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USACE / NAVFAC / AFCEA / NASA UFGS-31 32 11 (April 2006)  
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Preparing Activity: USACE Superseding  
UFGS-02370 (August 2004)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UML dated 18 July 2006

Revised throughout - latest change not indicated by CHG tags

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### SECTION 31 21 11

#### SOIL SURFACE EROSION CONTROL

04/06

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NOTE: This guide specification covers the requirements for soil surface erosion control. This specification does not include sediment and pollution control measures.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

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## PART 1 GENERAL

### 1.1 REFERENCES

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NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest guide specification. Use of SpecsIntact automated reference checking is recommended for projects based on older guide specifications.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 140	(2003) Sampling and Testing Concrete Masonry Units and Related Units
ASTM C 39/C 39M	(2004) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C 42M	(2004) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM D 1248	(2004) Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D 1560	(1992; R 2000) Resistance to Deformation and Cohesion of Bituminous Mixtures by Means of Hveem Apparatus
ASTM D 1682	(1959T; R 1975) Test for Breaking Load and Elongation of Textile Fabrics
ASTM D 1777	(1996; R 2002) Thickness of Textile Materials
ASTM D 2028	(1997; R 2004) Cutback Asphalt (Rapid-Curing Type)
ASTM D 2844	(2001e1) Resistance R-Value and Expansion Pressure of Compacted Soils
ASTM D 3776	(1996; R 2002) Mass Per Unit Area (Weight) of Fabric
ASTM D 3787	(2001) Bursting Strength of Textiles - Constant-Rate-of-Traverse (CRT), Ball Burst Test
ASTM D 3884	(2001e1) Abrasion Resistance of Textile Fabrics (Rotary Platform, Double-Head Method)
ASTM D 4355	(2002) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D 4491	(1999a) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(1991; R 1996) Trapezoid Tearing Strength of Geotextiles
ASTM D 4595	(1986; R 2001) Tensile Properties of Geotextiles by the Wide-Width Strip Method
ASTM D 4632	(1991; R 2003) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(1999a) Determining Apparent Opening Size

	of a Geotextile
ASTM D 4833	(2000e1) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 4972	(2001) pH of Soils
ASTM D 5035	(1995; R 2003) Breaking Force and Elongation of Textile Fabrics (Strip Method)
ASTM D 5268	(2002) Topsoil Used for Landscaping Purposes
ASTM D 5852	(1995; R 2000) Erodibility Determination of Soil in the Field or in the Laboratory by the Jet Index Method
ASTM D 648	(2004) Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
ASTM D 6629	(2001) Selection of Methods for Estimating Soil Loss by Erosion
ASTM D 698	(1978; R 2003) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft (600 kN-m/cu. m))
ASTM D 977	(2003) Emulsified Asphalt
U.S. DEPARTMENT OF AGRICULTURE (USDA)	
AMS Seed Act	(1940; R 1988; R 1998) Federal Seed Act
U.S. GREEN BUILDING COUNCIL (USGBC)	
LEED	(2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

## 1.2 SUBMITTALS

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NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the

submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### SD-01 Preconstruction Submittals

Work sequence schedule[; G][; G, [\_\_\_\_]]

Erosion control plan[; G][; G, [\_\_\_\_]]; (LEED)

#### SD-02 Shop Drawings

Layout; [\_\_\_\_]  
Obstructions Below Ground; [\_\_\_\_]  
Erosion Control; [\_\_\_\_]

Scale drawings defining areas to receive recommended materials as required by federal, state or local regulations.

#### Seed Establishment Period

Calendar time period for the seed establishment period. When there is more than one seed establishment period, the boundaries of the seeded area covered for each period shall be described.

#### Maintenance Record

Record of maintenance work performed, of measurements and findings for product failure, recommendations for repair, and products replaced.

#### SD-03 Product Data

[ Local/Regional Materials; (LEED)

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.]

#### [ Biobased Materials

Documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.]

Geosynthetic Binders; [\_\_\_\_]  
Recycled Plastic; (LEED)  
Wood Cellulose Fiber; (LEED)  
Paper Fiber; (LEED)  
Mulch Control Netting and Filter Fabric; (LEED)  
Hydraulic Mulch; [\_\_\_\_]; (LEED)  
Erosion Control Blankets Type XI; (LEED)  
Geotextile Fabrics; [\_\_\_\_]; (LEED)  
Aggregate; (LEED)  
Synthetic Grid Systems; [\_\_\_\_]  
Articulating Cellular Concrete Block Systems; [\_\_\_\_]

Manufacturer's literature including physical characteristics, application and installation instructions. Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

#### Equipment

A listing of equipment to be used for the application of erosion control materials.

#### Finished Grade Erosion Control Blankets

Condition of finish grade status prior to installation; location of underground utilities and facilities.

#### SD-04 Samples

##### Materials

- a. Geosynthetic and synthetic binding material; 1.13 L 1 quart.
- b. Standard mulch; 0.74 k 2 pounds.
- c. Hydraulic mulch; 0.74 k 2 pounds.
- d. Geotextile fabrics; 150 mm 6 inch square.
- e. Erosion control blankets; 150 mm 6 inch square.
- f. Synthetic grid systems; One sample grid.

g. Articulating cellular concrete block systems; 9.3 square meters 100 square feet area.

h. [Two] [\_\_\_\_\_] color charts displaying the colors and finishes for the articulating cellular block system.

#### SD-06 Test Reports

Geosynthetic Binders  
Hydraulic Mulch  
Geotextile Fabrics  
Erosion Control Blankets  
Synthetic Grid Systems  
Articulating Cellular Concrete Block Systems

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

Sand  
Gravel

Sieve test results. Sand shall be uniformly graded.

#### SD-07 Certificates

Fill Material  
Mulch  
Hydraulic Mulch  
Geotextile Fabrics

Prior to delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following.

For items listed in this section:

- a. Certification of recycled content or,
- b. Statement of recycled content.
- c. Certification of origin including the name, address and telephone number of manufacturer.

Geosynthetic Binders  
Synthetic Soil Binders

Certification for binders showing EPA registered uses, toxicity levels, and application hazards.

#### Installer's Qualification

The installer's company name and address; training and experience and or certification.

## Recycled Plastic

Individual component and assembled unit structural integrity test; creep tolerance; deflection tolerance; and vertical load test results. Life-cycle durability.

## Seed

Classification, botanical name, common name, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, and date tested.

## Asphalt Adhesive Tackifier

Composition.

## Wood By-Products

Composition, source, and particle size. Products shall be free from toxic chemicals or hazardous material.

## Wood Cellulose Fiber

Certification stating that wood components were obtained from managed forests.

## SD-10 Operation and Maintenance Data

### Maintenance Instructions

Instruction for year-round care of installed material. The Contractor shall include manufacturer supplied spare parts.

## SD-11 Closeout Submittals

### Local/Regional Materials; (LEED)

LEED documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

### Recycled Plastic; (LEED)

### Wood Cellulose Fiber; (LEED)

### Paper Fiber; (LEED)

### Mulch Control Netting and Filter Fabric; (LEED)

### Hydraulic Mulch; [\_\_\_\_]; (LEED)

### Erosion Control Blankets Type XI; (LEED)

### Geotextile Fabrics; [\_\_\_\_]; (LEED)

### Aggregate; (LEED)

LEED documentation relative to recycled content credit in

accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

### 1.3 MEASUREMENT AND PAYMENT

#### 1.3.1 Standard and Geosynthetic Binder

The standard and geosynthetic binder shall be measured by the square meter square yard of surface area covered. No measurement for payment shall be made for fine grading, trenching or other miscellaneous materials necessary for placement of the binder.

#### 1.3.2 Mulch and Compost

Mulch and compost shall be measured by the square meter square yard of surface area covered. No measurement for payment shall be made for binder, dye or other miscellaneous materials or equipment necessary for placement of the mulch or compost.

#### 1.3.3 Hydraulic Mulch

Hydraulic mulch shall be measured by the square meter square yard of surface area covered. Measurement for payment shall include binder, dye or both. No measurement for payment shall be made for other miscellaneous materials or equipment necessary for placement of the hydraulic mulch.

#### 1.3.4 Geotextile Fabric

The geotextile fabrics shall be measured by the square meter square yard of surface area covered. No measurement for payment shall be made for fine grading, trenching or other miscellaneous materials necessary for placement of the fabric.

#### 1.3.5 Erosion Control Blankets

The erosion control blankets shall be measured by the square meter square yard of surface area covered. No measurement for payment shall be made for fine grading, trenching or other miscellaneous materials necessary for placement of the erosion control blankets.

#### 1.3.6 Synthetic Grid/Sheet Systems

The synthetic grid/sheet system shall be measured by the square meter square yard of surface area covered. No measurement for payment shall be made for fine grading, trenching, geotextile, seams, grout, rock, topsoil or other miscellaneous materials necessary for placement of the articulating cellular concrete block system.

#### 1.3.7 Cellular Concrete Block Systems

The articulating cellular concrete block system shall be measured by the square meter square yard of surface area covered. No measurement for payment shall be made for fine grading, trenching, geotextile, seams, grout, rock, topsoil or other miscellaneous materials necessary for placement of the articulating cellular concrete block system.

### 1.4 DESCRIPTION OF WORK

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NOTE: Areas under construction required to provide temporary or permanent soil surface erosion control methods must be delineated on the drawings; the drawings must also depict details of the manufacturer's recommended installation methods. Erosion and sedimentation control contributes to the following LEED credit: SS Prerequisite 1.

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The work shall consist of furnishing and installing temporary and permanent soil surface erosion control materials to prevent the pollution of air, water, and land, including fine grading, blanketing, stapling, mulching, vegetative measures, structural measures, and miscellaneous related work, within project limits and in areas outside the project limits where the soil surface is disturbed from work under this contract at the designated locations. This work shall include all necessary materials, labor, supervision and equipment for installation of a complete system. This section shall be coordinated with the requirements of [Section 31 00 00 EARTHWORK] [and] [Section 32 92 23 SEEDING,] [and] [Section 32 92 23 SODDING].

#### 1.5 DELIVERY, INSPECTION, STORAGE, AND HANDLING

Materials shall be stored in designated areas and as recommended by the manufacturer protected from the elements, direct exposure, and damage. Containers shall not be dropped from trucks. Material shall be free of defects that would void required performance or warranty. Geosynthetic binders and synthetic soil binders shall be delivered in the manufacturer's original sealed containers and stored in a secure area.

- a. Erosion control blankets and geotextile fabric shall be furnished in rolls with suitable wrapping to protect against moisture and extended ultraviolet exposure prior to placement. Erosion control blanket and geotextile fabric rolls shall be labeled to provide identification sufficient for inventory and quality control purposes.
- b. All synthetic grids, synthetic sheets, and articulating cellular concrete block grids shall be sound and free of defects that would interfere with the proper placing of the block or impair the strength or permanence of the construction. Minor cracks in synthetic grids and concrete cellular block, incidental to the usual methods of manufacture, or resulting from standard methods of handling in shipment and delivery, shall not be deemed grounds for rejection.
- c. Seed shall be inspected upon arrival at the jobsite for conformity to species and quality. Seed that is wet, moldy, or bears a test date five months or older, shall be rejected.

#### 1.6 SUBSTITUTIONS

Substitutions will not be allowed without written request and approval from the Contracting Officer.

## 1.7 QUALITY ASSURANCE

### 1.7.1 Installer's Qualification

The installer shall be certified by the manufacturer for training and experience installing the material.

### 1.7.2 Erosion Potential

Assess potential effects of soil management practices on soil loss in accordance with ASTM D 6629. Assess erodibility of soil with dominant soil structure less than 70 to 80 mm 2.8 to 3.1 inches in accordance with ASTM D 5852.

## 1.8 SCHEDULING

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NOTE: For jobs that require state or local government approval of an erosion control plan, use the first bracketed item. For other jobs, use the second bracketed item. Submitting an erosion control plan contributes to the following LEED credit: SS Prerequisite 1.  
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The Contractor shall submit a construction work sequence schedule, with the [state or local government approved] [approved] erosion control plan a minimum of 30 days prior to start of construction. The work schedule shall coordinate the timing of land disturbing activities with the provision of erosion control measures to reduce on-site erosion and off-site sedimentation. Installation of temporary erosion control features shall be coordinated with the construction of permanent erosion control features to assure effective and continuous control of erosion, pollution, and sediment deposition. The schedule shall include a vegetative plan with planting and seeding dates and fertilizer, lime, and mulching rates. Copies of the work schedule and erosion control plan shall be distributed to site subcontractors. The erosion control plan shall address the following:

- a. Statement of erosion control and stormwater control objectives.
- b. Description of temporary and permanent erosion control, stormwater control, and air pollution control measures to be implemented on site.
- c. Description of the type and frequency of maintenance activities required for the chosen erosion control methods.
- d. Comparison of proposed post-development stormwater runoff conditions with predevelopment conditions.

## 1.9 TIME LIMITATIONS

Backfilling the openings in synthetic grid systems and articulating cellular concrete block systems shall be completed a maximum 7 days after placement to protect the material from ultraviolet radiation.

## 1.10 SUSTAINABLE DESIGN REQUIREMENTS

### 1.10.1 Local/Regional Materials

\*\*\*\*\*  
NOTE: Using local materials can help minimize transportation impacts, including fossil fuel consumption, air pollution, and labor. Using materials harvested and manufactured within a 500 mile radius from the project site contributes to the following LEED credit: MR5. Coordinate with Section 01 33 29 LEED(tm) DOCUMENTATION. Use second option if Contractor is choosing local materials in accordance with Section 01 33 29 LEED(tm) DOCUMENTATION. First option shall not be used for USACE projects. Army projects shall include second option only if pursuing this LEED credit.  
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[Use materials or products extracted, harvested, or recovered, as well as manufactured, within a [500][\_\_\_\_\_] mile [800][\_\_\_\_\_] kilometer radius from the project site, if available from a minimum of three sources.] [See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Erosion control materials may be locally available.]

### 1.10.2 Biobased Materials

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NOTE: The 2002 Farm Bill - Section 9002, Federal Procurement of Biobased Products, requires each Federal Agency to develop a procurement program which will ensure that items composed of biobased products will be purchased to the maximum extent practicable and which is consistent with applicable provisions of Federal procurement law.  
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[Use biobased materials when feasible and as specified.]

## 1.11 WARRANTY

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NOTE: The specifier should consult with the manufacturer's representative, during the design phase, to ensure proper application and installation techniques for project specific conditions. Warranties vary with different materials and may be void if proper technical advice is not obtained. Seed germination is not covered under the warranty.  
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Erosion control material shall have a warranty for use and durable condition for project specific installations. Temporary erosion control materials shall carry a minimum eighteen month warranty. Permanent erosion control materials shall carry a minimum three year warranty.

## PART 2 PRODUCTS

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NOTE: Consult local codes and regulations for additional information that may affect the project before design work begins. The choice of methods and materials will be a project specific requirement and will be at the discretion of the designer. Edit the specification choices of material to best suit the needs of each project.

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## 2.1 RECYCLED PLASTIC

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NOTE: Plastic lumber landscaping timbers and posts are EPA designated products for recycled content. See Section 00 62 35 RECYCLED/RECOVERED MATERIALS and include minimum recycled content unless designer determines that justification for non-use exists. EPA recycled content requirements must be addressed in all projects regardless of optional LEED/other recycled content goals. Designer must verify suitability, availability and adequate competition (including verification of bracketed percentages included in this guide specification) before specifying products meeting EPA minimum recycled content.

Use of materials with recycled content, calculated on the basis of post-industrial and post-consumer percentage content, contributes to the following LEED credit: MR4. Coordinate with Section 01 33 29 LEED(tm) DOCUMENTATION. Designer must verify suitability, availability and adequate competition (including verification of bracketed percentages included in this guide specification) before specifying product recycled content requirements. Use second option if Contractor is choosing recycled content products in accordance with Section 01 33 29 LEED(tm) DOCUMENTATION. Army projects shall specify recycled content exceeding EPA requirements only if pursuing this LEED credit.

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Recycled plastic shall contain a minimum 85 percent of recycled post-consumer product. Recycled material shall be constructed or manufactured with a maximum 6 mm 1/4 inch deflection or creep in any member, according to ASTM D 648 and ASTM D 1248. The components shall be molded of ultraviolet (UV) and color stabilized polyethylene. The material shall consist of a minimum 75 percent plastic profile of high-density polyethylene, low-density polyethylene, and polypropylene raw material. The material shall be non-toxic and have no discernible contaminants such as paper, foil, or wood. The material shall contain a maximum 3 percent air voids and shall be free of splinters, chips, peels, buckling, and cracks. Material shall be resistant to deformation from solar heat gain.

## 2.2 BINDERS

### 2.2.1 Synthetic Soil Binders

Calcium chloride, or other standard manufacturer's spray on adhesives designed for dust suppression.

### 2.2.2 Geosynthetic Binders

Geosynthetic binders shall be manufactured in accordance with ASTM D 1560, ASTM D 2844; and shall be referred to as products manufactured for use as modified emulsions for the purpose of erosion control and soil stabilization. Emulsions shall be manufactured from all natural materials and provide a hard durable finish.

## 2.3 MULCH

Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be native to the region.

### 2.3.1 Straw

Straw shall be stalks from oats, wheat, rye, barley, or rice, furnished in air-dry condition and with a consistency for placing with commercial mulch-blowing equipment.

### 2.3.2 Hay

Hay shall be native hay, sudan-grass hay, broomsedge hay, or other herbaceous mowings, furnished in an air-dry condition suitable for placing with commercial mulch-blowing equipment.

### 2.3.3 Wood Cellulose Fiber

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NOTE: Wood fiber mulch is an EPA designated product for recycled content. See Section 01670 RECYCLED/RECOVERED MATERIALS and include minimum recycled content options unless designer determines that justification for non-use exists. EPA recycled content requirements must be addressed in all projects regardless of optional LEED/other recycled content goals. Designer must verify suitability, availability and adequate competition (including verification of bracketed percentages included in this guide specification) before specifying products meeting EPA minimum recycled content.

Use of materials with recycled content, calculated on the basis of post-industrial and post-consumer percentage content, contributes to the following LEED credit: MR4. Coordinate with Section 01 33 29 LEED(tm) DOCUMENTATION. Designer must verify suitability, availability and adequate competition (including verification of bracketed percentages included in this guide specification) before specifying product recycled content requirements. Use second option if Contractor is choosing recycled content products in accordance with Section 01 33 29

LEED(tm) DOCUMENTATION. Army projects shall specify recycled content exceeding EPA requirements only if pursuing this LEED credit.

Include bracketed statement regarding heavy metals if project includes family housing or child-centered facilities. For other projects, statement may or may not be deleted.

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Wood cellulose fiber shall be 100 percent recycled material and shall not contain any growth or germination-inhibiting factors and shall be dyed with non-toxic, biodegradable dye an appropriate color to facilitate placement during application. Composition on air-dry weight basis: a minimum 9 to a maximum 15 percent moisture, and between a minimum 4.5 to a maximum 6.0 pH.[ See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. This item may contain post-consumer or post-industrial recycled content.][ Wood cellulose fiber shall not contain environmentally hazardous levels of heavy metals. Materials may be bulk tested or tested by toxicity characteristic leaching procedure (TCLP).]

#### 2.3.4 Paper Fiber

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NOTE: Paper fiber mulch is an EPA designated product for recycled content. See Section 01670 RECYCLED/RECOVERED MATERIALS and include minimum recycled content options unless designer determines that justification for non-use exists. EPA recycled content requirements must be addressed in all projects regardless of optional LEED/other recycled content goals. Designer must verify suitability, availability and adequate competition (including verification of bracketed percentages included in this guide specification) before specifying products meeting EPA minimum recycled content.

Use of materials with recycled content, calculated on the basis of post-industrial and post-consumer percentage content, contributes to the following LEED credit: MR4. Coordinate with Section 01 33 29 LEED(tm) DOCUMENTATION. Designer must verify suitability, availability and adequate competition (including verification of bracketed percentages included in this guide specification) before specifying product recycled content requirements. Use second option if Contractor is choosing recycled content products in accordance with Section 01 33 29 LEED(tm) DOCUMENTATION. Army projects shall specify recycled content exceeding EPA requirements only if pursuing this LEED credit.

\*\*\*\*\*

Paper fiber mulch shall be 100 percent post-consumer recycled news print that is shredded for the purpose of mulching seed.[ See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements.]

#### 2.3.5 Shredded Bark

Locally shredded material shall be treated to retard the growth of mold and fungi.

#### 2.3.6 Wood By-Products

Wood locally chipped or ground bark shall be treated to retard the growth of mold and fungi. Gradation: A maximum 50 mm 2 inch wide by 100 mm 4 inch long.

#### 2.3.7 Coir

\*\*\*\*\*  
NOTE: Ensure manufacturers and contractors supply coir cured in fresh water for use in mulching or blanket applications. Salt water or, lagoon cured, coir has a white appearance and is called white coir. Fresh water cured coir is dark brown in color and has higher strength and durability.  
\*\*\*\*\*

Coir shall be manufactured from 100 percent coconut fiber cured in fresh water for a minimum of 6 months.

#### 2.3.8 Asphalt Adhesive

Asphalt adhesive shall conform to the following: Emulsified asphalt, conforming to ASTM D 977, Grade SS-1; and cutback asphalt, conforming to ASTM D 2028, Designation RC-70.

#### 2.3.9 Mulch Control Netting and Filter Fabric

Mulch control netting and filter fabric may be constructed of lightweight recycled plastic, cotton, or paper or organic fiber. The recycled plastic shall be a woven or nonwoven polypropylene, nylon, or polyester containing stabilizers and/or inhibitors to make the fabric resistant to deterioration from UV, and with the following properties:

- a. Minimum grab tensile strength (TF 25 #1/ASTM D 4632), 0.8 kN 180 pounds.
- b. Minimum Puncture (TF 25 #4/ASTM D 3787), 0.52 MPa 75 psi in the weakest direction.
- c. Apparent opening sieve size of a minimum 40 and maximum 80 (U.S. Sieve Size).
- d. Minimum Trapezoidal tear strength (TF 25 #2/ASTM D 4533), 0.22 kN 50 pounds.

#### 2.3.10 Hydraulic Mulch

\*\*\*\*\*  
NOTE: Hydraulic mulch is an EPA designated product for recycled content. See Section 01670 RECYCLED/RECOVERED MATERIALS and include recycled content options unless designer determines that justification for non-use exists.  
\*\*\*\*\*

\*\*\*\*\*

Hydraulic mulch shall be made of 100 percent [recycled material][virgin aspen wood fibers]. Wood shall be naturally air-dried to a moisture content of 10.0 percent, plus or minus 3.0 percent. A minimum of 50 percent of the fibers shall be equal to or greater than 5 mm 0.15 inch in length and a minimum of 75 percent of the fibers shall be retained on a 28 mesh screen.[ No reprocessed paper fibers shall be included in the hydraulic mulch.] Hydraulic mulch shall have the following mixture characteristics:

CHARACTERISTIC (typical)	VALUE
pH	5.4 $\pm$ 0.1
Organic Matter (oven dried basis),	percent 99.3 within $\pm$ 0.2
Inorganic Ash (oven dried basis),	percent 0.7 within $\pm$ 0.2
Water Holding Capacity,	percent 1,401

#### 2.3.11 Tackifier

Tackifier shall be a blended polyacrylimide material with non-ionic galactomannan of Gramineae endosperm in powder and crystalline form with molecular weights over 250,000. Tackifier shall be pre-packaged in the hydraulic mulch at the rate of [\_\_\_\_\_] grams per kg ounces per lb of wood fiber.

#### 2.3.12 Dye

Dye shall be a water-activated, green color. Dye shall be pre-packaged in water dissolvable packets in the hydraulic mulch.

### 2.4 GEOTEXTILE FABRICS

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NOTE: Designer must verify that products meeting the indicated minimum recycled content are available, preferably from at least three sources, to ensure adequate competition. Designer must verify suitability, availability and adequate competition (including verification of bracketed percentages included in this guide specification) before specifying product recycled content requirements. Use second option if Contractor is choosing recycled content products in accordance with Section 01 33 29 LEED(tm) DOCUMENTATION. Army projects shall specify recycled content exceeding EPA requirements only if pursuing this LEED credit.

\*\*\*\*\*

Geotextile fabrics shall be woven of [polyester][polypropylene] filaments formed into a stable network so that the filaments retain their relative position to each other. [Content shall be a minimum of [75][\_\_\_\_\_] percent recycled materials.][See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Geotextile fabric may contain post-consumer or post-industrial recycled content.] Sewn seams shall have strength equal to or greater than the geotextile itself. Fabric shall be installed to withstand maximum velocity flows as recommended by the manufacturer. The geotextile shall conform to the following minimum average roll values:

Property	Performance	Test Method
Weight	264 g/m <sup>2</sup>	ASTM D 3776
Thickness	0.635 mm	ASTM D 1777
Permeability	0.12 cm/sec	ASTM D 4491
Abrasion Resistance,	58 percent X	
Type (percent strength	81 percent	ASTM D 3884
retained)		
Tensile Grab Strength	1,467 N X 1,	ASTM D 4632
	933 N	
Grab Elongation	15percent X	ASTM D 4632
	20percent	
Burst Strength	5,510 kN/m <sup>2</sup>	ASTM D 3787
Puncture Strength	733 N	ASTM D 4833
Trapezoid Tear	533 N X 533 N	ASTM D 4533
Apparent Opening Size	40 US Std Sieve	ASTM D 4751
UV Resistance @ 500 hrs	90 percent	ASTM D 4355

## 2.5 EROSION CONTROL BLANKETS

\*\*\*\*\*  
**NOTE:** The choice of materials will be a project specific condition requirement. Edit the specification choices of material to best suit the needs of each project. Specifying material and anchoring pattern will also depend on velocity flows, slopes and other variables.  
 \*\*\*\*\*

### 2.5.1 Erosion Control Blankets Type I

Type I blankets shall be used for erosion control and vegetation establishment on roadside embankments, abutments, berms, shoulders, and median swales where natural vegetation will provide long term stabilization. Erosion control blankets shall be a machine-produced mat of 100% straw. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with a photodegradable polypropylene netting having an approximate 13 by 13 mm 1/2 by 1/2 inch mesh and be sewn together on a maximum 40 mm 1.5 inch centers with degradable thread. The erosion control blanket shall have the following properties:

#### Material Content

Straw	100 percent with approximately .27 kg/m <sup>2</sup> .50 lb/yd <sup>2</sup> weight
Netting	One side only, lightweight photodegradable with approximately 8.0 kg/100 m <sup>2</sup> 1.64 lb/1,000 ft <sup>2</sup> weight.
Thread	Degradable

Note 1: Photodegradable life a minimum of 2 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 3:1 gradient.

### 2.5.2 Erosion Control Blankets Type II

Erosion control blankets shall be a machine-produced mat of 100 percent straw. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with a polypropylene netting having an approximate 13 by 13 mm 1/2 by 1/2 inch mesh with photodegradable accelerators to provide breakdown of the netting within approximately 45 days, depending upon geographic location and elevation. The blanket shall be sewn together on a maximum 40 mm 1.5 inch centers with degradable thread. The erosion control blanket shall have the following properties:

#### Material Content

Straw	100 percent with approximately .27 kg/m <sup>2</sup> .50 lb/yd <sup>2</sup> weight.
Netting	One side only, photodegradable with photo accelerators and approximately 8.0 kg/100 m <sup>2</sup> 1.64 lb/1,000 ft <sup>2</sup> weight.
Thread	Degradable

NOTE: Photodegradable life a minimum of 10 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 3:1 gradient.

### 2.5.3 Erosion Control Blankets Type III

Type III blankets shall be used for erosion control and vegetation establishment on roadside embankments, abutments, berms, shoulders, and median swales where natural vegetation will provide long term stabilization. Erosion control blanket shall be a machine-produced mat consisting of 70 percent straw and 30 percent coconut fiber. The blanket shall be of consistent thickness with the straw and coconut fiber evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with heavyweight photodegradable polypropylene netting having UV additives to delay breakdown and an approximate 16 by 16 mm 5/8 by 5/8 inch mesh, and on the bottom side with a lightweight photodegradable polypropylene netting with an approximate 13 by 13 mm 1/2 inch by 1/2 inch mesh. The blanket shall be sewn together on 40 mm 1.5 inch centers with degradable thread. The erosion control blanket shall have the following properties:

#### Material Content

Straw	70 percent by approximately .19 kg/m <sup>2</sup> .35 lb/yd <sup>2</sup> .
Coconut Fiber	30 percent by approximately .08 kg/m <sup>2</sup> .15 lb/yd <sup>2</sup> weight.
Netting	Top side heavyweight photodegradable with UV additives and approximately 16 kg/ m <sup>2</sup> 3 lb/1,000 ft <sup>2</sup> weight

#### Material Content

Bottom side lightweight photodegradable  
with approximately 8.0 kg/100 m<sup>2</sup>  
1.64 lb/1,000 ft<sup>2</sup> weight.

NOTE: Photodegradable life a minimum of 10 months with a minimum 90 percent light penetration. Apply to slopes with a gradient less than 1.5:1.

#### 2.5.4 Erosion Control Blankets Type IV

Erosion control blanket shall be a machine-produced mat of 100 percent straw. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top and bottom sides with lightweight photodegradable polypropylene netting having an approximate 13 by 13 mm 1/2 by 1/2 inch mesh. The blanket shall be sewn together on 40 mm 1.5 inch centers with degradable thread. The erosion control blanket shall have the following properties:

#### Material Content

Straw 100 percent with approximately .27 kg/m<sup>2</sup>  
.5 lb/yd<sup>2</sup> weight.

Netting Both sides lightweight photodegradable with  
approximately 8.0 kg/100 m<sup>2</sup> 1.64 lb/1,000 ft<sup>2</sup>  
weight.

Thread Degradable

NOTE: Photodegradable life a minimum of 2 months with a minimum 90 percent light penetration. Apply to slopes with a gradient of less than 1.5:1.

#### 2.5.5 Erosion Control Blankets Type V

Erosion control blanket shall be a machine-produced mat of 100 percent straw. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with polypropylene netting having an approximate 13 by 13 mm 1/2 by 1/2 inch mesh with photodegradable accelerators to provide breakdown of the netting within approximately 45 days, depending upon geographic location and elevation. The bottom shall be covered with a polypropylene netting having an approximate 13 by 13 mm 1/2 by 1/2 inch mesh with photo accelerators. The blanket shall be sewn together on 40 mm 1.5 inch centers with degradable thread. The erosion control blanket shall have the following properties:

#### Material Content

Straw 100 percent with approximately .27kg/m<sup>2</sup>  
.5 lb/yd<sup>2</sup> weight.

Netting Top side lightweight photodegradable with photo  
accelerators with approximately 8.0 kg/100 m<sup>2</sup>  
1.64 lb/1,000 ft<sup>2</sup> weight.

## Material Content

Thread	Bottom side lightweight photodegradable with photo accelerators and approximately 8.0 kg/100 m <sup>2</sup> 1.64 lb/1,000 ft <sup>2</sup> weight.
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NOTE: Photodegradable life a minimum of 10 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 2:1 gradient.

### 2.5.6 Erosion Control Blankets Type VI

Erosion control blanket shall be a machine-produced 100% biodegradable mat with a 100 percent straw fiber matrix. The blanket shall be of consistent thickness with the straw fiber evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with a 100 percent biodegradable woven natural organic fiber netting. The netting shall consist of machine directional strands formed from two intertwined yarns with cross directional strands interwoven through the twisted machine strands (commonly referred to as a Leno weave) to form an approximate 13 by 13 mm 1/2 by 1/2 inch mesh. The blanket shall be sewn together with biodegradable thread on 40 mm 1.5 inch centers. The erosion control blanket shall have the following properties:

#### Material Content

Matrix	100 percent straw fiber with approximately .27 kg/m <sup>2</sup> .50 lb/yd <sup>2</sup> weight
Netting	One side only, Leno woven 100% biodegradable natural organic fiber
Weight	approximately 45.4 kg/100 m <sup>2</sup> 9.3 lb/1,000 ft <sup>2</sup> .
Thread	Biodegradable

NOTE: Photodegradable life a minimum of 10 months with a minimum 90 Percent light penetration. Apply to slopes up to a maximum 2:1 gradient.

### 2.5.7 Erosion Control Blankets Type VII

Erosion control blanket shall be a machine-produced 100 percent biodegradable mat with an herbaceous straw fiber matrix. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top and bottom sides with 100 percent biodegradable woven natural fiber netting. The netting shall consist of machine directional strands formed from two intertwined yarns with cross directional strands interwoven through the twisted machine strands (commonly referred to as a Leno weave) to form an approximate 13 by 13 mm 1/2 by 1/2 inch mesh. The blanket shall be sewn together with biodegradable thread on 40 mm 1.5 inch centers. The blanket shall have the following properties:

#### Material Content

Straw	100 percent straw fiber with approximately
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#### Material Content

.27 kg/m<sup>2</sup> .5 lb/yd<sup>2</sup> weight.

Netting Top and bottom sides, Leno woven 100% biodegradable natural organic fiber with approximately

45.4 kg/100 m<sup>2</sup> 9.3 lb/1,000ft<sup>2</sup> weight.

Thread Biodegradable

Note: Photodegradable life a minimum of 18 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 1.5:1 gradient.

#### 2.5.8 Erosion Control Blankets Type VIII

Erosion control blanket shall be a machine-produced 100 percent biodegradable mat with a 70 percent herbaceous straw and 30 percent coconut fiber blend matrix. The blanket shall be of consistent thickness with the straw and coconut fiber evenly distributed over the entire area of the mat.

The blanket shall be covered on the top and bottom sides with 100 percent biodegradable woven natural organic fiber netting. The netting shall consist of machine directional strands formed from two intertwined yarns with cross directional strands interwoven through the twisted machine strands (commonly referred to as a Leno weave) to form an approximate 13 by 13 mm 1/2 by 1/2 inch mesh. The blanket shall be sewn together with biodegradable thread on 40 mm 1.5 inch centers. Straw/Coconut fiber erosion control blanket shall have the following properties:

#### Material Content

Matrix 70 percent straw fiber with approximately  
.19 kg/m<sup>2</sup> + .35 lb/yd<sup>2</sup> weight. 30 percent coconut  
fiber cured in fresh water with approximately  
.08 kg/m<sup>2</sup> .15 lb/yd<sup>2</sup> weight.

Netting Both sides woven 100% biodegradable natural organic  
fiber with approximately 45.4 kg/100 m<sup>2</sup> 9.3 lbs/1,000  
ft<sup>2</sup> weight.

Thread Biodegradable

NOTE: Photodegradable life a minimum of 24 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 1.5:1 gradient.

#### 2.5.9 Erosion Control Blankets Type IX (Turf Reinforcement Mat)

Permanent erosion control/turf reinforcement mat is constructed of 100 percent coconut fiber stitch bonded between a heavy duty UV stabilized bottom net, and a heavy duty UV stabilized cusped (crimped) middle netting overlaid with a heavy duty UV stabilized top net. The cusped netting forms prominent closely spaced ridges across the entire width of the mat. The three nettings are stitched together on 40 mm 1.5 inch centers with UV stabilized polypropylene thread to form a permanent three dimensional structure. The following list contains further physical properties of the turf erosion control mat.

Property	Test Method	Value	Units
Ground Cover	Image Analysis	93	percent
Thickness	ASTM D 1777		16 mm 0.63 in
Mass Per Unit Area	ASTM D 3776		0.5 kg/m <sup>2</sup> 0.92 lb/sy
Tensile Strength	ASTM D 5035		714 kg/m 480 lb/ft
Elongation	ASTM D 5035		percent
Tensile Strength	ASTM D 5035		1429 kg/m 960 lb/ft
Elongation	ASTM D 5035	31	percent
Tensile Strength	ASTM D 1682		80 kg 177 lbs
Elongation	ASTM D 1682	22	percent
Resiliency	ASTM D 1777	greater than 80	percent
UV Stability*	ASTM D 4355		68 kg 151 lbs
		86	percent
Color(permanent net)		UV Black	
Porosity(permanent net) Calculated		greater than 95	percent
Minimum Filament Measured Diameter (permanent net)			0.8 mm 0.03 in

NOTE 1: \*ASTM D 1682 Tensile Strength and percent Strength Retention of material after 1000 hours of exposure in Xenon-Arc Weatherometer

NOTE 2: Photodegradable life a minimum of 36 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 1:1 gradient.

#### 2.5.10 Erosion Control Blankets Type X (Turf Reinforcement Mat)

Permanent erosion control/turf reinforcement mat shall be constructed of 100 percent UV stabilized high denier polypropylene fiber sewn between a black UV stabilized 13 mm 1/2 inch mesh polypropylene netting on the top 24.4 kg/100 square m 5 lbs/1000 square ft and a black UV stabilized 16 mm 5/8 inch mesh polypropylene netting on the bottom 14.6 kg/100 square m 3 lbs/1000 square ft with polypropylene thread. The mat shall be resistant to photo and chemical degradation. The following list contains further physical properties of the turf reinforcement mat.

Property	Test Method	Value	Units
Thickness	ASTM D 1777		14 mm 0.56 in
Resiliency	100 PSI-3 cycles	94	percent
Mass Per Unit Area	ASTM D 3776		380 g/m <sup>2</sup> 11.2 oz/sq yd
Tensile Strength	ASTM D 4632		16 kg 35.2 lbs
Elongation	ASTM D 4632	25.5	percent
Tensile Strength	ASTM D 4595		385.7 kg/m 259.2 lbs/ft
Elongation	ASTM D 4595	20.9	percent
Tensile Strength	ASTM D 5035		446 kg/m 300 lbs/ft
Elongation	ASTM D 5035	51	percent
Tensile Strength	ASTM D 1682		40 kg 89 lbs
Elongation	ASTM D 1682	21	percent
UV Stability*	ASTM D 4355		37 kg 81* lbs
		90*	percent

NOTE 1: \*ASTM D 1682 Tensile Strength and percent Strength Retention

Property	Test Method	Value	Units
	of material after 1000 hours of exposure in Xenon-Arc Weatherometer.		

NOTE 2: Photodegradable life a minimum of 36 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 1:1 gradient.

#### 2.5.11 Erosion Control Blankets Type XI (Re-vegetation Mat)

\*\*\*\*\*  
**NOTE: The seed specified below will depend on location, climate and season. Custom mixes are available from some manufacturers.**  
 \*\*\*\*\*

Seed-incorporated blanket option shall consist of 2-ply 100 percent recycled, unbleached, cellulose tissue. A seed mix shall be uniformly distributed upon the bottom ply of cellulose tissue and fully overlaid with a top cellulose ply to provide complete envelopment of the seed layer. The seed-incorporated cellulose medium shall be sewn to the bottom side of the specified erosion control blanket.

##### Material Content

Top ply 1-ply 100 percent recycled unbleached cellulose tissue with approximately 21.0 kg/100 m<sup>2</sup> 4.3 lbs/ 1,000 ft<sup>2</sup> weight.

Seed [ ] 179 kg/ha 0.033 lbs/yd<sup>2</sup> (160 lbs/acre)

[ ] 90 kg/ha 0.017 lbs/yd<sup>2</sup> (80 lbs/acre)

Bottom ply 1-ply recycled unbleached cellulose issue with approximately 21.0 kg/100 m<sup>2</sup> 4.3 lbs/ (1,000 ft<sup>2</sup>) weight.

NOTE: Photodegradable life a minimum of 36 months with a minimum 90 percent light penetration. Apply to slopes up to a minimum 1:1 gradient.

#### 2.5.12 Erosion Control Blankets Type XII (Compost Mat)

\*\*\*\*\*  
**NOTE: Fine compost will penetrate the soil surface and increase water infiltration and water holding capacity. In addition, fine compost is essential for rapid vegetation establishment and long term soil and plant health. Coarse grades of compost, although harder to plant into, help to prevent splashing of raindrops directly on the soil surface and are less likely to be disturbed by rainfall and storm runoff. The coarse grades also perform like filters by stopping or catching soil particles already in motion. Dryer composts are recommended for areas prone to high rainfall because they will absorb more water and are more likely to bind pollutants, reducing the chance of leaching to**

ground and surface waters. Steeper slopes benefit from deeper layers of compost.

\*\*\*\*\*

Compost blanket shall consist of a layer of 100 percent biobased stable and mature compost uniformly distributed to a depth of 19 to 76 mm<sup>3/4</sup> to 3 inches along slopes with erosion potential. Compost shall encourage plant growth and seed shall be applied following compost application. The blanket shall have the following properties:

Parameter	Range
Particle size sieve (ratio = 3:1)	9.0-12.5 mm <sup>3/8</sup> -1/2 inch sieve and 50.0-76.0 mm <sup>2-3</sup> inch
Moisture content	20% - 50%
Soluble salt	3.0 - 6.0 mmhos/cm
Organic matter	40% - 70%
pH	6.0 - 8.0
Nitrogen content	0.5% - 2.0%
Human made inerts	0.0% - 1.0%

#### 2.5.13 Seed

\*\*\*\*\*

**NOTE: State-certified seed is more stringently monitored than State-approved seed; and therefore, more expensive.**

\*\*\*\*\*

##### 2.5.13.1 Seed Classification

[State-certified] [State-approved] native seed mix of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with AMS Seed Act and applicable state seed laws. The Contractor shall submit the Seed Establishment Period information as specified in the Submittals paragraph.

##### 2.5.13.2 Permanent Seed Species and Mixtures

Permanent seed species and mixtures shall be proportioned by weight as follows:

Mixture Percent by Weight	Percent Pure Live Seed	Botanical Name	Common Name
_____	_____	_____	_____
[_____]	[_____]	[_____]	[_____]

##### 2.5.13.3 Quality

Weed seed shall be a maximum 1 percent by weight of the total mixture.

##### 2.5.14 Staking

Stakes shall be 100 percent biodegradable manufactured from recycled plastic or wood and shall be designed to safely and effectively secure

erosion control blankets for temporary or permanent applications. The biodegradable stake shall be fully degradable by biological activity within a reasonable time frame. The bio-plastic resin used in production of the biodegradable stake shall consist of polylactide, a natural, completely biodegradable substance derived from renewable agricultural resources. The biodegradable stake must exhibit ample rigidity to enable being driven into hard ground, with sufficient flexibility to resist shattering. The biodegradable stake shall have serrations on the leg to increase resistance to pull-out from the soil. The biodegradable stake shall have the following dimensions: [\_\_\_\_].

#### 2.5.15 Staples

\*\*\*\*\*  
NOTE: Staples or anchoring methods and recommendations vary by manufacturers. The expectation of high flow velocities, sand, silt or uncompacted soils will dictate the pattern of fastening used as well as use of longer and more substantial anchors.  
\*\*\*\*\*

Staples shall be as recommended by the manufacturer.

#### 2.6 SYNTHETIC GRID AND SHEET SYSTEMS

Synthetic grid and sheet systems shall be formed of recycled plastic in accordance with paragraph RECYCLED PLASTICS and have interlocking components to form a uniform underlayment or strata to receive fill.

##### 2.6.1 Synthetic Grid Systems

Grids shall be made of modular interlocking components. Blocks shall be formed as rigid interlocking components or as expandable sheets and shall be manufactured to allow articulation upward and downward while restricting lateral movement. The assembled grid system shall articulate over three-directional vertical curves, both upward and downward. Nominal grid thickness shall be [\_\_\_\_] mm inches, or as indicated. Each pair of grids shall cover approximately [\_\_\_\_] square meters square feet. The system shall provide 100 percent coverage of the area with the cells back filled.

##### 2.6.2 Synthetic Sheet System

Synthetic sheet thickness shall be [\_\_\_\_] mm inches, or as indicated.

#### 2.7 SEDIMENT FENCING

\*\*\*\*\*  
NOTE: Sediment fencing does not stop erosion, but captures eroded soil before it damages adjoining properties. On steep slopes, fencing must be supported using driven steel or wooden posts spaced approximately every 1.2 m4 feet to prevent destruction from the weight of silt and water.  
\*\*\*\*\*

Wood or burlap.

## 2.8 COMPOST FILTER BERMS

\*\*\*\*\*

NOTE: Compost filter berms are contoured runoff and erosion filtration methods usually used for steeper slopes with high erosive potential. The berm allows runoff water to penetrate it and continue to flow while filtering sediment and pollutants from the water. It also slows the flow down, allowing soil particles to settle out. Berms work well in many of the same areas as blankets but are the preferred method if the slope exceeds a 4:1 gradient. Larger berms are recommended for steeper slopes. Compost berms are typically contoured to the base of the slope, but a second berm may be used on the shoulder contour of steeper slopes for added protection. Berms shall not be constructed in runoff channels, ditches, or gullies.

Windrow shaped berms should be 305 to 610 mm1 to 2 feet high and 762 to 1219 mm2.5 to 4 feet wide. Trapezoidal berms should be approximately 610 mm2 feet high, 610 to 914 mm2 to 3 feet wide at the top, and at least 1219 mm4 feet wide at the base. Trapezoidal berms provide maximum water filtration.

The compost mixture ratio may include a greater fraction of coarser grade compost (1:1) compared to compost blankets if vegetation establishment on the berm is not a primary goal or if there is a high runoff quantity potential.

\*\*\*\*\*

Compost berms shall consist of 100 percent biobased [windrow-][trapezoidal-]shaped compost piles arranged across slopes. Berms shall have the following properties:

Parameter	Range
Particle size sieve (ratio = 1:1)	9.0-12.5 mm3/8-1/2 inch sieve and 50.0-76.0 mm2-3 inch
Moisture content	20% - 50%
Soluble salt	4.0 - 6.0 mmhos/cm
Organic matter	40% - 70%
pH	6.0 - 8.0
Nitrogen content	0.5% - 2.0%
Human made inerts	0.0% - 1.0%
Size	[305 - 610 mm1 - 2 feet H x 762 - 1219 mm2.5 - 4 feet W] [610 mm2 feet H x 610 - 914 mm2 - 3 feet W at top, at least 1219 mm4 feet W at base]

## 2.9 AGGREGATE

\*\*\*\*\*

NOTE: NOTE: Designer must verify suitability before specifying recycled/reused materials and add what are considered acceptable materials.

\*\*\*\*\*

[Aggregate shall be [on-site] [or] [off-site] [\_\_\_\_\_] material generated from grading and demolition operations, as available.][ Recycled crushed concrete shall be free of steel, free-draining and graded between a minimum 19 mm3/4 inch and a maximum 38 mm1.5 inches.] Crushed rock shall be crushed run between a minimum [\_\_\_\_\_] mm inches and a maximum [\_\_\_\_\_] mm inches. Gravel shall be river run between a minimum [\_\_\_\_\_] mm inches and a maximum [\_\_\_\_\_] mm inches. Contractor shall submit sieve test results for both gravel and SAND.

## 2.10 ARTICULATING CELLULAR CONCRETE BLOCK SYSTEMS

Blocks shall be made of portland cement concrete, with no reinforcement, and shall be cast using block manufacturing equipment with vibratory compaction processes (dry cast). Blocks shall be made of modular interlocking components. Blocks shall be cast in pairs of "lock" and "key" blocks with each "lock" block having recesses and with each "key" block interlocking knobs. Blocks shall be manufactured to allow articulation upward and downward while restricting lateral movement. The assembled block system shall articulate over three-directional vertical curves, both upward and downward.

- a. Nominal block thickness shall be [\_\_\_\_\_] mm inches, or as indicated.
- b. Block weights, per pair of "key" and "lock" blocks, shall be approximately [\_\_\_\_\_] kg pounds for [\_\_\_\_\_] mm inch, thick blocks.
- c. Compressive strength testing of blocks, per ASTM C 39/C 39M, shall be performed on cylinders cut from random block samples in general conformance with ASTM C 42/C 42M.
- d. The average absorption of block samples shall be not greater than 7 percent, with no individual sample greater than 8 percent, in accordance with ASTM C 140.

## 2.11 WATER

\*\*\*\*\*  
NOTE: When water is Government furnished, locate the source. New, more sustainable, irrigation systems that recycle water may already be in place and, therefore, irrigation water may be supplied through a tertiary treatment plant onsite. Check project specific conditions.  
\*\*\*\*\*

Unless otherwise directed, water shall be the responsibility of the Contractor. Water shall be [collected rainwater] [greywater] [potable] or supplied by an existing irrigation system.

## PART 3 EXECUTION

### 3.1 CONDITIONS

Erosion control operations shall be performed under favorable weather conditions; when excessive moisture, frozen ground or other unsatisfactory conditions prevail, the work shall be stopped as directed. When special conditions warrant a variance to earthwork operations, a revised

construction schedule shall be submitted for approval. Erosion control materials shall not be applied in adverse weather conditions which could affect their performance.

#### 3.1.1 Finished Grade

\*\*\*\*\*  
NOTE: Coordinate the placement of erosion controls  
with grading and placement of topsoil in Section 31  
00 00 EARTHWORK, as well as Sections 32 92 23  
SEEDING, 32 92 23 SODDING, and 32 92 26 SPRIGGING.  
\*\*\*\*\*

The Contractor shall verify that finished grades are as indicated on the drawings; finish grading and compaction shall be completed in accordance with Section 31 00 00 EARTHWORK, prior to the commencement of the work. The location of underground utilities and facilities in the area of the work shall be verified and marked. Damage to underground utilities and facilities shall be repaired at the Contractor's expense.

#### 3.1.2 Placement of Erosion Control Blankets

Before placing the erosion control blankets, ensure the subgrade has been graded smooth; has no depressed, void areas; is free from obstructions, such as tree roots, projecting stones or other foreign matter. Verify that mesh does not include invasive species. Vehicles shall not be permitted directly on the blankets.

#### 3.1.3 Synthetic Grid

Before placing the grid system, ensure that the subgrade has been properly grubbed of large roots and rocks; compacted; has been graded smooth; has no depressed, void, soft or uncompacted areas; is free from obstructions, such as tree roots, projecting stones or other foreign matter; and has been seeded.

#### 3.1.4 Concrete Cellular Block

Before placing geotextile fabric under cellular block, ensure that the subgrade has been properly compacted; has been graded smooth; has no depressed, void, soft or uncompacted areas; is free from obstructions, such as tree roots, projecting stones or other foreign matter; and has been seeded. Subgrade compaction shall be at least 90 percent of the maximum dry density at optimum moisture content, as determined by ASTM D 698, and shall be installed to within plus or minus 25 mm 1 inch of the design elevation.

### 3.2 SITE PREPARATION

\*\*\*\*\*  
NOTE: Minimize exposed soil during construction to  
help control erosion. Reducing site disturbance  
contributes to the following LEED credit: SS5.  
\*\*\*\*\*

#### 3.2.1 Soil Test

Soil shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size and mechanical analysis. Sample collection

onsite shall be random over the entire site. The test shall determine the soil particle size as compatible for the specified material.

### 3.2.2 Layout

Erosion control material locations may be adjusted to meet field conditions. When soil tests result in unacceptable particle sizes, a shop drawing shall be submitted indicating the corrective measures.

### 3.2.3 Protecting Existing Vegetation

When there are established lawns in the work area, the turf shall be covered and/or protected or replaced after construction operations. Existing trees, shrubs, plant beds, and landscape features that are to be preserved shall be identified on site by appropriate tags and barricaded with reusable, high-visibility fencing along the dripline. Damage to existing trees shall be mitigated by the Contractor at no additional cost to the Government. Damage shall be assessed by a state certified arborist or other approved professional using the National Arborist Association's tree valuation guideline.

### 3.2.4 Obstructions Below Ground

When obstructions below ground affect the work, shop drawings showing proposed adjustments to placement of erosion control material shall be submitted for approval.

## 3.3 INSTALLATION

Immediately stabilize exposed soil using [fabric, ][mulch, ][compost, ][and ][seed]. Stabilize areas for construction access immediately as specified in the paragraph Construction Entrance. Install principal sediment basins and traps before any major site grading takes place. Provide additional sediment traps and sediment fences as grading progresses. Provide inlet and outlet protection at the ends of new drainage systems. [Remove temporary erosion control measures at the end of construction and provide permanent seeding.]

### 3.3.1 Construction Entrance

Provide as indicated on drawings, a minimum of 152 mm6 inches thick, at points of vehicular ingress and egress on the construction site. Construction entrances shall be cleared and grubbed, and then excavated a minimum of 76 mm3 inches prior to placement of the filter fabric and aggregate. The aggregate shall be placed in a manner that will prevent damage and movement of the fabric. Place fabric in one piece, where possible. Overlap fabric joints a minimum of 305 mm12 inches.

### 3.3.2 Compost Filter Berms

\*\*\*\*\*  
NOTE: Vegetation or compost blankets may be used in front or above berms but not under them. Use a second berm for areas extremely vulnerable to erosion.  
\*\*\*\*\*

Place compost filter berm uncompacted on bare soil as indicated on drawings, parallel to base of slope, and according to manufacturer

recommendations. [Place second berm in the same manner at top of slope parallel to first berm.] When no longer required, berm material may be left to decompose naturally, or distributed over [an adjacent ]area for use as a soil amendment or ground cover.

#### 3.3.3 Synthetic Binders

Synthetic binders shall be applied heaviest at edges of areas and at crests of ridges and banks to prevent displacement. Binders shall be applied to the remainder of the area evenly at the rate of [\_\_\_\_\_] or as recommended by the manufacturer.

#### 3.3.4 Seeding

When seeding is required prior to installing mulch on synthetic grid systems the Contractor shall verify that seeding will be completed in accordance with Sections 31 00 00 EARTHWORK and 32 92 23 SEEDING.

#### 3.3.5 Mulch Installation

Mulch shall be installed in the areas indicated. Mulch shall be applied evenly at the rate of [\_\_\_\_\_] Square per meter yard.

#### 3.3.6 Mulch Control Netting

Netting may be stapled over mulch according to manufacturer's recommendations.

#### 3.3.7 Mechanical Anchor

Mechanical anchor shall be a V-type-wheel land packer; a scalloped-disk land packer designed to force mulch into the soil surface; or other suitable equipment.

#### 3.3.8 Asphalt Adhesive Tackifier

Asphalt adhesive tackifier shall be sprayed at a rate between 666 to 866 liters per hectare 10 to 13 gallons per 1000 square feet. Sunlight shall not be completely excluded from penetrating to the ground surface.

#### 3.3.9 Non-Asphaltic Tackifier

Hydrophilic colloid shall be applied at the rate recommended by the manufacturer, using hydraulic equipment suitable for thoroughly mixing with water. A uniform mixture shall be applied over the area.

#### 3.3.10 Asphalt Adhesive Coated Mulch

Hay or straw mulch may be spread simultaneously with asphalt adhesive applied at a rate between 666 to 866 liters per hectare 10 to 13 gallons per 1000 square feet, using power mulch equipment which shall be equipped with suitable asphalt pump and nozzle. The adhesive-coated mulch shall be applied evenly over the surface. Sunlight shall not be completely excluded from penetrating to the ground surface.

#### 3.3.11 Wood Cellulose Fiber, Paper Fiber, and Recycled Paper

Wood cellulose fiber, paper fiber, or recycled paper shall be applied as part of the hydraulic mulch operation.

### 3.3.12 Hydraulic Mulch Application

#### 3.3.12.1 Unseeded Area

Hydraulic mulch shall be installed as indicated and in accordance with manufacturer's recommendations. Hydraulic mulch shall be mixed with water at the rate recommended by the manufacturer for the area to be covered. Mixing shall be done in equipment manufactured specifically for hydraulic mulching work, including an agitator in the mixing tank to keep the mulch evenly disbursed.

#### 3.3.12.2 Seeded Area

For drill or broadcast seeded areas, hydraulic mulch shall be applied evenly at the rate of [\_\_\_\_\_] per square meter yard. For hydraulic seeded areas, mulch shall be applied at the rate of [\_\_\_\_\_] per square meter yard with the seed and fertilizer, and at the rate of [\_\_\_\_\_] per square meter yard in a second application of mulch only.

### 3.3.13 Erosion Control Blankets

- a. Erosion control blankets shall be installed as indicated and in accordance with manufacturer's recommendations. The extent of erosion control blankets shall be as shown on drawings.
- b. Erosion control blankets shall be oriented in vertical strips and anchored with staples, as indicated. Adjacent strips shall be abutted to allow for installation of a common row of staples. Horizontal joints between erosion control blankets shall be overlapped sufficiently to accommodate a common row of staples with the uphill end on top.
- c. Where exposed to overland sheet flow, a trench shall be located at the uphill termination. The erosion control blanket shall be stapled to the bottom of the trench. Backfill and compact the trench as required.
- d. Where terminating in a channel containing an installed blanket, the erosion control blanket shall overlap installed blanket sufficiently to accommodate a common row of staples.

### 3.3.14 Synthetic Sheet System

Synthetic sheet systems shall be anchored in accordance with the manufacturer's recommendation. Systems shall be placed on a well graded surface and then backfilled, a maximum seven days after placement, to protect the material from ultraviolet radiation. As the installation progresses, backfilling shall include contiguous perimeter termination trenches.

#### 3.3.14.1 Sheet System Revegetation

For areas not requiring re-vegetation, openings shall be backfilled to grade with well graded fill material and surface prepared for finish as indicated on the drawings. For areas requiring re-vegetation, openings shall be backfilled using well graded fill and topsoil as indicated on the drawings.

#### 3.3.14.2 Sheet System Grids

Each pair of grids shall cover grade without gaps or open spaces between them. The system shall provide 100 percent coverage of the area with the cells backfilled.

#### 3.3.14.3 Sheet System Seeding

Seed shall be installed in accordance with Section 32 92 23 SEEDING.

#### 3.3.14.4 Grid System Grids

Synthetic grid systems shall be anchored in accordance with the manufacturer's recommendation. Interlocking grid systems shall be placed on well graded surface and the backfilling of openings shall be completed a maximum 7 days after placement, to protect the material from ultraviolet radiation. As the installation progresses, backfilling shall include contiguous perimeter termination trenches.

### 3.3.15 Grids

#### 3.3.15.1 Grid System Revegetation

For areas not requiring re-vegetation, openings shall be backfilled with a minimum 13 mm 1/2 inch nominal size crushed rock, to a minimum 50 mm 2 inch depth.

#### 3.3.15.2 Synthetic Grids

Each pair of grids shall cover grade without gaps or open spaces between them. The system shall provide 100 percent coverage of the area with the cells backfilled.

#### 3.3.13.3 Grid System Seeding

Seed shall be installed in accordance with Section 32 92 23 SEEDING.

### 3.3.16 Articulating Cellular Concrete Block System Installation

Block installation shall be underlain by geotextile fabric in accordance with the manufacturer's recommendation. Block installation shall begin from a straight-line oriented perpendicular to the direction of lay, and shall proceed toward an open area and not toward a point of fixity. Blocks shall be installed with the bottom side down. Blocks shall continue to be laid in straight-lines to maintain the interlock characteristic. To maintain straight-lines, no more than two rows of blocks shall be started at a time. The extent of blocks shall include the perimeter termination trenches and shall be as shown on the drawings. Each pair of "key" and "lock" blocks shall cover a minimum [\_\_\_\_\_] square meters feet, including uncovered openings between the blocks. The system shall provide a minimum [\_\_\_\_\_] percent coverage of the area with blocks, leaving a minimum [\_\_\_\_\_] percent uncovered area at the ground surface. For installation purposes, the bottom of the block shall be the side with a flat unformed surface.

#### 3.3.16.1 Concrete Grout

When abutting structures, such as culverts, piers and bridge abutments, concrete grout shall be furnished and installed full-depth in the void between the blocks and penetrations. Grout shall be installed as specified

in [Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE] [Section 03300N CAST-IN-PLACE CONCRETE].

#### 3.3.16.2 Toe Protection

Where exposed to hydraulic forces, the perimeter of the block system shall be turned into and buried beneath the adjacent ground level to a minimum 300 mm 12 inch depth or as directed. Where not exposed to hydraulic forces, the perimeter of the geotextile shall be placed in a minimum 300 mm 12 inch deep trench and the blocks shall be flush with the adjacent surface. Trenches shall be excavated as required for perimeter termination.

#### 3.3.16.3 Backfilling Cellular Block System

Backfilling of openings between blocks shall be completed a maximum of 7 days after placement of the filter, to protect the geotextile from ultraviolet radiation. As the installation progresses, backfilling shall include contiguous perimeter termination trenches.

#### 3.3.16.4 Block System Revegetation

For areas not requiring revegetation, openings shall be backfilled with a minimum 6 mm 1/4 inch nominal size crushed rock to a minimum 50 mm 2 inch depth or as otherwise specified, regardless of block thickness. For areas requiring revegetation as indicated, openings shall be backfilled with topsoil as specified.

#### 3.3.16.5 Seeding, Fertilizing, Mulching

Seed shall be installed in accordance with Section 32 92 23 SEEDING.

#### 3.3.17 Sediment Fencing

Install posts at the spacing indicated on drawings and at an angle between 2 degrees and 20 degrees towards the potential silt load area. Sediment fence height shall be approximately 406 mm 16 inches. Do not attach filter fabric to existing trees. Secure filter fabric to the post and wire fabric using staples, tie wire, or hog rings. Imbed the filter fabric into the ground as indicated on drawings. Splice filter fabric at support pole using a 152 mm 6 inches overlap and securely seal.

#### 3.4 CLEAN-UP

Excess material, debris, and waste materials shall be disposed offsite at an approved landfill or recycling center. Adjacent paved areas shall be cleared. Immediately upon completion of the installation in an area, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed. Signage shall be [in accordance with Section 10430 EXTERIOR SIGNAGE] [\_\_\_\_\_].

#### 3.5 WATERING SEED

\*\*\*\*\*  
NOTE: Water requirements to establish seed may be  
greater than for the establishment of exterior  
plants.  
\*\*\*\*\*

Watering shall be started immediately after installing erosion control

blanket type XI (revegetation mat). Water shall be applied to supplement rainfall at a sufficient rate to ensure moist soil conditions to a minimum 25 mm 1 inch depth. Run-off and puddling shall be prevented. Watering trucks shall not be driven over turf areas, unless otherwise directed. Watering of other adjacent areas or plant material shall be prevented.

### 3.6 MAINTENANCE RECORD

A record shall be furnished describing the maintenance work performed, record of measurements and findings for product failure, recommendations for repair, and products replaced.

#### 3.6.1 Maintenance

Maintenance shall include eradicating weeds; protecting embankments and ditches from surface erosion; maintaining the performance of the erosion control materials and mulch; protecting installed areas from traffic.

##### 3.6.1.1 Maintenance Instructions

Written instructions containing drawings and other necessary information shall be furnished, describing the care of the installed material; including, when and where maintenance should occur, and the procedures for material replacement.

##### 3.6.1.2 Patching and Replacement

Unless otherwise directed, material shall be placed, seamed or patched as recommended by the manufacturer. Material not meeting the required performance as a result of placement, seaming or patching shall be removed from the site. The Contractor shall replace the unacceptable material at no additional cost to the Government.

### 3.7 SATISFACTORY STAND OF GRASS PLANTS

When erosion control blanket type XI (revegetation mat) is installed, the grass plants shall be evaluated for species and health when the grass plants are a minimum 25 mm 1 inch high. A satisfactory stand of grass plants from the revegetation mat area shall be a minimum 100 grass plants per square meter 10 grass plants per square foot. The total bare spots shall not exceed 2 percent of the total revegetation mat area.

-- End of Section --