
USACE / NAVFAC / AFCEC / NASA UFGS-31 32 11 (August 2008)

Preparing Activity: USACE Superseding
UFGS-31 32 11 (October 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2017

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SECTION 31 32 11

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08/08

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SECTION 31 32 11

SOIL SURFACE EROSION CONTROL

08/08

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

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

PART 1 GENERAL

1.1 SUMMARY

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.

The work consists 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 includes all necessary materials, labor, supervision and equipment for installation of a complete system. Submit a listing of equipment to be used for the application of erosion control materials. Coordinate this section with the requirements of [Section 31 00 00 EARTHWORK] [and] [Section 32 92 19 SEEDING,] [and] [Section 32 92 23 SODDING]. Complete backfilling the openings in synthetic grid systems and articulating cellular concrete block systems a maximum 7 days after placement to protect the material from ultraviolet radiation.

1.2 MEASUREMENT AND PAYMENT

1.2.1 Standard and Geosynthetic Binder

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

1.2.2 Mulch and Compost

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

1.2.3 Hydraulic Mulch

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

1.2.4 Geotextile Fabric

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

1.2.5 Erosion Control Blankets

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

1.2.6 Synthetic Grid/Sheet Systems

Measure synthetic grid/sheet system by the square meter yard of surface area covered. No measurement for payment will 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.

1.2.7 Cellular Concrete Block Systems

Measure articulating cellular concrete block system by the square meter yard of surface area covered. No measurement for payment will 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 REFERENCES

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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 C140/C140M	(2016) Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
ASTM C39/C39M	(2016b) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42/C42M	(2013) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM D1248	(2012) Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D1560	(2015) Resistance to Deformation and Cohesion of Bituminous Mixtures by Means of Hveem Apparatus
ASTM D1777	(1996; E 2011; R 2011) Thickness of Textile Materials

ASTM D2028/D2028M	(2015) Cutback Asphalt (Rapid-Curing Type)
ASTM D2844/D2844M	(2013) Resistance R-Value and Expansion Pressure of Compacted Soils
ASTM D3776/D3776M	(2009a; R 2013) Standard Test Method for Mass Per Unit Area (Weight) of Fabric
ASTM D3787	(2016) Bursting Strength of Textiles - Constant-Rate-of-Traverse (CRT), Ball Burst Test
ASTM D3884	(2009; R 2013; E 2014) Abrasion Resistance of Textile Fabrics (Rotary Platform, Double-Head Method)
ASTM D4355/D4355M	(2014) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D4491/D4491M	(2015) Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D4533/D4533M	(2015) Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D4595	(2011) Tensile Properties of Geotextiles by the Wide-Width Strip Method
ASTM D4632/D4632M	(2015a) Grab Breaking Load and Elongation of Geotextiles
ASTM D4751	(2016) Standard Test Method for Determining Apparent Opening Size of a Geotextile
ASTM D4833/D4833M	(2007; E 2013; R 2013) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D4972	(2013) pH of Soils
ASTM D5034	(2009; R 2013) Breaking Strength and Elongation of Textile Fabrics (Grab Test)
ASTM D5035	(2011) Breaking Force and Elongation of Textile Fabrics (Strip Method)
ASTM D5268	(2013) Topsoil Used for Landscaping Purposes
ASTM D5852	(2000; R 2007; E 2014) Standard Test Method for Erodibility Determination of Soil in the Field or in the Laboratory by the Jet Index Method
ASTM D6629	(2001; E 2012; R 2012) Selection of Methods for Estimating Soil Loss by Erosion

ASTM D698 (2012; E 2014; E 2015) Laboratory
Compaction Characteristics of Soil Using
Standard Effort (12,400 ft-lbf/cu. ft.
(600 kN-m/cu. m.))

ASTM D977 (2013; E 2014) 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 BD+C (2009; R 2010) Leadership in Energy and
Environmental Design(tm) Building Design
and Construction (LEED-NC)

LEED GBDC Ref Guide (2009; R 2010) LEED Reference Guide for
Green Building Design, Construction and
Major Renovations of Commercial and
Institutional Buildings including Core &
Shell and K-12 Projects

1.4 SUBMITTALS

NOTE: Review submittal description (SD) definitions
in Section 01 33 00 SUBMITTAL PROCEDURES and edit
the following list to reflect only the submittals
required for the project.

The Guide Specification technical editors have
designated those items that require Government
approval, due to their complexity or criticality,
with a "G." Generally, other submittal items can be
reviewed by the Contractor's Quality Control
System. Only add a "G" to an item, 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,
Air Force, and NASA projects.

Use the "S" classification only in SD-11 Closeout
Submittals. The "S" following a submittal item
indicates that the submittal is required for the
Sustainability Notebook to fulfill federally
mandated sustainable requirements in accordance with

Section 01 33 29 SUSTAINABILITY REPORTING.

**Choose the first bracketed item for Navy, Air Force
and NASA projects, or choose the second bracketed
item for Army projects.**

Government approval is required for submittals with a "G" designation;
submittals not having a "G" designation are for [Contractor Quality Control
approval.] [information only. When used, a designation following the "G"
designation identifies the office that will review the submittal for the
Government.] Submittals with an "S" are for inclusion in the
Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY
REPORTING. Submit the following in accordance with Section 01 33 00
SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Work Sequence Schedule; G[, [____]]
Erosion Control Plan; G[, [____]]; (LEED BD+C)

SD-02 Shop Drawings

Layout; [____]
Obstructions Below Ground; [____]
Seed Establishment Period
Maintenance Record

SD-03 Product Data

[Local/Regional Materials; (LEED BD+C)
Biobased Materials]

Geosynthetic Binders; [____]
Recycled Plastic; (LEED BD+C)
Wood Cellulose Fiber; (LEED BD+C)
Paper Fiber; (LEED BD+C)
Mulch Control Netting and Filter Fabric; (LEED BD+C)
Hydraulic Mulch; [____]; (LEED BD+C)
Erosion Control Blankets Type XI; (LEED BD+C)
Geotextile Fabrics; [____]; (LEED BD+C)
Aggregate; (LEED BD+C)
Synthetic Grid Systems; [____]
Articulating Cellular Concrete Block Systems; [____]
Equipment
Finished Grade
Erosion Control Blankets

Submit 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.

SD-04 Samples

In addition to the samples, submit certification of recycled
content or Statement of recycled content. Also submit

certification of origin including the name, address and telephone number of manufacturer.

Geosynthetic Binders

1.13 L1 quart

Mulch

0.74 k 2 pounds

Hydraulic Mulch

0.74 k 2 pounds

Geotextile Fabrics

150 mm 6 inch square

Erosion Control Blankets

150 mm 6 inch square

Synthetic Grid Systems

One sample grid

Articulating Cellular Concrete Block Systems

9.3 square meters 100 square feet area sample and [two] [_____] color charts displaying the colors and finishes.

SD-06 Test Reports

Geosynthetic Binders
Hydraulic Mulch
Geotextile Fabrics
Erosion Control Blankets
Synthetic Grid Systems
Articulating Cellular Concrete Block Systems
Compressive Strength Testing
Sand
Gravel

SD-07 Certificates

Fill Material
Mulch
Hydraulic Mulch
Geotextile Fabrics
Geosynthetic Binders
Synthetic Soil Binders
Installer's Qualification
Recycled Plastic
Seed
Asphalt Adhesive
Tackifier
Wood By-Products
Wood Cellulose Fiber

SD-10 Operation and Maintenance Data

Maintenance Instructions; G[, [_____]]

SD-11 Closeout Submittals

Local/Regional Materials; S
Recycled Plastic; S
Wood Cellulose Fiber; S
Paper Fiber; S
Mulch Control Netting and Filter Fabric; S
Hydraulic Mulch; S
Erosion Control Blankets Type XI; S
Geotextile Fabrics; S
Aggregate; S

1.5 QUALITY ASSURANCE

1.5.1 Installer's Qualification

The installer shall be certified by the manufacturer for training and experience installing the material. Submit the installer's company name and address, and/or certification.

1.5.2 Erosion Potential

Assess potential effects of soil management practices on soil loss in accordance with ASTM D6629. Assess erodibility of soil with dominant soil structure less than 70 to 80 mm 2.8 to 3.1 inches in accordance with ASTM D5852.

1.5.3 Substitutions

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

1.5.4 SUSTAINABLE DESIGN REQUIREMENTS

1.5.4.1 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 800 km 500 mile radius from the project site contributes to the following LEED credit: MR5. Coordinate with Section 01 33 29 SUSTAINABILITY REPORTING. Use second option if Contractor is choosing local materials in accordance with Section 01 33 29 SUSTAINABILITY REPORTING. First option will not be used for USACE projects. Army projects will include second option only if pursuing this LEED credit.

[Use materials or products extracted, harvested, or recovered, as well as manufactured, within a [800] [_____] km [500] [_____] mile radius from the project site, if available from a minimum of three sources.][See Section

01 33 29 SUSTAINABILITY REPORTING for cumulative total local material requirements. Erosion control materials may be locally available.] Submit LEED documentation relative to local/regional materials credit in accordance with LEED GBDC Ref Guide. Submit 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.

1.5.4.2 Biobased Materials

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.

Use biobased materials when feasible and as specified. Submit 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.]

1.6 DELIVERY, STORAGE, AND HANDLING

Prior to delivery of materials, submit certificates of compliance attesting that materials meet the specified requirements. Store materials in designated areas and as recommended by the manufacturer protected from the elements, direct exposure, and damage. Do not drop containers from trucks. Material shall be free of defects that would void required performance or warranty. Deliver geosynthetic binders and synthetic soil binders in the manufacturer's original sealed containers and stored in a secure area.

- a. Furnish erosion control blankets and geotextile fabric in rolls with suitable wrapping to protect against moisture and extended ultraviolet exposure prior to placement. Label erosion control blanket and geotextile fabric rolls 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, will not be deemed grounds for rejection.
- c. Inspect seed 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.

1.7 SCHEDULING

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.

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. Coordinate installation of temporary erosion control features with the construction of permanent erosion control features to assure effective and continuous control of erosion, pollution, and sediment deposition. Include a vegetative plan with planting and seeding dates and fertilizer, lime, and mulching rates. Distribute copies of the work schedule and erosion control plan to site subcontractors. Address the following in the erosion control plan:

- 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.

1.8 WARRANTY

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.

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

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.

2.1 RECYCLED PLASTIC

NOTE: Plastic lumber landscaping timbers and posts are EPA designated products for recycled content. See Section 01 33 29 SUSTAINABILITY REPORTING 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 SUSTAINABILITY REPORTING. 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 SUSTAINABILITY REPORTING. Army projects will specify recycled content exceeding EPA requirements only if pursuing this LEED credit.

Submit individual component and assembled unit structural integrity test results; creep tolerance; deflection tolerance; and vertical load test results and Life-cycle durability. 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 D1248. 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. Submit certification for binders showing EPA registered uses, toxicity levels, and application hazards.

2.2.2 Geosynthetic Binders

Geosynthetic binders shall be manufactured in accordance with ASTM D1560,

ASTM D2844/D2844M; 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

NOTE: Wood fiber mulch is an EPA designated product for recycled content. See Section 01 33 29 SUSTAINABILITY REPORTING 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 SUSTAINABILITY REPORTING. 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 SUSTAINABILITY REPORTING. 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.

Submit certification stating that wood components were obtained from managed forests. 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 SUSTAINABILITY REPORTING 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

NOTE: Paper fiber mulch is an EPA designated product for recycled content. See Section 01 33 29 SUSTAINABILITY REPORTING 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 SUSTAINABILITY REPORTING. 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 SUSTAINABILITY REPORTING. 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 SUSTAINABILITY REPORTING 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

Submit composition, source, and particle size. Products shall be free from toxic chemicals or hazardous material. 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 D977, Grade SS-1; and cutback asphalt, conforming to ASTM D2028/D2028M, 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:

Minimum grab tensile strength (TF 25 #1/ ASTM D4632/D4632M)	0.8 kN 180 pounds
Minimum Puncture (TF 25 #4/ASTM D3787)	0.52 MPa 75 psi in the weakest direction
Apparent opening sieve size	minimum 40 and maximum 80 (U.S. Sieve Size)
Minimum Trapezoidal tear strength (TF 25 #2/ ASTM D4533/D4533M)	0.22 kN 50 pounds

2.3.10 Hydraulic Mulch

NOTE: Hydraulic mulch is an EPA designated product for recycled content. See Section 01 33 29 SUSTAINABILITY REPORTING 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. Pre-package dye in water dissolvable packets in the hydraulic mulch.

2.4 GEOTEXTILE FABRICS

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 SUSTAINABILITY REPORTING. 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 SUSTAINABILITY REPORTING 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. Install fabric 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 ²	ASTM D3776/D3776M
Thickness	0.635 mm	ASTM D1777
Permeability	0.12 cm/sec	ASTM D4491/D4491M
Abrasion Resistance, Type (percent strength retained)	58 percent X 81 percent	ASTM D3884
Tensile Grab Strength	1467 N X 1933 N	ASTM D4632/D4632M
Grab Elongation	15 percent X 20 percent	ASTM D4632/D4632M
Burst Strength	5510 kN/m ²	ASTM D3787
Puncture Strength	733 N	ASTM D4833/D4833M
Trapezoid Tear	533 N X 533 N	ASTM D4533/D4533M
Apparent Opening Size	40 US Std Sieve	ASTM D4751
UV Resistance @ 500 hours	90 percent	ASTM D4355/D4355M

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

Use Type I blankets 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 percent straw. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. Cover the blanket 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 0.27 kg/m ² 0.50 lb/yd ² weight

Material Content	
Netting	One side only, lightweight photodegradable with approximately 8.0 kg/100 m ² 1.64 lb/1,000 ft ² 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. Cover the blanket 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. Sew the blanket 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 0.27 kg/m ² 0.50 lb/yd ² weight
Netting	One side only, lightweight photodegradable with photo accelerators and approximately 8.0 kg/100 m ² 1.64 lb/1,000 ft ² weight
Thread	Degradable
Note 1: 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. Cover the blanket 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 by 1/2 inch mesh. Sew the blanket 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 0.19 kg/m ² 0.35 lb/yd ²
Coconut Fiber	30 percent by approximately 0.08 kg/m ² 0.15 lb/yd ² weight
Netting	Top side heavyweight photodegradable with UV additives and approximately 16 kg/ m ² 3 lb/1,000 ft ² weight
	Bottom side lightweight photodegradable with approximately 8.0 kg/100 m ² 1.64 lb/1,000 ft ² 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. Cover the blanket 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. Sew the blanket 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 0.27 kg/m ² 0.50 lb/yd ² weight
Netting	Both sides lightweight photodegradable with approximately 8.0 kg/100 m ² 1.64 lb/1,000 ft ² 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. Cover the blanket 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. Cover the bottom with a polypropylene netting having an approximate 13 by 13 mm 1/2 by 1/2 inch mesh with photo accelerators. Sew the blanket 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 0.19 kg/m ² 0.35 lb/yd ²
Netting	Top side lightweight photodegradable with photo accelerators with approximately 8.0 kg/100 m ² 1.64 lb/1,000 ft ² weight
	Bottom side lightweight photodegradable with photo accelerators and approximately 8.0 kg/100 m ² 1.64 lb/1,000 ft ² weight
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 percent 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. Cover the blanket 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. Sew the blanket 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 0.27 kg/m ² 0.50 lb/yd ² weight
Netting	One side only, Leno woven 100 percent biodegradable natural organic fiber
Weight	approximately 45.4 kg/100 m ² 9.3 lb/1,000 ft
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. Cover the blanket 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. Sew the blanket 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 0.27 kg/m ² 0.50 lb/yd ² weight
Netting	Top and bottom sides, Leno woven 100 percent biodegradable natural organic fiber with approximately 45.4 kg/100 m ² 9.3 lb/1,000ft ² 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. Cover the blanket 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. Sew the blanket 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 ² + 0.35 lb/yd ² weight. 30 percent coconut fiber cured in fresh water with approximately 0.08 kg/m ² 0.15 lb/yd ² weight
Netting	Both sides woven 100 percent biodegradable natural organic fiber with approximately 45.4 kg/100 m ² 9.3 lbs/1,000 ft ² 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
Ground Cover	Image Analysis	93 percent
Thickness	ASTM D1777	16 mm 0.63 in
Mass per Unit Area	ASTM D3776/D3776M	0.5 kg/m ² 0.92 lb/sy
Tensile Strength	ASTM D5035	714 kg/m 480 lb/ft
Elongation	ASTM D5035	[_____] percent
Tensile Strength	ASTM D5035	1429 kg/m 960 lb/ft
Elongation	ASTM D5035	31 percent
Tensile Strength	[ASTM D5034][ASTM D5035]	80 kg 177 lbs
Elongation	[ASTM D5034][ASTM D5035]	22 percent
Resiliency	ASTM D1777	greater than 80 percent
UV Stability*	ASTM D4355/D4355M	68 kg 151 lbs 86 percent
Color(permanent net)		UV Black
Porosity(permanent net)Calculated		greater than 95 percent
Minimum Filament Measured		0.8 mm 0.03 in
Diameter (permanent net)		0.8 mm 0.03 in
NOTE 1: *[ASTM D5034][ASTM D5035] 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
Thickness	ASTM D1777	14 mm 0.56 in
Mass per Unit Area	ASTM D3776/D3776M	380 g/m ² 11.2 oz/sq yd
Tensile Strength	ASTM D4632/D4632M	16 kg 35.2 lbs
Elongation	ASTM D4632/D4632M	25.5 percent
Tensile Strength	ASTM D4595	385.7 kg/m 259.2 lbs/ft
Elongation	ASTM D4595	20.9 percent
Tensile Strength	ASTM D5035	446 kg/m 300 lbs/ft
Elongation	ASTM D5035	51 percent
Tensile Strength	[ASTM D5034][ASTM D5035]	40 kg 89 lbs
Elongation	[ASTM D5034][ASTM D5035]	21 percent
Resiliency	100 PSI-3 cycles	94 percent
UV Stability*	ASTM D4355/D4355M	37 kg 81* lbs 90* percent
NOTE 1: *[ASTM D5034][ASTM D5035] 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		

2.5.11 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. Uniformly distribute a seed mix upon the bottom ply of cellulose tissue and fully overlaid with a top cellulose ply to provide complete envelopment of the seed layer. Sew the seed-incorporated cellulose medium 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 ² 4.3 lbs/1,000 ft ² weight
Seed	[_____] 179 kg/ha 0.033 lbs/yd ² (160 lbs/acre)

Material Content	
	[_____] 90 kg/ha 0.017 lbs/yd ² (80 lbs/acre)
Bottom Ply	1-ply recycled unbleached cellulose issue with approximately 21.0 kg/100 m ² 4.3 lbs/(1,000 ft ²) 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 75 mm 3/4 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	9.0-12.5 mm 3/8-1/2 inch sieve and 50.0-76.0 mm 2-3 inch sieve (ratio = 3:1)
Moisture content	20 - 50 percent
Soluble salt	3.0 - 6.0 mmhos/cm
Organic matter	40 - 70 percent
pH	6.0 - 8.0
Nitrogen content	0.5 - 2.0 percent
Human made inerts	0.0 - 1.0 percent

2.5.13 Seed

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

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

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. Conform labels to the AMS Seed Act and applicable state seed laws. Submit the calendar time for 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.

2.5.13.2 Permanent Seed Species and Mixtures

Proportion permanent seed species and mixtures 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. Serrate the biodegradable stake 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. Form blocks as rigid interlocking components or as expandable sheets and manufacture 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 feet. 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 m 4 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 300 to 610 mm 1 to 2 feet high and 760 to 1220 mm 2.5 to 4 feet wide. Trapezoidal berms should be approximately 610 mm 2 feet high, 610 to 915 mm 2 to 3 feet wide at the top, and at least 1220 mm 4 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	9.0-12.5 mm 3/8-1/2 inch sieve and 50.0-76.0 mm 2-3 inch sieve (ratio = 1:1)
Moisture content	20 - 50 percent
Soluble salt	4.0 - 6.0 mmhos/cm
Organic matter	40 - 70 percent
pH	6.0 - 8.0
Nitrogen content	0.5 - 2.0 percent
Human made inerts	0.0 - 1.0 percent
Size	[305 - 610 mm 1 - 2 feet H x 762 - 1219 mm 2.5 - 4 feet W][610 mm 2 feet H x 610 - 914 mm 2 - 3 feet W at top, at least 1219 mm 4 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.

Submit LEED documentation relative to recycled content credit in accordance with LEED GBDC Ref Guide. Include in LEED Documentation Notebook. [Aggregate shall be [onsite] [or] [offsite] [_____] 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 mm 3/4 inch and a maximum 38 mm 1.5 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. Submit sieve test results for both gravel and sand. Sand shall be uniformly graded.

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. Cast blocks in pairs of "lock" and "key" blocks with each "lock" block having recesses and with each "key" block interlocking knobs. Manufacture blocks 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 [_____] mm inches, or as indicated.
- b. Block weights, per pair of "key" and "lock" blocks, approximately [_____] kg pounds for [_____] mm inch, thick blocks.
- c. Perform compressive strength testing of blocks, in accordance with ASTM C39/C39M, on cylinders cut from random block samples in general conformance with ASTM C42/C42M.
- d. The average absorption of block samples not greater than 7 percent, with no individual sample greater than 8 percent, in accordance with ASTM C140/C140M.

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 is the responsibility of the Contractor. Water shall be [collected rainwater][greywater][potable] or supplied by an existing irrigation system.

PART 3 EXECUTION

3.1 WEATHER CONDITIONS

Perform erosion control operations 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, submit a revised construction schedule for approval. Do not apply erosion control materials 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 19 SEEDING, 32 92 23 SODDING, and 32 92 26 SPRIGGING.

Provide condition of finish grade status prior to installation, location of underground utilities and facilities. Verify that finished grades are as indicated on the drawings; complete finish grading and compaction in accordance with Section 31 00 00 EARTHWORK, prior to the commencement of the work. Verify and mark the location of underground utilities and facilities in the area of the work. Repair damage to underground utilities and facilities 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 will 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. Compact subgrade compaction to at least 90 percent of the maximum dry density at optimum moisture content, as determined by ASTM D698, with a tolerance of 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.

3.2.1 Soil Test

Test soil in accordance with ASTM D5268 and ASTM D4972 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

Submit scale drawings defining areas to receive recommended materials as required by federal, state or local regulations. Erosion control material locations may be adjusted to meet field conditions. When soil tests result in unacceptable particle sizes, submit a shop drawing 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. Identify existing trees, shrubs, plant beds, and landscape features that are to be preserved on site by appropriate tags and barricade with reusable, high-visibility fencing along the dripline. Mitigate damage to existing trees 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, submit shop drawings showing proposed adjustments to placement of erosion control material 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 mm 6 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 75 mm 3 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 303 mm 12 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

Apply synthetic binders heaviest at edges of areas and at crests of ridges and banks to prevent displacement. Apply binders 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 verify that seeding will be completed in accordance with Sections 31 00 00 EARTHWORK and 32 92 19 SEEDING.

3.3.5 Mulch Installation

Install mulch in the areas indicated. Apply mulch 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 L/hectare 10 to 13 gallons/1000 square feet. Do not completely exclude sunlight from penetrating to the ground surface.

3.3.9 Non-Asphaltic Tackifier

Apply hydrophilic colloid at the rate recommended by the manufacturer, using hydraulic equipment suitable for thoroughly mixing with water. Apply a uniform mixture 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 L/hectare 10 to 13 gallons/1000 square feet, using power mulch equipment equipped with suitable asphalt pump and nozzle. Apply the adhesive-coated mulch evenly over the surface. Do not completely exclude sunlight from penetrating to the ground surface.

3.3.11 Wood Cellulose Fiber, Paper Fiber, and Recycled Paper

Apply wood cellulose fiber, paper fiber, or recycled paper as part of the hydraulic mulch operation.

3.3.12 Hydraulic Mulch Application

3.3.12.1 Unseeded Area

Install hydraulic mulch as indicated and in accordance with manufacturer's recommendations. Mix hydraulic mulch 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, apply hydraulic mulch evenly at the rate of [_____] per square meter yard. For hydraulic seeded areas, apply mulch 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. Install erosion control blankets as indicated and in accordance with manufacturer's recommendations. The extent of erosion control blankets shall be as indicated.
- b. Orient erosion control blankets in vertical strips and anchored with staples, as indicated. Abut adjacent strips to allow for installation of a common row of staples. Overlap horizontal joints between erosion control blankets sufficiently to accommodate a common row of staples with the uphill end on top.
- c. Where exposed to overland sheet flow, locate a trench at the uphill termination. Staple the erosion control blanket 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

Anchor synthetic sheet systems in accordance with the manufacturer's recommendation. Place systems on a well graded surface and then backfill, a maximum seven days after placement, to protect the material from ultraviolet radiation. Include contiguous perimeter termination trenches as the installation progresses.

3.3.14.1 Sheet System Revegetation

For areas not requiring re-vegetation, backfill openings to grade with well graded fill material and surface prepared for finish as indicated on the drawings. For areas requiring re-vegetation, backfill openings 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. Provide 100 percent coverage of the area with the cells backfilled.

3.3.14.3 Sheet System Seeding

Install seed in accordance with Section 32 92 19 SEEDING.

3.3.14.4 Grid System Grids

Anchor synthetic grid systems in accordance with the manufacturer's recommendation. Place interlocking grid systems on well graded surface. Complete the backfilling of openings 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, backfill openings 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.

3.3.15.3 Grid System Seeding

Install seed in accordance with Section 32 92 19 SEEDING.

3.3.16 Articulating Cellular Concrete Block System Installation

Underlay block installation with geotextile fabric in accordance with the manufacturer's recommendation. Begin block installation from a straight-line oriented perpendicular to the direction of lay, and proceed toward an open area and not toward a point of fixity. Install blocks with the bottom side down. Continue to lay blocks 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. 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 is the side with a flat unformed surface.

3.3.16.1 Concrete Grout

When abutting structures, such as culverts, piers and bridge abutments, furnish and install concrete grout full-depth in the void between the blocks and penetrations. Install grout as specified in [Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE][Section 03 30 00 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, place the perimeter of the geotextile in a minimum 300 mm 12 inch deep trench with the blocks flush with the adjacent surface. Excavate trenches as required for perimeter termination.

3.3.16.3 Backfilling Cellular Block System

Complete backfilling of openings between blocks 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, backfill openings 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, backfill openings with topsoil as specified.

3.3.16.5 Seeding, Fertilizing, Mulching

Install seed in accordance with Section 32 92 19 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

Dispose of excess material, debris, and waste materials offsite at an approved landfill or recycling center. Clear adjacent paved areas. Immediately upon completion of the installation in an area, protect the area against traffic or other use by erecting barricades and providing signage as required, or as directed. Signage shall be [in accordance with Section 10 14 00.10 EXTERIOR SIGNAGE] [_____].

3.5 WATERING SEED

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

Start watering immediately after installing erosion control blanket type XI (revegetation mat). Apply water to supplement rainfall at a sufficient rate to ensure moist soil conditions to a minimum 25 mm 1 inch depth. Prevent run-off and puddling. Do no drive watering trucks over turf areas, unless otherwise directed. Prevent watering of other adjacent areas or plant material.

3.6 MAINTENANCE RECORD

Furnish a record 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.

3.6.2 Maintenance Instructions

Furnish written instructions containing drawings and other necessary information, describing the care of the installed material; including, when and where maintenance should occur, and the procedures for material replacement. Submit instruction for year-round care of installed material. Include manufacturer supplied spare parts.

3.6.3 Patching and Replacement

Unless otherwise directed, material shall be placed, seamed or patched as recommended by the manufacturer. Remove material not meeting the required performance as a result of placement, seaming or patching from the site. 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, evaluate the grass plants 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 --