Section I – SITE PREPARATION

March 2003

37.0 STANDARDS AND SPECIFICATIONS

FOR

LAND GRADING

Definition

Reshaping of the existing land surface in accordance with a plan as determined by engineering survey and layout.

Purpose

The purpose of a land grading specification is to provide for erosion control and vegetative establishment on those areas where the existing land surface is to be reshaped by grading according to plan.

Design Criteria

The grading plan should be based upon the incorporation of building designs and street layouts that fit and utilize existing topography and desirable natural surroundings to avoid extreme grade modifications. Information submitted must provide sufficient topographic surveys and soil investigations to determine limitations that must be imposed on the grading operation related to slope stability, effect on adjacent properties and drainage patterns, measures for drainage and water removal and vegetative treatment, etc.

The plan must show existing and proposed contours of the area(s) to be graded. The plan shall also include practices for erosion control, slope stabilization, safe disposal of runoff water and drainage, such as waterways, lined ditches, reverse slope benches (include grade and cross section), grade stabilization structures, retaining walls, and surface and subsurface drains. The plan shall also include phasing of these practices. The following shall be incorporated into the plan:

1. Provisions shall be made to safely conduct surface runoff to storm drains, protected outlets or to stable water courses to insure that surface runoff will not damage slopes or other graded areas.

2. Cut and fill slopes that are to be stabilized with grasses shall not be steeper than 2:1. (Where the slope is to be mowed the slope should be no steeper than 3:1; 4:1 is preferred because of safety factors related to mowing steep slopes.) Slopes exceeding 2:1 shall require special design and stabilization considerations that shall be adequately shown on the plans.

3. Reverse benches shall be provided whenever the vertical interval (height) of any 2:1 slope exceeds 20 feet; for 3:1 slope it shall be increased to 30 feet and for 4:1

to 40 feet. Benches shall be located to divide the slope face as equally as possible and shall convey the water to a stable outlet. Soils, seeps, rock outcrops , etc. , shall also be taken into consideration when designing benches.

a. Benches shall be a minimum of six-feet wide to provide for ease of maintenance.

b. Benches shall be designed with a reverse slope of 6:1 or flatter to the toe of the upper slope and with a minimum of one foot in depth. Bench gradient to the outlet shall be between 2 percent and 3 percent, unless accompanied by appropriate design and computations.

c. The flow length within a bench shall not exceed 800' unless accompanied by appropriate design and computations. For flow channel stabilization, see temporary swale.

4. Surface water shall be diverted from the face of all cut and/or fill slopes by the use of earth dikes, ditches and swales or conveyed downslope by the use of a designed structure, except where:

   a. The face of the slope is or shall be stabilized and the face of all graded slopes shall be protected from surface runoff until they are stabilized.

   b. The face of the slope shall not be subject to any concentrate flows of surface water such as from natural drainageways, graded swales, downspouts, etc.

   c. The face of the slope will be protected by special erosion control materials, to include, but not limited to: approved vegetative stabilization practices (see section G), rip-rap or other approved stabilization methods.

5. Cut slopes occurring in ripable rock shall be serrated as shown in detail 70, Serrated Slopes on the following diagram. These serrations shall be made with conventional equipment as the excavation is made. Each step or serration shall be constructed on the contour and will have steps cut at nominal two-foot intervals with nominal three-foot horizontal shelves. These steps will vary depending on the slope ratio or the cut slope. The nominal slope line is 1:5:1. These steps will weather and act to hold moisture, lime, fertilizer and seed thus producing a much quicker and longer lived vegetative cover and better slope stabilization. Overland flow shall be diverted from the top of all serrated cut slopes and carried to a suitable outlet.

6. Subsurface drainage shall be provided where necessary to intercept seepage that would otherwise adversely affect slope stability or create excessively wet site conditions.

7. Slopes shall not be created so close to property lines as to endanger adjoining properties without adequately protecting such properties against sedimentation, erosion, slippage, settlement, subsidence or other related damages.

8. Fill material shall be free of snow, ice, frozen materials, trash, brick, clay lumps, hazardous material, broken concrete, tree roots, sod, ashes, cinders, glass, plaster, orgainic matter, brush, logs, stumps, building debris and any other foreign material. It should be free of stones over two (2) inches in diameter where compacted by hand or mechanical tampers or over eight (8) inches in diameter where compacted by rollers or other equipment. Frozen material shall not be placed in the fill nor shall the fill material be placed on a frozen foundation.

9. Stockpiles, borrow areas and spoil shall be shown on the plans and shall be subject to the provisions of this Standard and Specifications.

10. All disturbed areas shall be stabilized structurally or vegetatively in compliance with 42.0 Standards and Specifications for Vegetative Stabilization.

Fill – Classes

1. The grading plans and specifications shall specify and delineate the use and extent of fills in accordance with the following classifications:

   a. Class 1 fill – Load-bearing fills proposed for support of buildings, walls, and other structures, the function thereof which would be especially impaired by settlement.

   b. Class 2 fill – Load-bearing fills proposed for support of roadways, pavements, rigid utility lines, house connections, and structures which would not be especially impaired by moderate settlement.

   c. Class 3 fill – Common fills proposed for lawns, landscape plantings, or for other nonload-bearing usage.

Fill – Materials

1. All class 1 and 2 fills shall consist of readily compactible soils meeting the following minimum requirements:

   a. Fill material shall be free of snow, ice, frozen materials, trash, clay lumps, hazardous materials, tree roots, sod, ashes, cinders, glass, plaster, orgainc matter, brush, logs, stumps, building debris, organic or other deleterious materials subject to decay, and high shrink-swell soils.

b. Irreducible materials other than rock (such as concrete or brick) shall only be allowed only upon approval of the Watershed Protection Division.

c. No rock or approved irreducible material with a maximum dimension greater than eighteen (18) inches shall be buried or placed in any portion of the fill, with the top two and one-half (2-1/2) feet below finished grade, foundations, utility service connections having nothing larger than eight (8) inches, unless permitted by the Building Official after receipt of a report by a geotechnical engineer certifying that he has investigated the property and the fill materials, and that a fill including oversized materials may be constructed to meet the intent of the Watershed Protection Division.

2. All class 3 fills shall meet the following minimum requirements:

a. Irreducible materials other than rock (such as concrete or brick) shall only be allowed upon approval of the Watershed Protection Division.

b. Class 3 fills may include the more difficult to compact soils, at other than optimum moisture content; rock and similar approved materials without limit to size provided no detectable voids are formed, into which overlying soils may later be washed; and top soil, intermittently layered with nonorganic soil. In other than rock gardens, at least twelve (12) inches of soil must cover all rock, or approved irreducible materials with a maximum dimension greater than eight (8) inches.

3. The material must be free of contamination levels of any pollutant which is, or may be considered to represent, a possible health hazard to the public or may be detrimental to surface or ground water quality, or which may cause damage to property or the drainage system.

4. <u>All fill material shall be free of hazardous materials and shall be in compliance with the applicable articles (article numbers 204, 206, 207.04, 208, 804.02, 804.03, 804.04, 805.02) of the District of Columbia DPW Standard Specification for Highways and Structures 1996.</u>

Fills – Compaction

1. Each layer of class 1 and class 2 fills shall be compacted at optimum moisture content (plus or minus two (2) percentage points), and to a minimum of ninety-five (95) to ninety (90) percent, respectively, of maximum density as determined in the laboratory by the Standard Proctor Test (AASHTO T-99, ASTM D-698). Each layer of class 3 fills shall be compacted sufficiently to support customarily used tracked spreading equipment and upon completion to be stable and after planting to prevent erosion. Other methods of compaction that the Director

deems appropriate and results in an equal or better quality of compaction for Class 1 and 2 fills may be accepted.

a. Lower degrees of compaction may be permitted by the Watershed Protection Division after receipt of a report by a geotechnical engineer certifying that the geotechnical engineer has investigated the subsoils of the site, has tested representative fill materials and that, in the opinion of the geotechnical engineer, such lower degree of compaction will be adequate for the intended use of the fill.

b. In-place (field) density shall be determined in accordance with the ASTM test Method D-1556-82E, D-2922-91 or AASHTO T-191-86, T-238-86.

c. All fills shall be placed in approximately horizontal layers, each layer having a loose thickness of not more than eight (8) inches for class 1, twelve (12) inches for class 2, and two (2) feet for class 3 fills. If approved by the Watershed Protection Division, thicker lifts may be permitted only upon submittal of adequate density test documentation of limited test fills.

Subgrade – Compaction

1. The top eight (8) inches of soil in cut, or the required class 2 fill sections to be used as subgrade for support of patios, building floor slabs, driveways, parking pads and lots, sidewalks, and other structures which would not be especially impaired by moderate settlement shall be compacted, or recompacted, to at least ninety (90%) of maximum density as determined by the Standard Proctor Test.

Slopes

1. Slopes of site grading drainage, and other improvements and facilities shall be determined by the preparer of the plan to suit the specific site and in accordance with accepted engineering practice.

a. No fill or cut shall be made which created an exposed surface steeper in slope than two (2) horizontal to one (1) vertical unless specifically waived by the Watershed Protection Division after receipt of a report by a geotechnical engineer certifying that the engineer has investigated the property, and that, in the engineer's opinion, such steeper slope will be structurally stable and that the ground cover to be used is of a low maintenance type and will effectively control erosion.

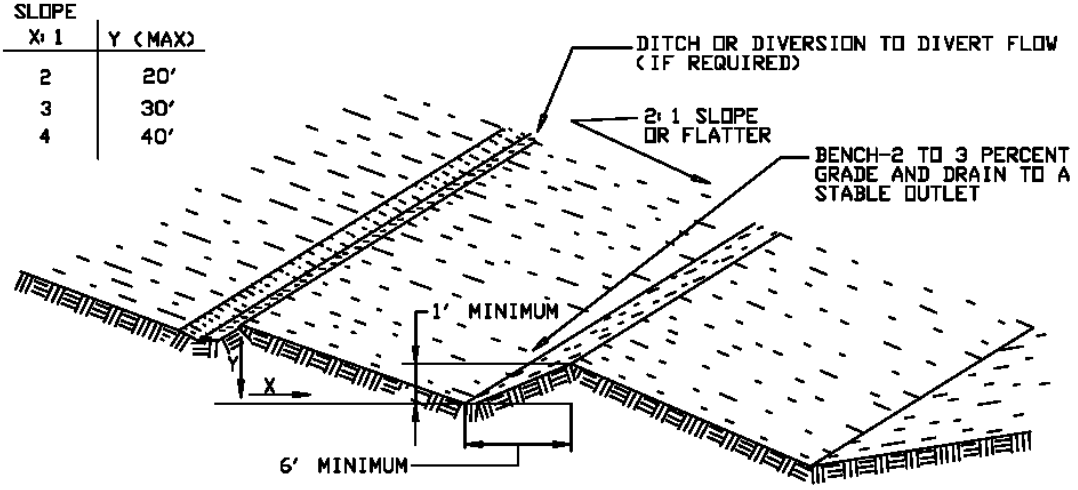
b. The Watershed Protection Division may require that slopes be constructed with exposed surface flatter than those shown in Detail 69, or may require

such other measures as the Watershed Protection Division deems necessary for stability and safety.

c. Sides of temporary excavations made for foundations, buildings, and utility installations shall be protected, shored, or sloped as required by applicable District of Columbia regulations.

DETAIL 69 - BENCHED SLOPES

SLOPE X: 1	Y (MAX)
2	20'
3	30'
4	40'



Construction Specifications

1. All fills shall be compacted as required to reduce erosion, slippage, settlement, subsidence or other related problems. Fill intended to support buildings, structures and conduits, etc., shall be compacted in accordance with local requirements or codes.

2. All fill shall be placed and compacted in layers not to exceed 8" in thickness.

3. Except for approved landfills or nonstructural fills, fill material shall be free of snow, ice, frozen materials, trash, brick, clay lumps, hazardous material, broken concrete, tree roots, sod, ashes, cinders, glass, plaster, orgainic matter, brush, logs, stumps, building debris and any other foreign materials that would interfere with or prevent construction of satisfactory fills.

4. Frozen material or soft, mucky or highly compressible materials shall not be incorporated into fill slopes or structural fills. Fill shall not be placed on a frozen foundation.

5. All benches shall be kept free of sediment during all phases of development.

6. Seeps or springs encountered during construction shall be handled in accordance with the Standard and Specification for Subsurface Drain or other approved methods.

7. All graded areas shall be permanently stabilized immediately following finished grading.

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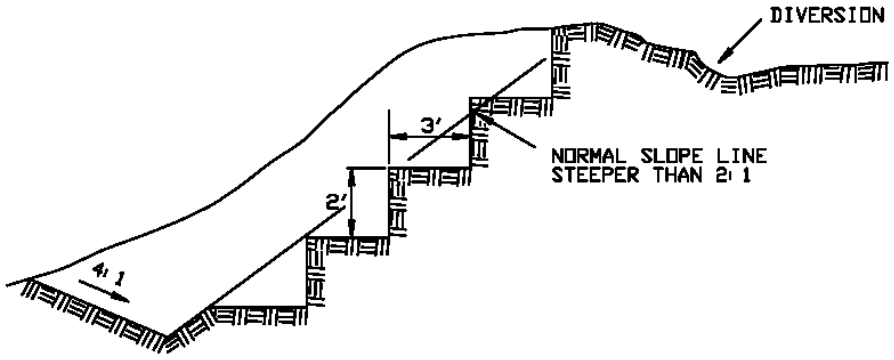
DETAIL 70 - SERRATED SLOPES



TYPICAL SECTION

Construction Specifications

1. Cut slopes occurring in ripable rock shall be serrated as shown. Serrations shall be made with conventional equipment as the excavation is made.

2. Each step or serration shall be constructed on the contour and will have steps cut at nominal two-foot intervals with nominal three-foot horizontal shelves.

3. Steps will vary depending on the slope ratio or the cut slope.

4. Overland flow shall be diverted from the top of all serrated cut slopes and carried to a suitable outlet.

5. All benches shall be kept free of sediment during all phases of development.

6. Seeps or springs encountered during construction shall be handled in accordance with the Standard and Specification for Subsurface Drain or other approved methods.

7. All graded areas shall be permanently stabilized immediately following finished grading.

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38.0 STANDARD AND SPECIFICATIONS

FOR

TOPSOIL

Definition

Placement of topsoil over a prepared subsoil prior to establishment of permanent vegetation.

Purpose

To provide a suitable soil medium for vegetative growth. Soils of concern have low moisture content, low nutrient levels, low pH, materials toxic to plants, and/or unacceptable soil gradation.

Conditions Where Practice Applies

I. This practice is limited to areas having 2:l or flatter slopes where:

   a. The texture of the exposed subsoil/parent material is not adequate to produce vegetative growth.

   b. The soil material is so shallow that the rooting zone is not deep enough to support plants or furnish continuing supplies of moisture and plant nutrients.

   c. The original soil to be vegetated contains material toxic to plant growth.

   d. The soil is so acidic that treatment with limestone is not feasible.

II. For the purpose of these Standards and Specifications, areas having slopes steeper than 2:1 require special consideration and design for adequate stabilization. Areas having slopes steeper than 2:1 shall have the appropriate stabilization shown on the plans.

Construction and Material Specifications

I. Topsoil salvaged from the existing site may be used provided that it meets the standards as set forth in these specifications. Typically, the depth of topsoil to be salvaged for a given soil type can be found in the representative soil profile section in the Soil Survey published in the NRCS District of Columbia Soil Survey Manual.

II. Topsoil Specifications - Soil to be used as topsoil must meet the following:

i. Topsoil shall be a loam, sandy loam, clay loam, silt loam, sandy clay loam, loamy sand. Other soils may be used if recommended by an agronomist or soil scientist and approved by the Watershed Protection Division. Regardless, topsoil shall not be a mixture of contrasting textured subsoils and shall contain less than 5% by volume of cinders, stones, slag, coarse fragments, gravel, sticks, roots, trash, or other materials larger than 11/2 " in diameter.

ii. Topsoil must be free of plants or plant parts such as bermuda grass, quackgrass, Johnsongrass, nutsedge, poison ivy, thistle, other posionous plants or others as specified.

iii. Where the subsoil is either highly acidic or composed of heavy clays, ground limestone shall be spread at the rate of 4-8 tons/acre (200-400 pounds per 1,000 square feet) prior to the placement of topsoil. Lime shall be distributed uniformly over designated areas and worked into the soil in conjunction with tillage operations as described in the following procedures.

III. For sites having disturbed areas under 5 acres:

i. Place topsoil (if required) and apply soil amendments as specified in 42.0 Vegetative Stabilization - **Section I - Vegetative Stabilization Method and Materials.**

IV. For sites having disturbed areas over 5 acres:

i. On soil meeting Topsoil specifications, obtain test results dictating fertilizer and lime amendments required to bring the soil into compliance with the following:

a. pH for topsoil shall be between 6.0 and 7.5. If the tested soil demonstrates a pH of less than 6.0, sufficient lime shall be perscribed to raise the pH to 6.5 or higher.

b. Organic content of topsoil shall be not less than 1.5 percent by weight.

c. Topsoil having soluble salt content greater than 500 parts per million shall not be used.

d. No sod or seed shall be placed on soil which has been treated with soil sterilants or chemicals used for weed control until sufficient time has elapsed (14 days min.) to permit dissipation of phyto-toxic materials.

Note: Topsoil substitutes or amendments, as recommended by a qualified agronomist or soil scientist and approved by the Waterhed Protection Agency, may be used in lieu of natural topsoil.

ii. Place topsoil (if required) and apply soil amendments as specified in 42.0 Vegetative Stabilization - **Section I- Vegetative Stabilization Method and Materials.**

V. Topsoil Application

i. When topsoiling, maintain needed erosion and sediment control practices such as diversions, Grade Stabilization Structures, Earth Dikes, Slope Silt Fence and Sediment Traps and Basins.

ii. Grades on the areas to be topsoiled, which have been previously established, shall be maintained, albeit 4" - 8" higher in elevation.

iii. Topsoil shall be uniformly distributed in a 4" - 8" layer and lightly compacted to a minimum thickness of 4". Spreading shall be performed in such a manner that sodding or seeding can proceed with a minimum of additional soil preparation and tillage. Any irregularities in the surface resulting from topsoiling or other operations shall be corrected in order to prevent the formation of depressions or water pockets.

iv. Topsoil shall not be placed while the topsoil or subsoil is in a frozen or muddy condition, when the subsoil is excessively wet or in a condition that may otherwise be detrimental to proper grading and seedbed preparation.

VI. Alternative for Permanent Seeding - Instead of applying the full amounts of lime and commercial fertilizer, composted sludge and amendments may be applied as specified below:

i. Composted Sludge Material for use as a soil conditioner for sites having disturbed areas over 5 acres shall be tested to prescribe amendments and for sites having disturbed areas under 5 acres shall conform to the following requirements:

a. Composted sludge shall be supplied by, or originate from, a person or persons that are permitted (at the time of acquisition of the compost) by either the state of Maryland or the state of Virgina.

b. Composted sludge shall contain at least 1 percent nitrogen, 1.5 percent phosphorus, and 0.2 percent potassium and have a Ph of 7.0 to 8.0. If compost does not meet these requirements, the appropriate constituents must be added to meet the requirements prior to use.

c. Composted sludge shall be applied at a rate of 1 ton/1,000 square feet.

ii. Composted sludge shall be amended with a potassium fertilizer applied at the rate of 4 lb/1,000 square feet, and 1/3 the normal lime application rate.

References: Guideline Specifications, Soil Preparation and Sodding. MD- V A, Pub. #1, Cooperative Extension Service, University of Maryland and Virginia Polytechnic Institutes. Revised 1973.

39.0 STANDARDS AND SPECIFICATIONS

FOR

BLANKETS AND MATTING

Definition

The installation of a protective covering (blanket) or a soil stabilization mat on a prepared planting area of a steep slope, channel or shoreline.

Purpose

To aid in controlling erosion on critical areas by providing a micro climate which protects young vegetation and promotes its establishment. In addition, some types of soil stabilization mats are also used to raise the maximum permissible velocity of turf grass stands in channelized areas by "reinforcing the turf' to resist the forces of erosion during storm events.

Conditions Where Practice Applies

On short, steep slopes where erosion hazard is high and planting is likely to be too slow in providing adequate protective cover; in vegetated channels where the velocity of design flow exceeds "allowable" velocity; on streambanks or tidal shorelines where moving water is likely to wash out new plantings; or in areas where the forces of wind prevent standard mulching practices from remaining in place until vegetation becomes established.

Planning Considerations

Soil stabilization blankets and mats can be applied to problem areas to supplement nature's erosion control system (vegetation) in its initial establishment and in providing a safe and "natural" conveyance for high velocity stormwater runoff. They are being used today in many applications where previously a structural lining would have been required. Care must be taken to choose the type of blanket or matting which is most appropriate for the specific needs of a project. Two general types of blankets and mats are discussed within this specification. However, with the abundance of soil stabilization products available today, it is impossible to cover all the advantages, disadvantages and specifications of all manufactured blankets and mats. Therefore, as with many erosion control-type products, recommendations and a site visit by a designer or plan reviewer to verify a product's appropriateness.

Treatment-l is a degradable soil stabilization blanket which includes "combination" blankets consisting of a plastic netting which covers and is intertwined with a natural

organic or manmade mulch; or, a jute mesh which is typically homogeneous in design and can act alone as a soil stabilization blanket.

It should be used to help establish vegetation on previously disturbed slopes - normally problem slopes of 3:1 or greater. Since the materials which compose the soil stabilization blankets will deteriorate over time, they should be used in permanent conveyance channels with the realization that the system's resistance to erosion is based on the type of vegetation planted and the existing soil characteristics. During the establishment of vegetation, **Treatment-l** should not be subjected to shallow or deep concentrated flows moving at greater than 4 feet/second.

Treatment-l provides the following benefits in the achievement of vegetative stabilization when properly applied over seed and required amendments:

1. Protection of the seed and soil from raindrop impact and subsequent displacement.

2. Thermal consistency and moisture retention for seedbed area.

3. Stronger and faster germination of grasses and legumes.

4. Planing off excess stormwater runoff.

5. Prevention of sloughing of topsoil added to steeper slopes.

Treatment-2 is a soil stabilization matting which consists of a non-degradable, 3-dimensional plastic structure which can be filled with soil prior to planting. This configuration provides a matrix for root growth where the matting becomes entangled and penetrated by roots, forming continuous anchorage for surface growth and promoting enhanced energy dissipation. Treatment-2 can be used on problem slopes (normally 3:1 or greater), and in stormwater conveyance channels.

In addition to those benefits noted for **Treatment-l, Treatment-2** provides the following benefits in the achievement of vegetative stabilization and in the replacement of more traditional channel linings such as concrete and riprap:

1. Causes soil to drop out of stormwater and fill matrix with fine soils which become the growth medium for the development of roots.

2. When embedded in the soil within stormwater channels, it acts with the vegetative root system to form an erosion resistant cover which resists hydraulic lift and shear forces.

Since **Treatment-2** is non-degradable, it can be used in permanent conveyance channels and can withstand higher velocities of flow than the vegetation and soil would normally allow. However, a 10 feet/second velocity of flow should be the maximum allowed in a conveyance system which utilizes **Treatment-2**.

TREATMENT-l: SOIL STABILIZATION BLANKET

(Allowable Velocity Range During Vegetation Establishment: 0- 4 f.p.s.)

Materials

1. Combination Blankets - They shall consist of a photo-degradable plastic netting which covers and is entwined in a natural organic or man-made mulching material.

   The mulching material shall consist of wood fibers, wood excelsior, straw, coconut fiber, or man-made fibers, or a combination of the same. The blanket shall be of consistent thickness with the mulching material/fibers evenly distributed over its entire length. The mulching material/fibers must interlock or entwine to form a dense layer which not only resists raindrop impact, but will allow vegetation to penetrate the blanket.

   The blanket shall be nontoxic to vegetation and to the germination of seed and shall not be injurious to the unprotected skin of humans. At a minimum, the plastic netting must cover the top side of the blanket and possess a high web strength. The netting shall be entwined with the mulching material/fiber to maximize strength and provide for ease of handling.

2. Jute Mesh - It shall be of a uniform, open, plain weave, of undyed and unbleached single jute yarn. The yarn shall be of loosely twisted construction and shall not vary in thickness by more than one half of its normal diameter. Jute mesh shall be new and shall conform to the following:

   a. Length of jute mesh shall be marked on each roll.

   b. There shall be 0.60-inch openings (± 25%) between strands, lengthwise.

   c. There shall be 0.90-inch openings (± 25%) between strands, lengthwise.

   d. Weight shall average 0.90 lbs./square yard with a tolerance of 5%.

   As previously noted, jute mesh provides such good coverage (large surface area of strands) and contains such small openings that it can be used alone as a blanket.

3. Other **Treatment-l** Products - These shall conform to manufacturer's specifications and be approved by the Watershed Protection Division prior to being specified for a particular application. These products should be installed in accordance with manufacturer's recommendations, provided those recommendations are at least as stringent as this specification. In no case shall these products cover less than 30% of the soil surface.

4. Staples - Staples for anchoring Treatment-1 shall be No. 11-gauge wire or heavier. Their length shall be a minimum of 6 inches. A larger staple with a length of up to 12 inches should be used on loose, sandy, or unstable soils.

Installation Requirements

Site Preparation - After site has been shaped and graded to approved design, prepare a friable seedbed relatively free from clods and rocks more than 1 1/2 inches in diameter and any foreign material that will prevent uniform contact of the protective covering with the soil surface.

Planting - Lime, fertilize, and seed in accordance with seeding or other type of planting plan. When using jute mesh on a seeded area, apply approximately one-half the seed after laying the mat. The protective covering can be laid over sprigged areas where small grass plants have been inserted into the soil. Where ground covers are to be planted, lay the protective covering first and then plant through the material as per planting design.

When open-weave nets are used, lime, fertilizer, seed and mulch should be applied before laying the net. When a combination blanket (such as an "excelsior" blanket) is used, seed and soil amendments must also be applied before the blanket is laid.

Orientation - See detail 71A for orientation of **Treatment-l** for different topographic conditions.

Laying and Stapling (see detail B) - If instructions have been followed, all needed check slots will have been installed, and the protective covering will be laid on a friable seedbed free from clods, rocks, roots, etc. that might impede good contact.

1. Start laying the protective covering from the top of the channel or top of slope and unroll down-grade.

2. Allow to lay loosely on soil - do not stretch.

3. Up slope ends of the protective covering should be buried in an anchor slot no less than 6-inches deep. Tamp earth firmly over the material. Staple the material at a minimum of every 12 inches across the top end.

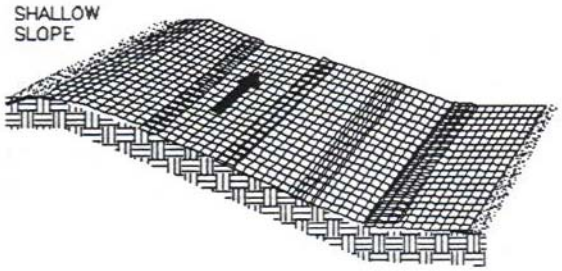
4. Edges of the material shall be stapled every 3 feet. Where multiple widths are laid side by side, the adjacent edges shall be overlapped a minimum of 2 inches and stapled together.

5. Staples shall be placed down the center, staggered with the edges at 3 foot intervals.

Check slots - On highly erodible soils and on slopes steeper than 4:1, erosion check slots should be made every 50 feet (see detail 71B). Insert a fold of the material (separate

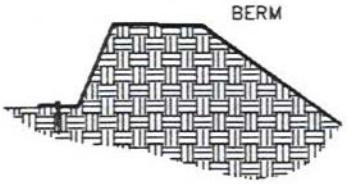
piece) into a 6-inch trench and tamp firmly. Staple fold to "main" blanket at minimum 12-inch intervals across the upstream and downstream portion of the blanket.

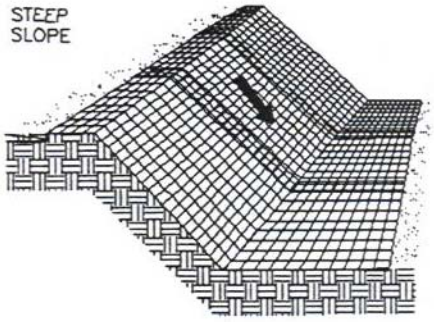
TYPICAL ORIENTATION OF TREATMENT – 1 (SOIL STABILIZATION BLANKET)



ON SHALLOW SLOPES, STRIPS OF NETTING PROTECTIVE COVERINGS MAY BE APPLIED ACROSS THE SLOPE.

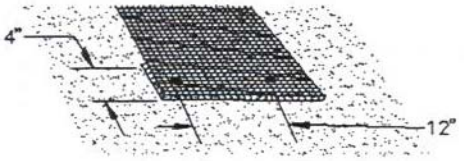
WHERE THERE IS A BERM AT THE TOP OF THE SLOPE, BRING THE MATERIAL OVER THE BERM AND ANCHOR IT BEHIND THE BERM.

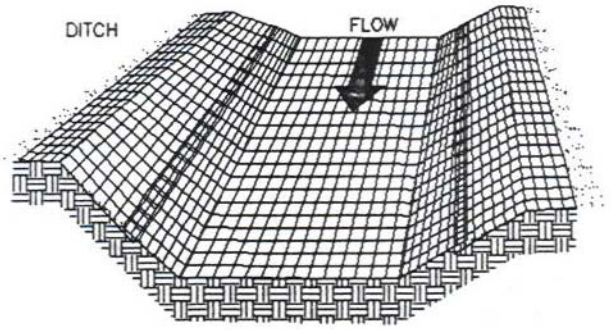




ON STEEP SLOPES, APPLY PROTECTIVE COVERING PARALLEL TO THE DIRECTION OF FLOW AND ANCHOR SECURELY.

BRING MATERIAL DOWN TO A LEVEL AREA BEFORE TERMINATING THE INSTALLATION. TURN THE END UNDER 4" AND STAPLE AT 12" INTERVALS.

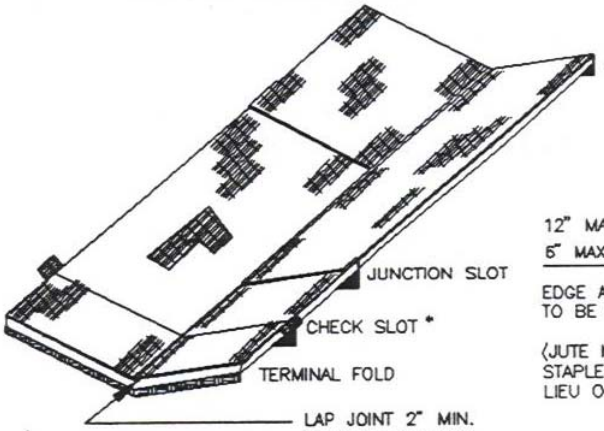




IN DITCHES, APPLY PROTECTIVE COVERING PARALLEL TO THE DIRECTION OF FLOW. USE CHECK SLOTS AS REQUIRED. AVOID JOINING MATERIAL IN THE CENTER OF THE DITCH IF AT ALL POSSIBLE.

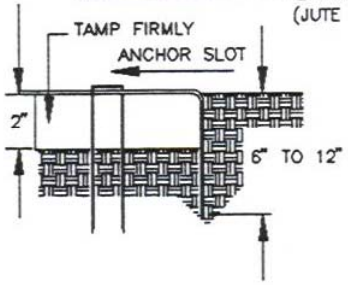
Source: Adapted from Ludlow Products Brochure

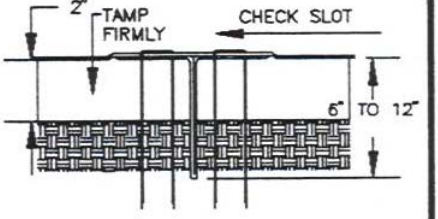
TYPICAL TREATMENT – 1
(SOIL STABILIZATION BLANKET)
INSTALLATION CRITERIA

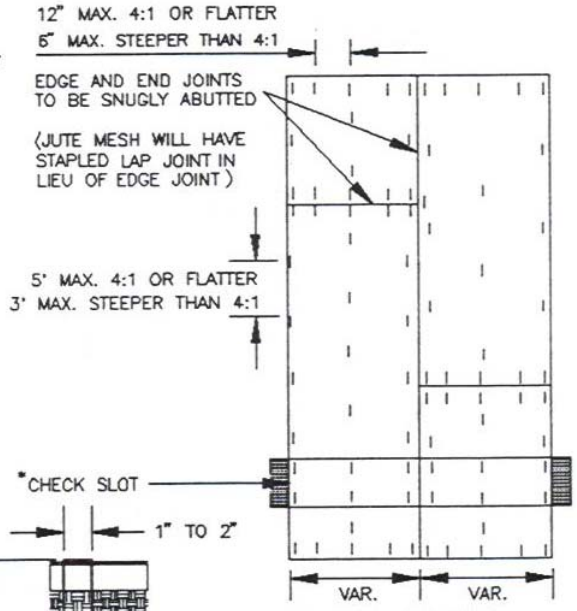


NOTES

APPROXIMATELY 200 STAPLES REQUIRED PER 100 SQ. YDS. OF MATERIAL ROLL. ANCHOR SLOTS, JUNCTION SLOTS & CHECK SLOTS TO BE BURIED 6" TO 12".



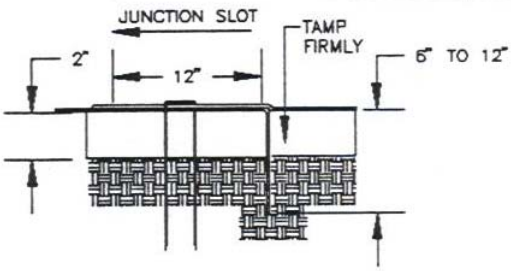


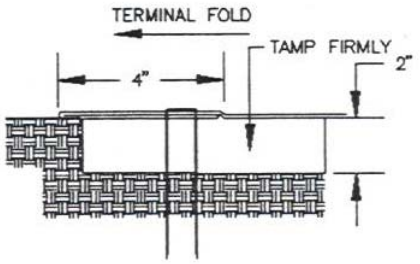


PLAN VIEW
STAPLING DIAGRAM

STAPLE FORMED FROM NO.11 STEEL WIRE.
8" STAPLE MIN. LENGTH FOR SANDY SOIL.
6" STAPLE MIN. LENGTH FOR OTHER SOIL.

*CHECK SLOTS AT MIN. 50' C–C INTERVALS; NOT REQ.'D WITH ALL "COMBINATION" BLANKETS





Note: Many combination blankets are designed and manufactured to resist movement and uplift to a point which check slots may not be required. Plan designers and review authorities are urged to study manufacturers' recommendations and site conditions.

Joining Protective Coverings - Insert a new roll of material into an anchor slot, as with up slope ends. Overlap the end of the previous roll a minimum of 12 inches, and staple across the end of the roll just below the anchor slot and across the material every 12 inches.

Terminal End - At the point at which the material is discontinued, or at which time the protective covering meets a structure of some type, fold 4 inches of the material underneath and staple every 12 inches (minimum).

At bottom of slopes - Lead net out onto a level area before anchoring. Turn ends under 4 inches, and staple across end every 12 inches.

Final Check - These installation techniques must be adhered to:

1. Protective blanket is in uniform contact with the soil.

2. All lap joints are secure.

3. All staples are driven flush with the ground.

4. All disturbed "areas have been seeded.

TREATMENT-2: SOIL STABILIZATION MATTING

(Allowable velocity range after vegetative establishment: 0- 10 f.p.s.)

Materials

Matting - The majority of these products provide a three dimensional geomatrix of nylon, polyethylene, or randomly oriented monofilaments, forming a mat. These products contain ultra violet (UV) inhibiting stabilizers, added to the compounds to ensure endurance and provide "permanent root reinforcement."

The three dimensional feature creates an open space which is allowed to fill with soil. The roots of the grass plant become established within the mat itself, forming a synergistic root and mat system. As the grass becomes established, the two actually "reinforce" each other, preventing movement or damage to the soil. Allowable velocities are increased considerably over natural turf stands.

Selection of the appropriate matting materials along with proper installation become critical factors in the success of this practice. Consultation with the supplier or the manufacturer and thorough evaluation of performance data to ensure proper selection of a

soil stabilization matting are essential. Although many manufacturers claim their products may inhibit erosion associated with channel velocities of up to 20 ft./sec., it is recommended that any velocities that exceed 10 ft./sec. be properly protected with some form of structural lining (see Std.& Spec. 33, Grassed Waterway).

Staples - Staples or anchoring methods and recommendations vary by manufacturers. The expectation of high velocities should dictate the use of more substantial anchoring. Some of the typically recommended stakes, staples and pins are depicted in Detail 71C

Installation Requirements

Site Preparation - After site has been shaped and graded to approved design, prepare a friable seedbed relatively free from clods and rocks more than 1 inch in diameter, and any foreign material that will prevent contact of the soil stabilization mat with the soil surface. If necessary, redirect any runoff away from the ditch or slope during installation.

Planting - lime, fertilize and seed in accordance with Std. & Spec. 42.0 Vegetative Stabilization and the approved plan, paying special attention to the plant selection that may have been chosen for the matted area. If the area has been seeded prior to installing the mat, make sure and reseed all areas disturbed during installation.

Mulching- Mulch (normally straw) should be applied following installation of Treatment-2 at rates noted in Std. & Spec. 42.0 Vegetative Stabilization.

Laying and Securing - See Details 71D, 71E and 71F. Similar to installing **Treatment-l**, but the Watershed Protection Division requirements or manufacturer's recommendations followed as detailed. The key to achieving desired performance is dependent upon proper installation.

Check Slots - See Detail 71D. Matting manufacturers vary significantly in their check slot requirements. Similar to the installation of **Treatment-l**, a check slot may be required when laying **Treatment-2** to "correct" the flow of water if it has the potential to undermine the matting. Most authorities require that the sides of the matting also be entrenched, creating a slope shelf for the material to rest on, preventing water from entering under the mat on the sides.

Securing the Material and Joining Mats - Again, product specifications vary - upstream and downstream terminal slots, new roll overlaps and multiple width installations differ by various products and manufacturers.

Final Check - These installation techniques must be adhered to:

1. Soil stabilization mat is in uniform contact with the soil.

2. All required slots and lapped joints are in place.

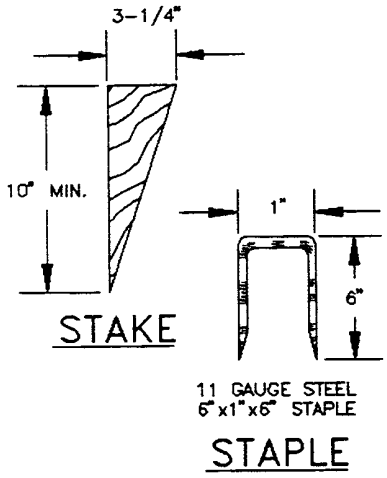
3. The material is properly anchored.

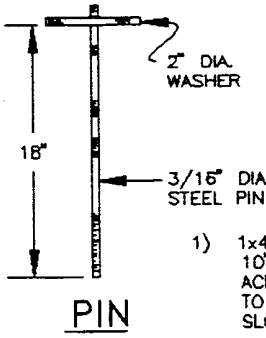
4. All disturbed areas are seeded.

Maintenance

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

STAKES, STAPLES, & PINS FOR INSTALLATION OF TREATMENT – 2 SOIL STABILIZATION MATTING



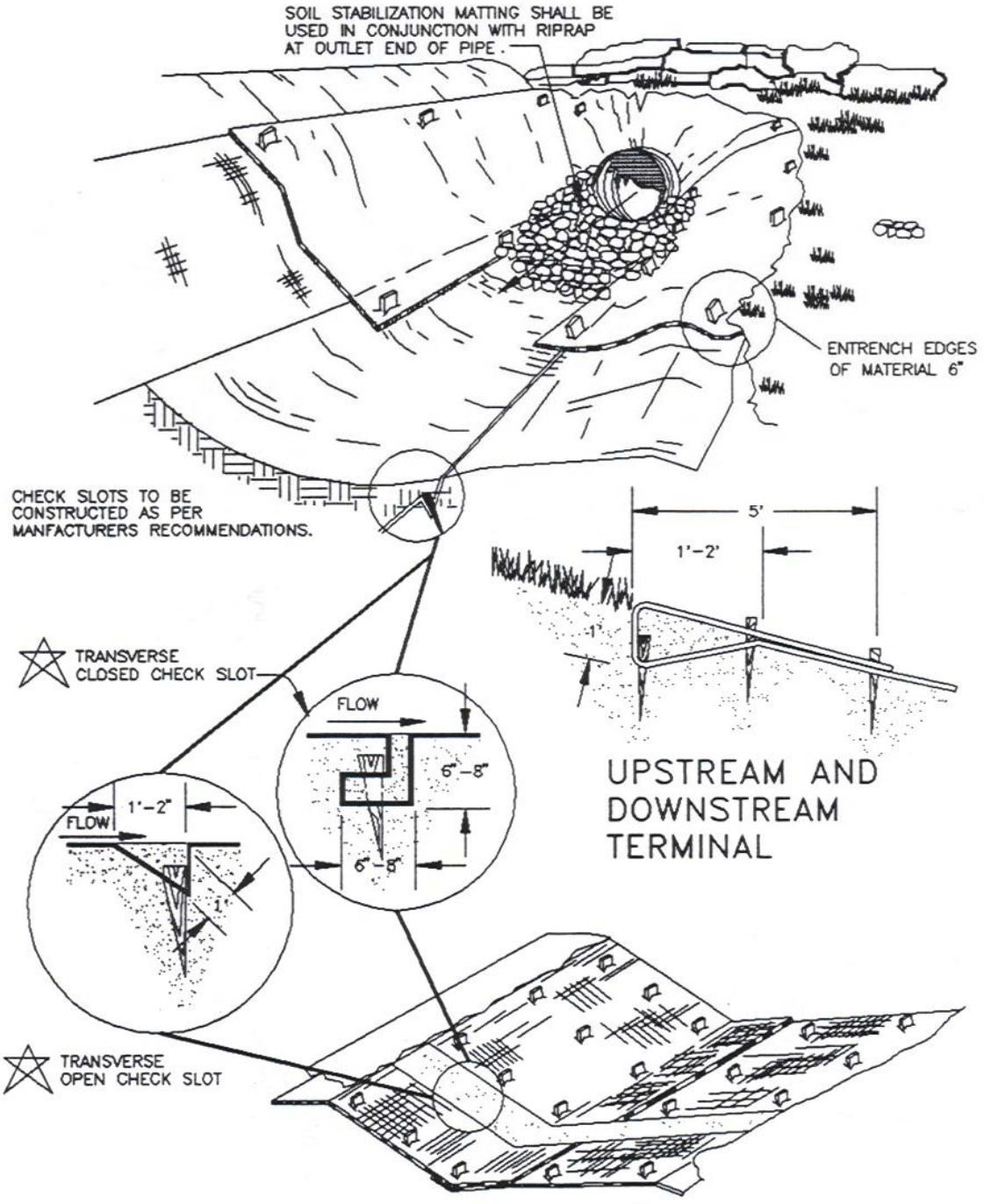


1) 1x4 TRIANGULAR SURVEY STAKE – MINIMUM 10" IN LENGTH. PLACEMENT OF THE STAKE ACROSS THE FLOW OF THE WATER IS THOUGHT TO PROVIDE A "PINBALL EFFECT" TO HELP SLOW THE VELOCITY.

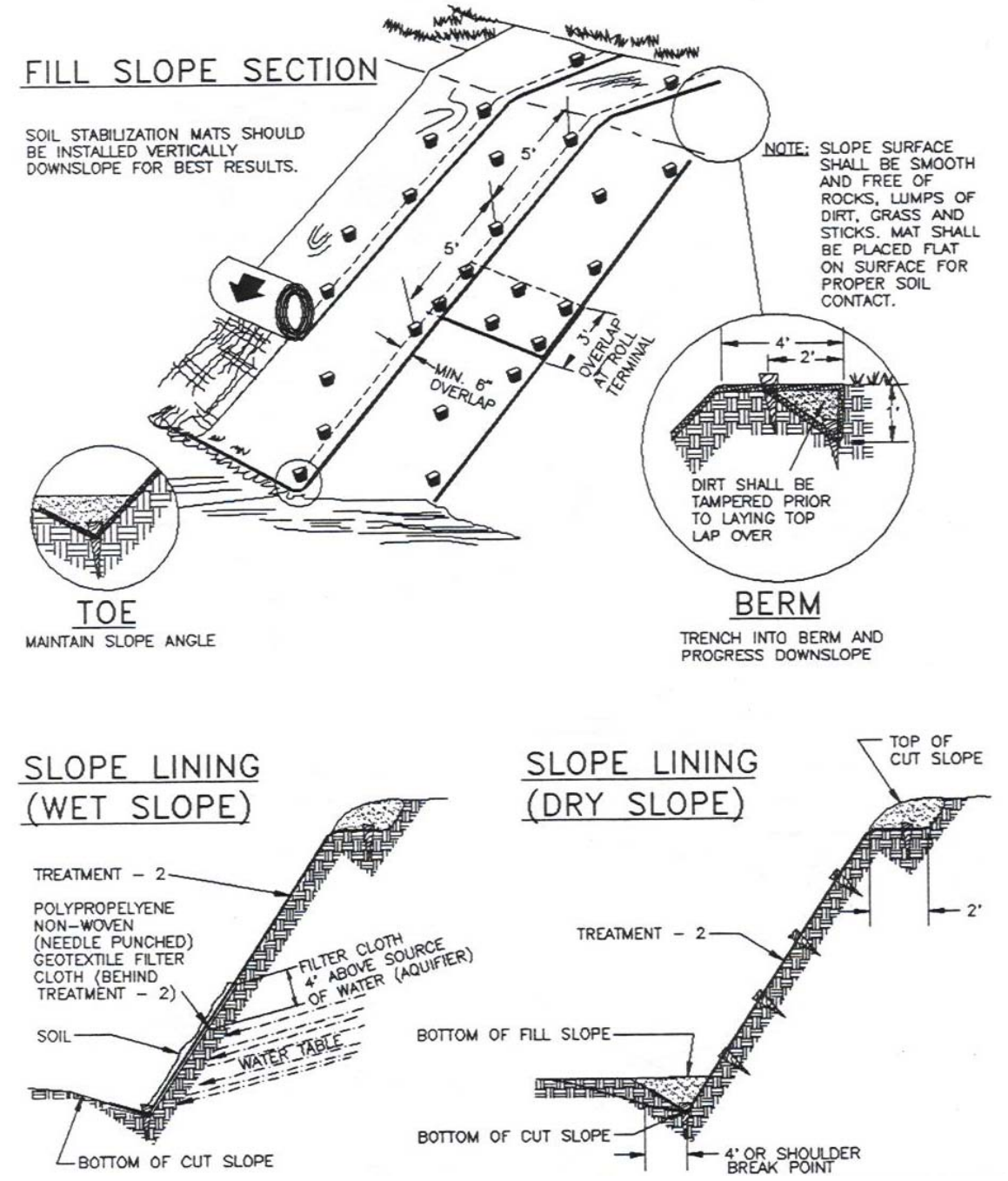
2) 11 GAUGE STEEL – MINIMUM 1" WIDE BY 6" IN LENGTH STEEL STAPLE – 2"x8" STAPLE MAY BE REQUIRED IN CERTAIN SOIL CONDITIONS.

3) STEEL PINS – 3/16 DIAMETER STEEL PIN BY 18" IN LENGTH WITH A 2" DIAMETER WASHER ON TOP. (SEE ILLUSTRATION)

TYPICAL TREATMENT–2
SOIL STABILIZATION
MATTING INSTALLATION

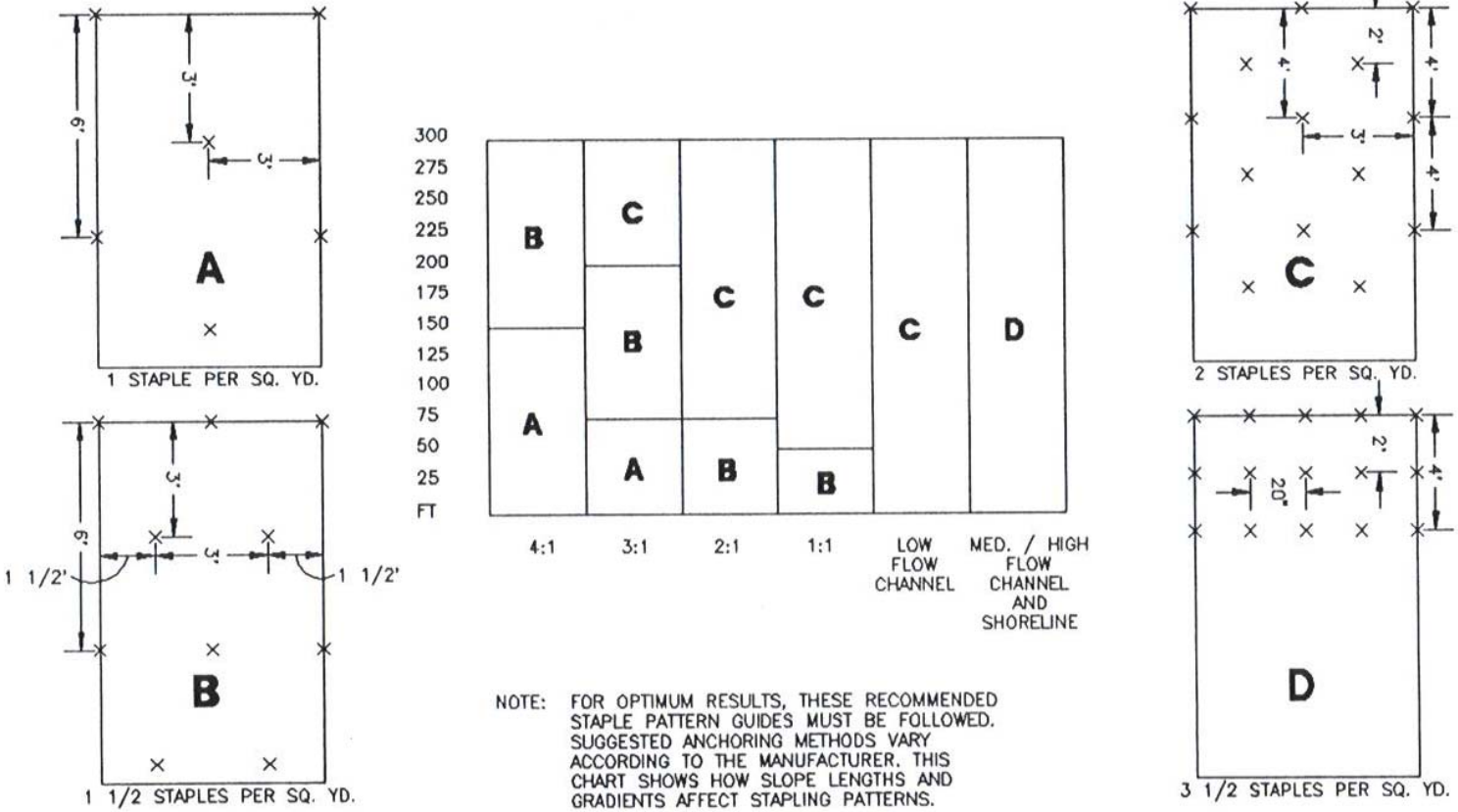


TYPICAL TREATMENT – 2
SOIL STABILIZATION MATTING
SLOPE INSTALLATION



Source: VDOT Road and Bridge Standards

GENERAL STAPLE PATTERN GUIDE AND RECOMMENDATIONS FOR TREATMENT – 2 (SOIL STABILIZATION MATTING)



NOTE: FOR OPTIMUM RESULTS, THESE RECOMMENDED STAPLE PATTERN GUIDES MUST BE FOLLOWED. SUGGESTED ANCHORING METHODS VARY ACCORDING TO THE MANUFACTURER. THIS CHART SHOWS HOW SLOPE LENGTHS AND GRADIENTS AFFECT STAPLING PATTERNS.

40.0 STANDARDS AND SPECIFICATIONS

FOR

SUBSURFACE DRAIN

Definition

A conduit, such as tile, pipe, or tubing, installed beneath the ground surface which intercepts, collects, and/or conveys drainage water.

Purpose

A subsurface drain may serve one or more of the following purposes:

1. Improve the environment for vegetative growth by regulating the water table and groundwater flow.
2. Intercept and prevent water movement into a wet area.
3. Relieve artisan pressures.
4. Remove surface runoff.
5. Provide internal drainage of slopes to improve their stability and reduce erosion.
6. Provide internal drainage behind bulkheads, retaining walls, etc.
7. Replace existing subsurface drains that are interrupted or destroyed by construction operations.
8. Provide subsurface drainage for dry stormwater management structures.
9. Improve dewatering of sediment in sediment basins. (See Standard and Specifications for Sediment Basins.)

Conditions Where Practice Applies

Subsurface drains are used in areas having a high water table or where subsurface drainage is required. The soil shall have enough depth and permeability to permit installation of an effective system. This standard does not apply to storm drainage systems or foundation drains. An outlet for the drainage system shall be available, either by gravity flow or by pumping. The outlet shall be adequate for the quantity of water to

be discharged without causing damage above or below the point of discharge and shall comply local laws.

Design Criteria

The design and installation shall be based on adequate surveys and on site soils investigations.

1. Required Capacity of Drains

The required capacity shall be determined by one or more of the following:

a. Where subsurface drainage is to be uniform over an area through a systematic pattern of drains, a drainage coefficient of 1" to be removed in 24 hours shall be used.

b. Where subsurface drainage is to be by a random interceptor system, a minimum inflow rate of 0.5 cfs per 1,000 feet of line shall be used to determine the required capacity. If actual field tests and measurements of flow amounts are available, they may be used for determining capacity. For interceptor subsurface drains on sloping land, increase the inflow rate as follows:

Land Slopes	Increase Inflow Rate By
2 - 5 percent	10 percent
5 - 12 percent	20 percent
Over 12 percent	30 percent

c. Additional design capacity must be provided if surface water is allowed to enter the system.

2. Size of Subsurface Drain

The size of subsurface drains shall be determined from the Drain Charts. All subsurface drains shall have a nominal diameter which equals or exceeds four 4 inches.

3. Depth and Spacing

The minimum depth of cover of subsurface drains shall be 24" where possible. The minimum depth of cover may be reduced to 15" where it is not possible to attain the 24" depth and where the drain is not subject to equipment loading or frost action. Roots from some types of vegetation can plug drains as the drains get closer to the surface.

The spacing of drain laterals will be dependent on the permeability of the soil, the depth of installation of the drain and degree of drainage required. Generally, drains installed 36" deep and spaced 50' center-to-center will be adequate. For more specific information see the NRCS Drainage Guide.

4. Minimum Velocity and Grade

The minimum grade for subsurface drains shall be 0.10 percent. Where surface water enters the system a velocity of not less than 2' per second shall be used to establish the minimum grades. Provisions shall be made for preventing debris or sediment from entering the system by means of filters or collection and periodic removal of sediment from installed traps.

5. Materials for Subsurface Drains

Acceptable subsurface drain materials include perforated, continuous closed joint conduits of polyethylene plastic, concrete, corrugated metal, asbestos-cement, bituminized fiber, and polyvinyl chloride.

The conduit shall meet strength and durability requirements of the site.

6. Loading

The allowable loads on subsurface drain conduits shall be based on the trench and bedding conditions specified for the job. A factor of safety of not less than 1.5 shall be used in computing the maximum allowable depth of cover for a particular type of conduit.

7. Envelopes and Envelope Materials

Envelopes shall be used around subsurface drains for proper bedding and to provide better flow into the conduit. Not less than 3" of envelope material shall be used for sand-gravel envelopes. Where necessary to improve the characteristics of flow of groundwater into the conduit, more envelope material may be required.

Where local regulations do not allow sand-gravel envelopes, but require a special type and size of envelope material, they shall be followed.

Envelope material shall be placed to the height of the uppermost seepage strata. Behind bulkheads and retaining walls, it shall go to within twelve inches of the top of the structure. This standard does not cover the design of filter materials where needed.

Materials used for envelopes shall not contain materials which will cause an accumulation of sediment in the conduit or render the envelope unsuitable for

bedding of the conduit. Envelope materials shall consist of either geotextile fabric or sand-gravel material, which shall pass a 1 1/2" sieve, 90 to 100 percent shall pass a 3/4" sieve, and not more than 10 percent shall pass a No. 60 sieve.

Geotextile fabric[30] envelopes can be either woven or nonwoven monofilament yarns and shall have a sieve opening ranging from 40-80. The envelope shall be placed in such a manner that once the conduit is installed, it shall completely encase the conduit.

The conduit shall be placed and bedded in a sand-gravel envelope. A minimum of 3" of envelope materials shall be placed on the bottom of a conventional trench. The conduit shall be placed on this and the trench completely filled with envelope material to a minimum depth of 3" above the conduit.

Soft or yielding soils under the drain shall be stabilized where required and lines protected from settlement by adding gravel or other suitable material to the trench, by placing the conduit on plank or other rigid support, or by using long sections of perforated or watertight pipe with adequate strength to insure satisfactory subsurface drain performance.

8. Use of Heavy Duty Corrugated Plastic Drainage Tubing

Heavy duty corrugated drainage tubing shall be specified where rocky or gravelly soils are expected to be encountered during installation operations. The quality of tubing will also be specified when cover over this tubing is expected to exceed 24" for 4", 5", 6", or 8" tubing. Larger size tubing designs will be handled on an individual job basis.

9. Auxiliary Structure and Subsurface Drain Protection

The outlet shall be protected against erosion and undermining of the conduit, against damaging periods of submergence, and against entry of rodents or other animals into the subsurface drain. An animal guard shall be installed on the outlet end of the pipe. A continuous 10' section of corrugated metal, cast iron, or steel pipe without perforations shall be used at the outlet end of the line and shall outlet 1.0 foot above the normal elevation of low flow in the outlet ditch or above mean high tide in tidal areas. No envelope material shall be used around the 10' section of pipe. Two-thirds of the pipe shall be buried in the ditch bank and the cantilevered section shall extend to a point above the toe of the ditch side slope. If not possible, the side slope shall be protected from erosion.

Conduits under roadways and embankments shall be watertight and designed to withstand the expected loads.

[30] Class F, See Table 44 (located on page L-53-1)

Where surface water is to be admitted to subsurface drains, inlets shall be designed to exclude debris and prevent sediment from entering the conduit. Lines flowing under pressure shall be designed to withstand the resulting pressures and velocity of flow. Surface waterways shall be used where feasible.

The upper end of each subsurface drain line shall be capped with a tight fitting cap of the same material as the conduit or other durable material unless connected to a structure.

Construction Specifications

1. Deformed, warped, or otherwise damaged pipe or tubing shall not be used.

2. All subsurface drains shall be laid to a uniform line and covered with envelope material. The pipe or tubing shall be laid with the perforations down and oriented symmetrically about the vertical center line. Connections will be made with manufactured functions comparable in strength with the specified pipe or tubing unless otherwise specified. The method of placement and bedding shall be as specified on the drawing.

3. Envelope material shall consist of geotextile fabric or a sand/gravel (which shall pass the 1 1/2" sieve, 90 to 100 percent shall pass 3/4" sieve, and not more than 10 percent shall pass the No. 60 sieve).

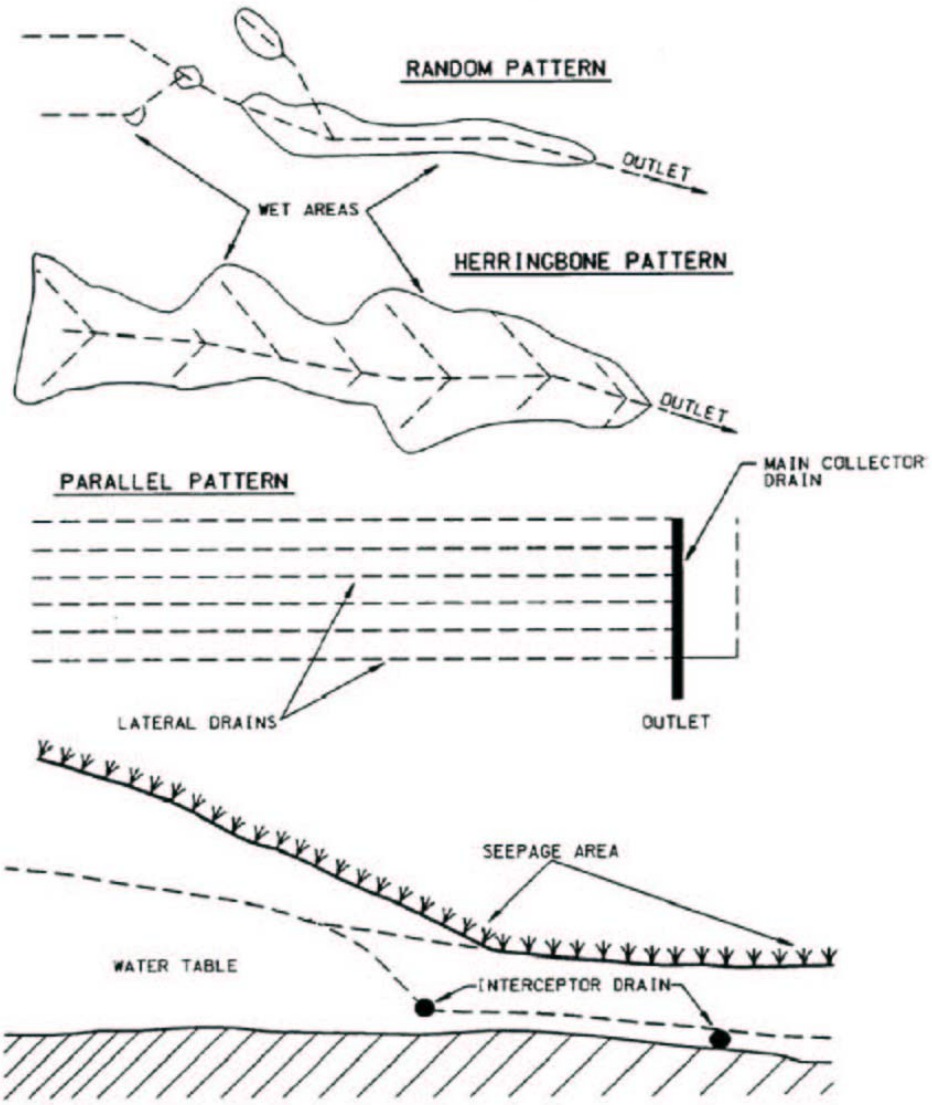
4. The upper end of each subsurface drain line shall be capped with a tight fitting cap of the same material as the conduit or other durable material unless connected to a structure.

5. A continuous 10' section of HDPE, PVC, or steel pipe without perforations shall be used at the outlet end of the line. No envelope material shall be used around the 10' section of pipe. An animal guard shall be installed on the outlet end of the pipe.

6. Earth backfill material shall be placed in the trench in such a manner that displacement of the drain will not occur.

7. Where surface water is entering the system, the pipe outlet section of the system shall contain a swing type trash and animal guard.

DETAIL 81 - SUBSURFACE DRAIN



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SUBSURFACE DRAIN

Construction Specification

1. Deformed, warped, or otherwise damaged pipe or tubing shall not be used.

2. All subsurface drains shall be laid to a uniform line and covered with envelope material. The pipe or tubing shall be laid with the perforations down and oriented symmetrically about the vertical center line. Connections will be made with manufactured functions comparable in strength with the specified pipe or tubing unless otherwise specified. The method of placement and bedding shall be as specified on the drawing.

3. Envelope material shall consist of filter cloth or a sand/gravel (which shall pass the 11/2" sieve, 90 to 100 percent shall pass 3/4" sieve, and not more than 10 percent shall pass the No. 60 sieve).

4. The upper end of each subsurface drain line shall be capped with a tight fitting cap of the same material as the conduit or other durable material unless connected to a structure.

5. A continuous 10' section of corrugated metal, cast iron, or steel pipe without perforations shall be used at the outlet end of the line. No envelope material shall be used around the 10' section of pipe. An animal guard shall be installed on the outlet end of the pipe.

6. Earth backfill material shall be placed in the trench in such a manner that displacement of the drain will not occur.

7. Where surface water is entering the system, the pipe outlet section of the system shall contain a swing type trash and animal guard.

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41.0 STANDARDS AND SPECIFICATIONS

FOR

BRICKBAT GROUND COVER

Definition

Temporary ground cover consisting of broken brick (1/2 piece or smaller) placed over denuded earth.

Purpose

Brickbats provide a temporary ground cover over denuded urban earth to prevent the transportation of sediment from the site.

Conditions When Practice Applies

Brickbats may be used on any site in need of temporary ground cover.

Design Criteria

The brickbats shall be placed to a depth of 3 inches to 4 inches covering the denuded earth on the site, then compacted and leveled.

DETAIL 82 - BRICKBRAT GROUND COVER

DETAIL NOT TO SCALE

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