

SECTION 02660**GEOSYNTHETICS****PART 1 GENERAL****1.01 SUMMARY**

- A. This Section includes requirements for geotextile fabric and geogrid materials use.
- B. Provide non-woven geotextile fabric as a filter and separation layer between the outfall riprap and the underlying subgrade soil, as well as between undisturbed subgrade soil, screened gravel, crushed-stone foundation, or pipe-bedding materials. Non-woven geotextile fabric shall also be used for fabric root barrier for tree protection.
- C. Provide woven geotextile fabric for temporary stabilized construction entrances and silt fence as indicated on the Contract Drawings.
- D. Provide woven geotextile fabric for silt fence as indicated on the Contract Drawings.
- E. Provide geogrid materials for slope stabilization.
- F. Provide HDPE Geomembrane for Refueling Site.

1.02 RELATED SECTIONS

- A. Section 01300 – Submittals
- B. Section 01600 – Control of Materials

1.03 CODES AND STANDARDS

- A. American Society for Testing and Materials International (ASTM):
 - 1. ASTM D1004 – Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting
 - 2. ASTM D1505 – Standard Test Method for Density of Plastics by the Density-Gradient Technique
 - 3. ASTM D1603 – Standard Test Method for Carbon Black Content in Olefin Plastics
 - 4. ASTM D3895 – Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
 - 5. ASTM D4354 – Standard Practice for Sampling of Geosynthetics for Testing

6. ASTM D4355 – Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus
7. ASTM D4491 – Standard Test Methods for Water Permeability of Geotextile by Permittivity
8. ASTM D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles
9. ASTM D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
10. ASTM D4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile
11. ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
12. ASTM D4873 – Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
13. ASTM D5199 – Standard Test Method for Thickness of Geomembranes
14. ASTM D526 – Standard Test Method for Evaluating the Unconfined Creep Behavior of Geosynthetics
15. ASTM D5397 – Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
16. ASTM D5596 – Standard Test Method for Microscopic Evaluation of Carbon Black Dispersion in Polyolefin Geosynthetics
17. ASTM D6637 – Standard Test Method for Determining Tensile Properties of Geogrids by Single or Multi-Rib Tensile Method
18. ASTM D6693 – Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes

B. Geosynthetic Accreditation Institute (GAI):

1. Laboratory Accreditation Program (LAP)

1.04 SUBMITTALS

- A. For each type of geotextile fabric from each manufacturer, submit the following in

accordance with Section 01300 – Submittals:

1. Manufacturer's data sheet for physical, mechanical and chemical properties of the geotextile fabric.
2. Certification of geotextile fabric's minimum average roll values and tests to determine those properties.
3. Certificate of compliance indicating that requirements for materials are in conformance as specified.
4. For informational purposes only, submit manufacturer's printed installation instructions.

1.05 QUALITY ASSURANCE

A. General

1. Manufacturer of geotextile fabric to maintain competent laboratory at point of manufacture to ensure quality control in accordance with ASTM testing procedures. Laboratory to maintain records of quality control results.
2. Quality control testing shall be performed at a laboratory accredited by GAI-LAP for tests required for the geotextile at frequency no less than that per ASTM D4354.
3. Take all precautions to protect geotextile fabric from damage resulting from any cause. Either repair or replace geotextile fabric to the Authority's satisfaction at no additional cost.

1.06 QUALIFICATIONS (NOT USED)

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Section 01600 – Control of Material and as specified.
- B. Deliver, store and handle geotextile rolls in a manner to prevent damage.
- C. Provide geotextile fabric in rolls wrapped with protective covering to protect geotextile fabric from mud, dirt, dust, and debris. Label each roll of geotextile fabric with number or symbol to identify production run.
- D. Geotextile rolls shall be labeled and packaged per ASTM D4873.
- E. After unloading, inspect geotextile fabric rolls for defects and damage.
- F. Do not expose geotextile fabric, except the geotextile fabric for silt fence, to ultraviolet

radiation (sunlight) for more than 14 days total in period of time following manufacture until geotextile fabric is installed and covered with fill or backfill material.

- G. Store geotextile fabric rolls off ground, protected from precipitation, strong chemicals, sparks and flames, temperatures in excess of 160 degree Fahrenheit, and other environmental conditions or physical conditions that could cause damage to the geotextile fabric.

1.08 PROJECT/SITE CONDITIONS (NOT USED)

1.09 DEFINITIONS (NOT USED)

1.10 TOLERANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS:

- A. Acceptable manufacturers for non-woven geotextile fabric, where required:

- 1. GSE Environmental;
- 2. US Fabrics;
- 3. Propex;
- 4. or approved equal.

- B. Acceptable manufacturers for woven geotextile fabric except for silt fence:

- 1. Propex;
- 2. TenCate Mirafi;
- 3. Thrace-LINQ;
- 4. or approved equal.

- C. Acceptable manufacturers for woven geotextile fabric for silt fence:

- 1. Propex;
- 2. TenCate Mirafi;
- 3. Belton Industries Inc.;
- 4. or approved equal.

D. Acceptable manufactures for HDPE Sheet Materials:

1. US Fabrics;
2. SolMax;
3. Titan;
4. or approved equal.

2.02 MATERIAL

- A. Geotextile fabric shall conform to test requirements for minimum average roll value (weakest principle direction) for strength properties of any individual roll tested from manufacturing lot or lots of particular shipment in excess of minimum average roll value (weakest principle direction) as specified hereafter.
- B. Non-woven geotextile fabric shall be used for outfall riprap and to separate undisturbed subgrade soil from aggregate, crushed stone, or pipe-bedding materials. Non-woven geotextile shall meet the following requirements on Physical Properties of Minimum Average Roll:

Property	ASTM Test Method	Units	Value
Grab Strength	D4632	lbs [N]	380 [1690] (min.)
Grab Elongation	D4632	%	50 (min.)
Trapezoidal Tear Strength	D4533	lbs [N]	145 [644] (min.)
CRB Puncture	D4833	lbs [N]	145 [644] (min.)
Ultraviolet Stability	D4355	lbs [N]	1025 [4561] (min.)

- C. Woven geotextile fabric, except for silt fence, shall be used for temporary road reinforcement and temporary stabilized construction entrances. Woven geotextile fabric shall meet the following requirements on Physical Properties of Minimum Average Roll:

Property	ASTM Test Method	Units	Value
Grab Strength	D4632	lbs [N]	200 [900] (min.)
Grab Elongation	D4632	%	15 (min.)
Trapezoidal Tear Strength	D4533	lbs [N]	75 [300] (min.)
Puncture Strength	D4833	lbs [N]	80 [350] (min.)
Permittivity	D4491	Sec -1	0.02 (min.)
Apparent Opening Size	D4751	Sieve Number	30-70
Ultraviolet Stability	D4355	%	70 (min.)

- D. Woven geotextile fabric for silt fence shall meet the following requirements on Physical Properties of Minimum Average Roll:

Property	ASTM Test Method	Units	Value
Grab Strength	D4632	lbs [N]	100 [450] (min.)
Grab Elongation	D4632	%	0.10 (min.)
Apparent Opening Size	D4751	Sieve Number	20-30
Ultraviolet Stability	D4355	%	70 (min.)

- E. Geogrid shall consist of a high-strength polymeric uniaxial geogrid suitable for reinforced slope stabilization applications. Geogrid shall be manufactured from polyester, polypropylene, HDPE, or other approved polymer and shall be resistant to ultraviolet degradation, biological degradation, and chemicals normally encountered in soil environments. The geogrid shall be installed with its principal strength direction oriented as indicated on the Drawings. Geogrids shall meet the following minimum strength properties:

Property	Test Method	Value
Ultimate Tensile Strength	ASTM D-6637	4700 lbs/ft
Creep Rupture Strength	ASTM D-5262	3264 lbs/ft
Long-Term Design Strength (LTDS)	GRI-GG4 (b) / NCMA	2826 lbs/ft

- F. HDPE Geomembrane shall be an impervious liner used to protect against sediment and contaminant release during refueling operations. HDPE Geomembrane shall be manufactured into uniform sheets and comply with material properties of GRI Test Method GM13 for the thickness specified.

1. HDPE Geomembrane shall meet the following physical properties:

Property	Test Method	English
Thickness (MAV)	ASTM D-5199	40 mils
Thickness (Minimum)	ASTM D-5199	36 mils
Density (Minimum)	ASTM D-1505	0.94 g/cc
Strength @ Yield (MAV)	ASTM D-6693	84 x 84 lb/in width
Elongation @ Yield (1.3 in. GL, MAV)	ASTM D-6693	12 x 12 %

Strength @ Break (MAV)	ASTM D-6693	152 x 152 lb/in width
Elongation @ Break (2 in. GL, MAV)	ASTM D-6693	700 x 700 %
Tear Resistance (MAV)	ASTM D-1004	28 lbs
Puncture Resistance (MAV)	ASTM D-4833	72 lbs
Carbon Black Content (Range)	ASTM D-1603	2 - 3 %
Carbon Black Dispersion	ASTM D-5596	Category (2)
Stress Crack Resistance (Minimum)	ASTM D-5397	500 hours
Oxidative Induction Time (Minimum, 200 Deg/C atm O2)	ASTM D-3895	100 minutes

PART 3 EXECUTION

3.01 INSTALLATION

- A. The subgrade shall be graded to the required lines and elevations and shall be free of standing water, saturated soils, excessive ruts, vegetation, organic materials, debris, and other deleterious substances.
- B. Soft or unstable areas identified by the Engineer shall be corrected prior to geotextile fabric and geogrid placement.
- C. Install geotextile fabric and geogrid in accordance with manufacturer's instructions.
- D. Place geotextile fabric and geogrid on the approved subgrade prior to placing fill, screened gravel or crushed stone. Do not drag geosynthetics across subgrade.
- E. Overlap geotextile fabric 18 inches [45 centimeters] minimum for unsewn lap joint. Overlap fabric 6 inches [15 centimeters] at seam for sewn joint.
- F. Geogrid shall be placed directly on the prepared subgrade surface and pulled taut to eliminate wrinkles, folds, and slack. Geogrid shall be secured as necessary using staples, pins, stakes, or fill material to prevent movement during placement of overlying materials.
- G. The principal strength direction of the geogrid shall be oriented as shown on the Contract Drawings. Where not otherwise indicated, the primary strength direction shall be placed perpendicular to the centerline of the slope, embankment, roadway, or retaining structure.
- H. Geogrid sections shall be placed with 24-inch overlaps or as recommended by the manufacturer and approved by the Engineer.

- I. Place geotextile fabric in relatively smooth condition to prevent tearing or puncturing. Lay geotextile fabric loosely but without wrinkles or creases so that placement of the backfill materials will not stretch or tear geotextile fabric. Leave sufficient slack in geotextile fabric around irregularities to allow for re-adjustments.
- J. Patch all tears in geotextile fabric by placing additional section of geotextile fabric over tear with a minimum of 3 feet [90 centimeters] overlay.
- K. Damaged geogrid shall be repaired or replaced at the Contractor's expense. Repairs shall consist of a geogrid patch extending a minimum of three (3) feet beyond the damaged area in all directions, unless otherwise recommended by the manufacturer.
- L. Extend the geotextile fabric and wrap around the screened gravel or crushed stone along the perimeter of the foundation.
- M. Fill material shall be placed in a manner that minimizes displacement, distortion, or damage to the geotextile fabric or geogrid.
- N. Construction equipment shall not operate directly on exposed geotextile fabric or geogrid.
- O. For geogrid, initial fill placement shall begin at one end of the installation and progress across the geogrid in a uniform manner. Fill shall be dumped onto previously placed fill and pushed forward over the geogrid using low ground-pressure equipment whenever practical. Fill shall not be end-dumped directly onto exposed geogrid from excessive heights that could damage the reinforcement. The minimum loose lift thickness for the first lift of fill over the geogrid shall be 10 inches or as recommended by the manufacturer and approved by the Engineer. Fill shall be spread and leveled to avoid creating ruts, uneven loading, or localized overstressing of the geogrid.
- P. Fill placed over geogrid shall be compacted in accordance with the requirements specified for the applicable fill material. Compaction equipment shall not operate directly on exposed geogrid. Smaller compaction equipment shall be used at the outer edge of the slope, as needed. Vibratory compaction equipment shall be operated in a manner that prevents displacement, raveling or damage to the geogrid. Fill shall be compacted uniformly to the specified density and moisture requirements.
- Q. Geogrid shall be protected from excessive exposure to sunlight, chemicals, fuels, lubricants, welding operations, and other sources of damage prior to placement of cover material. Geogrid exposed to damage or deterioration as determined by the Engineer shall be removed and replaced. Geogrid shall not be installed during conditions that prevent proper placement or when weather conditions may adversely affect performance of the installation.

- R. Install silt fence in accordance with the manufacturer's printed instructions and as indicated.
- S. Place geomembrane liner over prepared surfaces to ensure minimum handling. Install according to Shop Drawings and in compliance with geomembrane liner manufacturer's written instructions. Begin placing geomembrane liner at Project's upwind direction and proceed downwind. Install geomembrane liner in a relaxed condition, free from stress and with minimum wrinkles, and in full contact with subgrade. Do not bridge over voids or low areas in the subgrade. Fit closely and seal around inlets, outlets, and other projections through geomembrane liner. Permanently secure edges.
- T. Repair tears, punctures, and other imperfections in geomembrane liner field and seams using patches of geomembrane liner material, liner-to-liner bonding materials, and bonding methods according to geomembrane liner manufacturer's written instructions. Apply bonding solvent or weld to contact surfaces of both patch and geomembrane liner, and press together immediately. Roll to remove wrinkles.

**** END OF SECTION ****