-applied matrix or medium at the manufacturer's suggested application rate.

Apply MCNs (Materials Type 1.A., 2.A., 3.A.) immediately after dry mulch application.

Anchor Trenches, Seams and Terminal Ends

(A) **Anchor Trenches** – Utilize one of the methods detailed below for initial anchoring of RECPs:

1. Staples. Install the RECPs 3 ft. beyond the shoulder of the slope onto flat final grade. Secure roll end with a single row of stakes/staples on 1 ft. centers.
2. Anchor trench. Excavate a 6 in. by 6 in. (150 mm by 150 mm) anchor trench. Extend the upslope terminal end of the RECPs 3 ft. past the anchor trench. Use stakes or staples to fasten the product into the bottom of the anchor trench on 1 ft. centers. Backfill the trench and compact the soil into the anchor trench. Apply seed and any necessary soil amendments to the compacted soil and cover with remaining 1 ft. terminal end of the RECPs. Secure terminal end of RECPs with a single row of stakes or staples on 1 ft. centers.
3. Check slot. Construct a stake/staple check slot along the top edge of the RECPs by installing two rows of staggered stakes/staples 4 in. apart on 4 in. centers.

(B) **Seams** – Utilize one of the methods detailed below for seaming of RECPs:

1. Adjacent seams. Overlap edges of adjacent RECPs by 6 in. or by abutting products as defined by manufacturer. Use a sufficient number of stakes or staples to prevent seam or abutted rolls from separating.
2. Consecutive rolls. Shingle and overlap consecutive rolls 6 in. in the direction of flow. IE Cover the downslope roll with the next upslope roll.
3. Check seam. Construct a stake/staple check seam along the top edge of RECPs for slope application and at specified intervals in a channel by installing two staggered rows of stakes/staples 4 in. apart on 4 in. centers.

(C) **Terminal Ends** – Utilize one of the methods detailed below for all terminal ends of RECPs:

1. Staples. Install the RECPs 3 ft. beyond the end of the channel and secure end with a single row of stakes/staples on 1 ft. centers. Stakes/staples for securing

RECPS to the soil are typically 6 in. long. Use longer staples in sandy soils.

2. Anchor trench. Excavate a 6 in. by 6 in. anchor trench. Extend the terminal end of the RECPs 3 ft. past the anchor trench. Use stakes or staples to fasten the product into the bottom of the anchor trench on 1 ft. centers. Backfill the trench and compact the soil into the anchor trench. Apply seed and any necessary soil amendments to the compacted soil and cover with remaining 1 ft. terminal end of the RECPs. Secure terminal end of RECPs with a single row of stakes or staples on 1 ft. centers.

3. Check slot. Construct a stake/staple check slot along the terminal end of the RECPs by installing two rows of staggered stakes/staples 4 in. apart on 4 in. centers.

Slope Installations. At the top of slope, anchor the RECPs according to one of the method detailed in Section (A) above. Securely fasten all RECPs to the soil by installing stakes/staples at a minimum rate of 1.5/yd2. For the most effective RECP installation use stake/staple patterns and densities as recommended by the manufacturer. For adjacent and consecutive rolls of RECPs follow seaming instructions detailed in Section (B) above. The terminal end of the RECPs installation must be anchored using one of the methods detailed in Section (C) above.

Channel Installations. Construct an anchor trench at the beginning of the channel across its entire width according to Section (A) (2) above. Follow the manufacturer's installation guidelines in constructing additional anchor trenches or stake/staple check slots at intervals along the channel reach and at the terminal end of the channel, according to paragraph (A) above respectively. Unroll RECPs down the center of the channel in the primary water flow direction. Securely fasten all RECPs to the soil by installing stakes/staples at a minimum rate of 2/yd2. Significantly higher anchor rates and longer stakes/staples may be necessary in sandy, loose, or wet soils and in severe applications. For adjacent and consecutive rolls of RECPs follow seaming instructions detailed in Section (B) above. All terminal ends of the RECPs must be anchored using one of the methods detailed in Section (C) above.

With any RECP installation, ensure sufficient staples to resist uplift from hydraulics, wind, mowers, and foot traffic. For the most effective installation of RECPs, it is recommended to use stake/staple patterns and densities as recommended by the manufacturer.

Maintenance

During the initial period after installation inspect once at week or after every rain of 0.5" or more. Basic monitoring should consist of visual inspections to determine mat integrity and attachment performance. Rill development beneath the mat or edge lifting is evidence of inadequate attachment.

Until the vegetation is fully established, the ground surface should be inspected for signs of rill or gully erosion below the matting. Any signs of erosion, tearing of the matting, or areas where the matting is no longer anchored firmly to the ground should be repaired. Repair any damaged areas immediately by restoring soil to finished grade, re-applying soil amendments and seed, and replacing the RECPs. Additional staking and trenching can be employed to correct defects. Recently placed mats may be replaced, but once vegetation becomes established, replacement is not a reasonable option unless large failures have occurred. If the RECPs are vegetated, the vegetation should be watered as needed. Getting grass established as quickly as possible is very important.

Table 3.13.1 ECTC STANDARD SPECIFICATION FOR TEMPORARY ROLLED EROSION CONTROL PRODUCTS

For use where natural vegetation alone will provide permanent erosion protection.

ULTRA SHORT-TERM - Typical 3 month functional longevity.

Type	Product Description	*Material Composition*	Slope Applications* Maximum Gradient	Slope Applications* C Factor[2, 5]	Channel Applications* Max. Shear Stress[3, 4, 6]	Minimum Tensile Strength[1]
1.A	Mulch Control Nets	A photodegradable synthetic mesh or woven biodegradable natural fiber netting.	5:1 (H:V)	≤ 0.10 @ 5:1	0.25 lbs/ft^2 (12 Pa)	5 lbs/ft (0.073 kN/m)
1.B	Netless Rolled Erosion Control Blankets	Natural and/or polymer fibers mechanically interlocked and/or chemically adhered together to form a RECP.	4:1 (H:V)	≤ 0.10 @ 4:1	0.5 lbs/ft^2 (24 Pa)	5 lbs/ft (0.073 kN/m)
1.C	Single-net Erosion Control Blankets & Open Weave Textiles	Processed degradable natural and/or polymer fibers mechanically bound together by a single rapidly degrading, synthetic or natural fiber netting or an open weave textile of processed rapidly degrading natural or polymer yarns or twines woven into a continuous matrix.	3:1 (H:V)	≤ 0.15 @ 3:1	1.5 lbs/ft^2 (72 Pa)	50 lbs/ft (0.73 kN/m)
1.D	Double-net Erosion Control Blankets	Processed degradable natural and/or polymer fibers mechanically bound together between two rapidly degrading, synthetic or natural fiber nettings.	2:1 (H:V)	≤ 0.20 @ 2:1	1.75 lbs/ft^2 (84 Pa)	75 lbs/ft (1.09 kN/m)

SHORT-TERM - Typical 12 month functional longevity.

Type	Product Description	Material Composition	Slope Applications* Maximum Gradient	Slope Applications* C Factor[2, 5]	Channel Applications* Max. Shear Stress[3, 4, 6]	Minimum Tensile Strength[1]
2.A	Mulch Control Nets	A photodegradable synthetic mesh or woven biodegradable natural fiber netting.	5:1 (H:V)	≤ 0.10 @ 5:1	0.25 lbs/ft^2 (12 Pa)	5 lbs/ft (0.073 kN/m)
2.B	Netless Rolled Erosion Control Blankets	Natural and/or polymer fibers mechanically interlocked and/or chemically adhered together to form a RECP.	4:1 (H:V)	≤ 0.10 @ 4:1	0.5 lbs/ft^2 (24 Pa)	5 lbs/ft (0.073 kN/m)
2.C	Single-net Erosion Control Blankets & Open Weave Textiles	An erosion control blanket composed of processed degradable natural or polymer fibers mechanically bound together by a single degradable synthetic or natural fiber netting to form a continuous matrix or an open weave textile composed of processed degradable natural or polymer yarns or twines woven into a continuous matrix.	3:1 (H:V)	≤ 0.15 @ 3:1	1.5 lbs/ft^2 (72 Pa)	50 lbs/ft (0.73 kN/m)
2.D	Double-net Erosion Control Blankets	Processed degradable natural and/or polymer fibers mechanically bound together between two degradable, synthetic or natural fiber nettings.	2:1 (H:V)	≤ 0.20 @ 2:1	1.75 lbs/ft^2 (84 Pa)	75 lbs/ft (1.09 kN/m)

EXTENDED-TERM - Typical 24 month functional longevity.

Type	Product Description	Material Composition	Slope Applications* Maximum Gradient	Slope Applications* C Factor[2, 5]	Channel Applications* Max. Shear Stress[3, 4, 6]	Minimum Tensile Strength[1]
3.A	Mulch Control Nets	A slow degrading synthetic mesh or woven natural fiber netting.	5:1 (H:V)	≤ 0.10 @ 5:1	0.25 lbs/ft^2 (12 Pa)	25 lbs/ft (0.36 kN/m)
3.B	Erosion Control Blankets & Open Weave Textiles	An erosion control blanket composed of processed slow degrading natural or polymer fibers mechanically bound together between two slow degrading synthetic or natural fiber nettings to form a continuous matrix or an open weave textile composed of processed slow degrading natural or polymer yarns or twines woven into a continuous matrix.	1.5:1 (H:V)	≤ 0.25 @ 1.5:1	2.00 lbs/ft^2 (96 Pa)	100 lbs/ft (1.45 kN/m)

LONG-TERM - Typical 36 month functional longevity.

Type	Product Description	Material Composition	Slope Applications* Maximum Gradient	Slope Applications* C Factor[2, 5]	Channel Applications* Max. Shear Stress[3, 4, 6]	Minimum Tensile Strength[1]
4	Erosion Control Blankets & Open Weave Textiles	An erosion control blanket composed of processed slow degrading natural or polymer fibers mechanically bound together between two slow degrading synthetic or natural fiber nettings to form a continuous matrix or an open weave textile composed of processed slow degrading natural or polymer yarns or twines woven into a continuous matrix.	1:1 (H:V)	≤ 0.25 @ 1:1	2.25 lbs/ft^2 (108 Pa)	125 lbs/ft (1.82 kN/m)

** "C" factor and shear stress for Types 1.A., 2.A. and 3.A mulch control nettings must be obtained with netting used in conjunction with pre-applied mulch material.*

[1] Minimum Average Roll Values, Machine direction using ECTC Mod. ASTM D 5035.

[2] "C" Factor calculated as ratio of soil loss from RECP protected slope (tested at specified or greater gradient, h:v) to ratio of soil loss from unprotected (control) plot in large-scale testing.These performance test values should be supported by periodic bench scale testing under similar test conditions using Erosion Control Technology Council (ECTC) Test Method # 2.

[3] Required minimum shear stress RECP (unvegetated) can sustain without physical damage or excess erosion (> 12.7 mm (0.5 in) soil loss) during a 30-minute flow event in large-scale testing. These performance test values should be supported by periodic bench scale testing under similar test conditions and failure criteria using Erosion Control Technology Council (ECTC) Test Method #3.

[4] The permissible shear stress levels established for each performance category are based on historical experience with products characterized by Manning's roughness coeffecients in the range of 0.01 - 0.05.

[5] Acceptable large-scale test methods may include ASTM D6459, Erosion Control Technology Council (ECTC) Test Method # 2, or other independent testing deemed acceptable by the engineer.

[6] Per the engineers discretion. Recommended acceptable large-scale testing protocol may include ASTM D6460, Erosion Control Technology Council (ECTC) Test Method #3 or other independent testing deemed acceptable by the engineer.

Table 3.13.2 ECTC STANDARD SPECIFICATION FOR PERMANENT ROLLED EROSION CONTROL PRODUCTS

For applications where vegetation alone will not sustain expected flow conditions and/or provide sufficient long-term erosion protection.

Permanent[1] - All categories of TRMs must have a minimum thickness of 0.25 inches (6.35 mm) per ASTM D 6525 and U.V. stability of 80% per ASTM D 4355 (500 hours exposure).

Type	Product Description	Material Composition	Slope Applications Maximum Gradient	Channel Applications Maximum Shear Stress[4, 5]	Minimum Tensile Strength[2,3]
5.A	Turf Reinforcement Mat	Turf Reinforcement Mat (TRM) – A rolled erosion control product composed of non-degradable synthetic fibers, filaments, nets, wire mesh and/or other elements, processed into a permanent, three-dimensional matrix of sufficient thickness. TRMs, which may be supplemented with degradable components, are designed to impart immediate erosion protection, enhance vegetation establishment and provide long-term functionality by permanently reinforcing vegetation during and after maturation. Note: TRMs are typically used in hydraulic applications, such as high flow ditches and channels, steep slopes, stream banks, and shorelines, where erosive forces may exceed the limits of natural, unreinforced vegetation or in areas where limited vegetation establishment is anticipated.	0.5:1 (H:V)	6.0 lbs/ft^2 (288 Pa)	125 lbs/ft (1.82 kN/m)
5.B	Turf Reinforcement Mat		0.5:1 (H:V)	8.0 lbs/ft^2 (384 Pa)	150 lbs/ft (2.19 kN/m)
5.C	Turf Reinforcement Mat		0.5:1 (H:V)	10.0 lbs/ft^2 (480 Pa)	175 lbs/ft (2.55 kN/m)

[1] For TRMs containing degradable components, all property values must be obtained on the non-degradable portion of the matting alone.

[2] Minimum Average Roll Values, machine direction only for tensile strength determination using ASTM D6818 (Supercedes Mod. ASTM D5035 for RECPs)

[3]Field conditions with high loading and/or high survivability requirements may warrant the use of a TRM with a tensile strength of 44 kN/m (3,000 lb/ft) or greater.

[4] Required minimum shear stress TRM (fully vegetated) can sustain without physical damage or excess erosion (> 12.7 mm (0.5 in.) soil loss) during a 30-minute flow event in large scale testing. These performance test values should be supported by periodic bench scale testing under similar test conditions and failure criteria using Erosion Control Technology Council (ECTC) Test Method #3.

[5] Acceptable large-scale testing protocol may include ASTM D6460, Erosion Control Technology Council (ECTC) Test Method #3, or other independent testing deemed acceptable by the engineer

Table 3.13.3 PERMISSIBLE VELOCITIES FOR EARTH LININGS

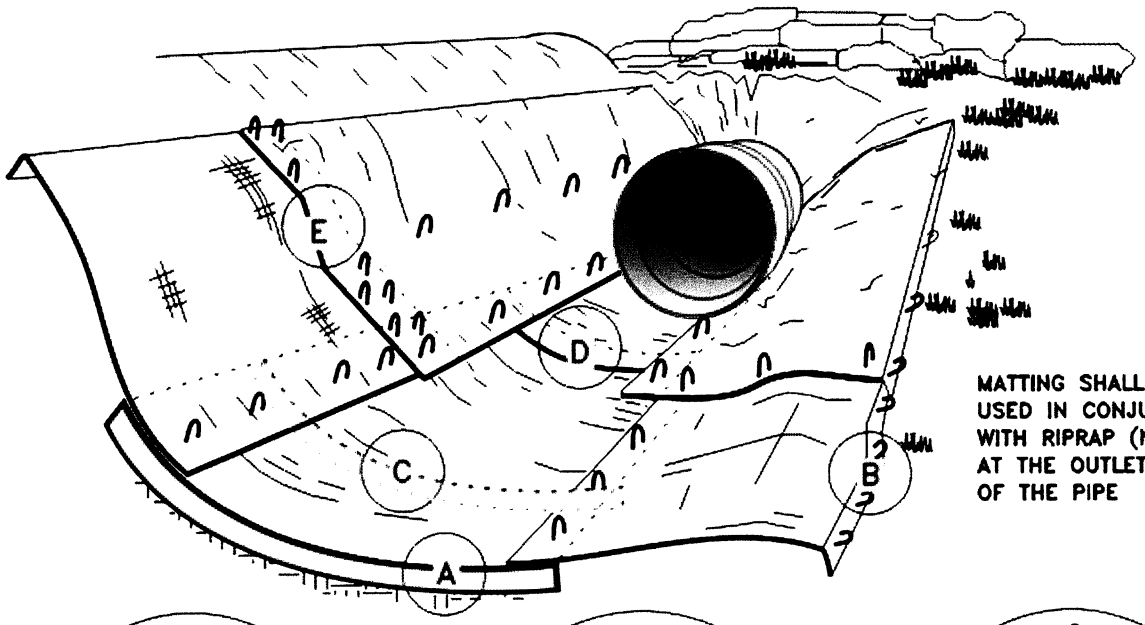
Soil Types	Permissible Velocities (ft./sec.)
Fine Sand (noncolloidal)	2.5
Sandy Loam (noncolloidal)	2.5
Silt Loam (noncolloidal)	3.0
Ordinary Firm Loam	3.5
Fine Gravel	5.0
Stiff Clay (very colloidal)	5.0
Graded, Loam to Cobbles (noncolloidal)	5.0
Graded, Silt to Cobbles (colloidal)	5.5
Alluvial Silts (noncolloidal)	5.5
Alluvial Silts (colloidal)	5.0
Coarse Gravel (noncolloidal)	6.0
Cobbles and Shingles	5.5
Shales and Hard Plans	6.0

Table 3.13.4 PERMISSIBLE VELOCITIES FOR GRASS-LINED CHANNELS

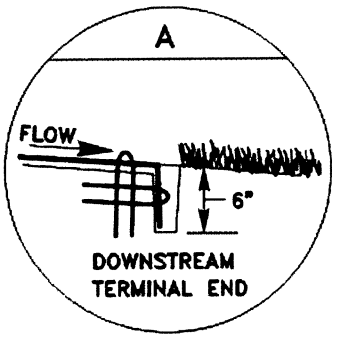
Channel Slope	Lining	Velocity* (ft./sec.)
0 - 0.5%	Bermudagrass	6
	Reed canarygrass Tall fescue Kentucky bluegrass	5
	Grass-legume mixture	4
	Red fescue Redtop Sericea lespedeza Annual lespedeza Small grains Temporary vegetation	2.5
5 - 10%	Bermudagrass	5
	Reed canarygrass Tall fescue Kentucky bluegrass	4
	Grass-legume mixture	3
Greater than 10%	Bermudagrass	4
	Reed canarygrass Tall fescue Kentucky bluegrass	3
* For highly erodible soils, decrease permissible velocities by 25%.		

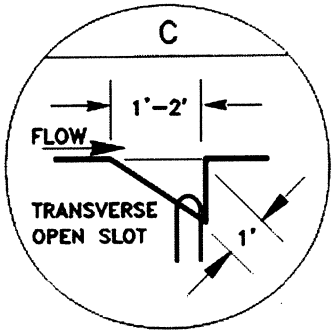
FIGURE 3.13.1

TYPICAL RECP CHANNEL INSTALLATION

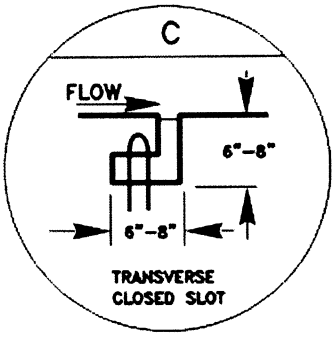


MATTING SHALL BE USED IN CONJUNCTION WITH RIPRAP (NOT SHOWN) AT THE OUTLET END OF THE PIPE

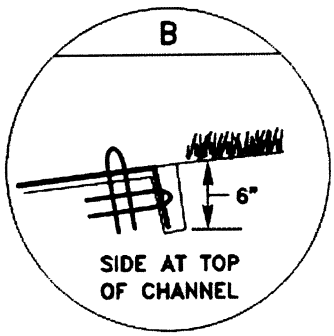


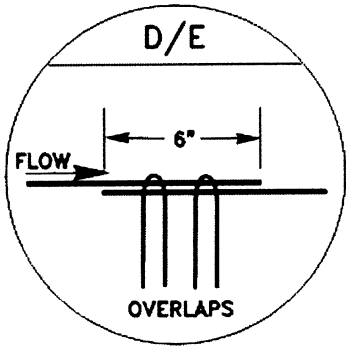


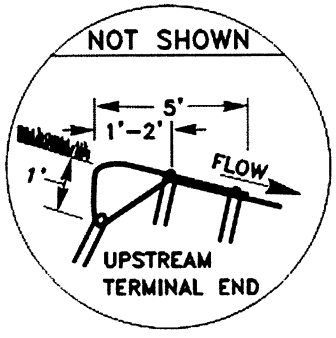
OR



THESE CONFIGURATIONS ARE EXAMPLES ONLY
ALWARYS INSTALL PER MANUFACTURER'S RECOMMENDATIONS



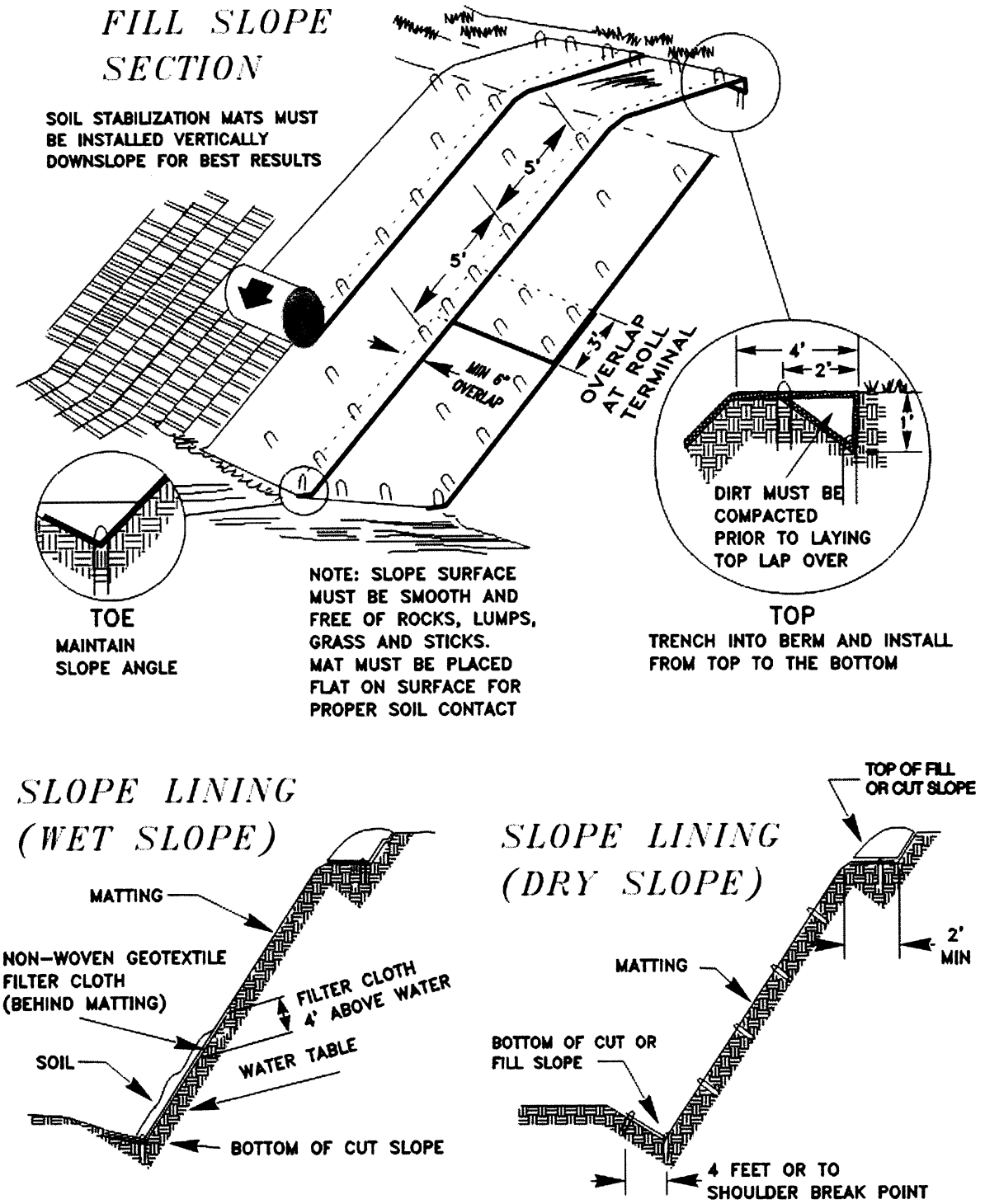




SOURCE: VIRGINIA DCR–DSWC AND NORTH AMERICAN GREEN

FIGURE 3.13.2

ROLLED EROSION CONTROL PRODUCTS



SOURCE: VDOT STANDARDS AND VIRGINIA DCR-DSWC

3.14 - SODDING

Introduction

The purpose of sodding is to establish permanent turf for immediate erosion protection and to stabilize drainage ways where concentrated overland flow will occur.

Conditions Where Practice Applies

Sodding may be used in the following areas:

1. Disturbed areas that require short-term or long-term cover
2. Disturbed areas that require immediate vegetative cover
3. All waterways that require vegetative lining. Waterways may also be seeded rather than sodded and protected with a RECP.

Design Consideration

Sod shall be free of weeds, of uniform thickness (approximately 1-inch thick), and shall have a dense root mat for mechanical strength.

Construction Specifications

The following steps are recommended for sod installation:

1. Shape and smooth the surface to final grade in accordance with the approved grading plan.
2. Amend two inches (minimum) of well-rotted compost into the top six inches of the soil if the organic content of the soil is less than 10 percent.
3. Fertilize according to the supplier's recommendations. Disturbed areas within 200 feet of waterbodies and wetlands must use non-phosphorus fertilizer.
4. Work lime and fertilizer one to two inches into the soil, and smooth the surface.
5. Lay strips of sod beginning at the lowest area to be sodded and perpendicular to the direction of water flow. Wedge strips securely into place. Square the ends of each strip to provide for a close, tight fit.
6. Stagger joints at least 12 inches. Staple on slopes steeper than 3:1. Roll the sodded area and irrigate.
7. When sodding is carried out in alternating strips or other patterns, seed the areas between the sod immediately after sodding.

Maintenance

If the grass is unhealthy, the cause shall be determined and appropriate action taken to reestablish a healthy groundcover. If it is impossible to establish a healthy groundcover due to frequent saturation, instability or some other cause, the sod shall be removed, the area seeded with an appropriate mix, and protected with a net or blanket.

3.15 - TEMPORARY DIVERSION

Introduction

A temporary berm or excavated channel or combination berm and channel constructed across sloping land on a predetermined grade. This variable practice is used to protect work areas from upslope runoff and reduce the size of the drainage are going to sediment trapping structures, transport runoff across a project to minimize erosion and to divert sediment-laden water to an appropriate sediment trapping facility.

Conditions Where Practice Applies

This practice applies to construction areas where runoff can be diverted and disposed of properly to control erosion, sedimentation, or flood damage. Specific locations and conditions can include the following:

1. To divert upslope clean water around a construction site to reduce the quantity of water within the sediment control system. Also called a clean water ditch or upslope diversion.
2 To shorten or reduce the length of the slope that runoff will cross. (see also RIGHT OF WAY DIVERSION and the WATER CONTROL sections)
3. To divert upslope water from disturbed areas such as cut or fill slopes to a stabilized outlet or if sediment laden, to a sediment trapping device. Similar in concept to upslope diversion.
5. To divert sediment laden water at or near the perimeter of the construction area to either a sediment basin or a sediment trap. Also called a dirty water ditch or perimeter ditch.
6. To divert internal sediment laden water to a sediment-trapping structure or a stabile internal waterway.
7. Above critical disturbed areas before stabilization to prevent erosion and maintain acceptable working conditions
8. To divert water away from footers, walls, and other structures.

Design Considerations

It is important that diversions are properly designed, constructed and maintained since they concentrate water flow and increase erosion potential. Temporary diversions must be designed and installed so they stable throughout their useful life and to meet the criteria given in this section. Particular care must be taken in planning diversion grades. Too much slope can result in erosion in the diversion channel. This is especially true at the entrance to a sediment trapping structure. Conversely, a reduction in grade will cause sediment to be deposited, plugging the channel. The blockage may cause failure by overtopping and the discharge of sediment-laden runoff off site.

Frequent inspection and timely maintenance are essential to the proper functioning of diversions. Sufficient area should be available to construct and properly maintain diversions.

It is usually less costly to excavate a channel and form a ridge or dike on the downhill side with the spoil than to build diversions by other methods. Where space is limited, it may be necessary to build the ridge by hauling in the berm material. If the diversion is located where construction traffic will cross, stabilize the channel and berm with stone. If there will be extensive traffic it will be necessary to install a temporary culvert.

Whenever possible, install dirty water diversions in conjunction with the construction of the sediment trapping structure prior clearing and grubbing. Install other types diversions as needed.

Because diversions collect overland flow, changing it into concentrated flows, they can create an additional erosion hazard. In areas of highly erodible soils it may be necessary to armor the channel with riprap. This will be necessary especially in the transition into a sediment trap or basin and on slopes over 10 percent.

For longer slopes, several dikes or swales are placed across the slope at intervals. This practice reduces the amount of runoff that accumulates on the face of the slope and carries the runoff safely down the slope.

Diversion may create difficulties in establishing vegetation if water flow is too fast or ponds.

Poorly laid out and constructed diversion require unnecessary additional maintenance, inspections, and repairs.

Interceptor dikes and swales can be permanent controls. However, permanent controls: must be designed to handle runoff after construction is complete, must be permanently stabilized, and should be inspected and maintained on a regular basis.

If the watershed drained by the diversion is unstabilized at any time, the diversion must lead to a sediment-trapping device.

General design criteria:

1. Drainage area should not exceed five acres.
2. The minimum cross section should be adequate for the anticipated flows but at a minimum must handle the peak discharge from a 2-year/24-hour storm.
3. The grade may be variable depending upon the topography and must have a positive grade along its entire length. The maximum channel grade should be limited to 5.0 percent.

5 Diverted runoff must outlet onto a stabilized area, into a properly designed waterway, grade stabilization structure or sediment trapping facility.

6. Diversions that are to serve longer than 14 working days shall be stabilized immediately with seed and mulch with or without a