

GEOSYNTHETICS

**From Bennington AC NH 019-1(54)

**From Richmond-So. Burlington IM 089-2(39)/So. Burlington-Colchester IM 089-3(60)

xx. DESCRIPTION. This work shall consist of furnishing and installing geosynthetics (including geomembrane and geocomposite drainage layer components) and geogrid at the locations shown in the Plans and as directed by the Engineer.

xx. MATERIALS.

(a) Geosynthetic for Ditch Lining.

(1) The geosynthetic shall consist of a geomembrane component and a geocomposite component. The geomembrane and geocomposite can be either manufactured as a dual purpose composite material or as two separate materials.

(2) The geomembrane component shall be textured, high density polyethylene geomembrane.

a. The resin shall be new first quality, compounded polyethylene resin that is manufactured specifically for producing geomembrane. At no time shall the manufacturer intermix resin types. The natural resin (without carbon black) shall meet the requirements of Table 1.

Table 1 - Natural Resin Requirements

Property	Test Method ¹	HDPE Resin
Density g/cm ³ (lb/in ³)	ASTM D1505	≥0.0005 (≥0.034)
Melt Flow Index g/10 min. (lb/10 min.)	ASTM D1238 (190/2.16)	≤ 0.907 (≤ 0.002)
OIT (minutes)	ASTM D3895 (1 atm, 200 °C)	>100

b. The extrudate rod and/or bead shall be made from the same raw materials as the geomembrane. Additives shall be thoroughly dispersed and the material shall be free of contamination by moisture or foreign matter.

c. Geomembrane shall be free of holes, pinholes, bubbles, blisters, excessive contamination by foreign matter, and nicks or cuts on roll edges.

- d. Geomembrane shall meet the requirements of Table 2. Samples shall be taken and tested by the manufacturer at a frequency of 1 sample per 4645 square meters (50,000 square feet), unless otherwise noted, to assure conformance with the requirements.
- e. Manufacturer's Certification. The Contractor shall furnish the geomembrane manufacturer's certified test results attesting that the geomembrane and all factory seams meet the requirements stated in these specifications. A Type D Certification shall be furnished that provides the information required under Subsection 700.02, including minimum average roll values for each type of geomembrane used.

Table 2 - Minimum Values for Coextruded
Textured HDPE Geomembranes

Property	Test Method	Values
Minimum Thickness ¹ , mm (mil)	ASTM D5994	0.97 (38)
Density, g/cm ³ (lb/in ³)	ASTM D1505	0.941 (0.034)
Asperity Height, mm (mil)	GRI GM-12	See Note 3
Carbon Black Content, %	ASTM D1603	2.0
Carbon Black Dispersion	ASTM D5596	See Note 4
Tensile Properties (each direction) ²		
Strength @ Yield, g/cm (lb/in)	ASTM D6693; 2 ipm	15,002 (84)
Elongation @ Yield, %	33.0 mm (1.3 in) gauge length	2143 (12)
Strength @ Break, g/cm (lb/in)	50.8 mm (2.0 in) gauge length	10,716 (60)
Elongation @ Break, %		100
Tear Resistance, N (lb)	ASTM D1004	124.6 (28)
Puncture Resistance, N (lb)	ASTM D 4833	266.9 (60)

1. To be measured per roll. Minimum average = 0.97 mm (38 mils), lowest individual for 8 out of 10 values = 0.91 mm (36 mils), lowest individual for any of the values = 0.86 mm (34 mils).

2. The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are minimum average roll values.
 3. 0.25 mm (10 mil) average. 8 of 10 readings \geq 0.18 mm (7 mils). Lowest individual \geq 0.13 mm (5 mils).
 4. Only near spherical agglomerates are considered. Nine of ten views shall be Category 1 or 2. No more than one view Category 3.
- (3) The geocomposite component shall be composed of a high density polyethylene drainage net, with a non-woven geotextile bonded to both sides, for separate layer installation, or a non-woven geotextile bonded to one side, for composite installation.
- a. The geocomposite (drainage net and geotextiles) and its individual components shall have properties that meet or exceed the values in Tables 3, 4, and 5.
 - b. The resin shall be new first quality, compounded polyethylene resin. The natural resin (without carbon black) shall meet the minimum requirements in Table 1.
 - c. Manufacturer's Certification. The Contractor shall furnish the geomembrane manufacturer's certified test results attesting that the geomembrane and all factory seams meet the requirements stated in these specifications. A Type D Certification shall be furnished that provides the information required under Subsection 700.02, including minimum average roll values for each type of geocomposite used.
 - d. The manufacturer shall provide material certificates of compliance and certified test reports at sampling frequencies specified in Tables 3, 4, and 5.

Table 3 - Minimum Average Roll Values (MARV)
for
Geocomposite with 6 oz/yd²-nonwoven
geotextile.

Property	Test Method	Testing Frequency	MARV
Transmissivity ¹ m ² /sec (ft ² /sec)	ASTM D4716	1 per Project	9.00 x 10 ⁻⁴ (9.69 x 10 ⁻³)
Ply Adhesion g/cm (ppi)	ASTM D7005	1 per 9290 m ² (100,000 ft ²)	89 (0.5)

1. Gradient of 0.1, normal load of 479 KPa (10,000 psf), water at 21°C (70°F), between stainless steel plates and at a 15-minute seat time.

Table 4 - MARV for Geocomposite - Net Component

Property	Test Method	Testing Frequency	MARV
Thickness mm (mil)	ASTM D5199	1 per 9290 m ² (100,000 ft ²)	7.62 vs 7.11 (300 vs 280)
Density g/cm ² (lb/in ³)	ASTM D1505	1 per 9290 m ² (100,000 ft ²)	0.941 (0.034)
Tensile Strength g/cm (ppi)	ASTM D5035 or ASTM D4595	1 per 9290 m ² (100,000 ft ²)	13,395 (75)
Carbon Black Content (%)	ASTM D1603	1 per 9290 m ² (100,000 ft ²)	2.0

Table 5 - MARV for Geocomposite - Geotextile
Component¹

Property	Test Method	Testing Frequency	MARV
Mass per Unit Area g/m ² (oz/yd ²)	ASTM D5261	1 per 9290 m ² (100,000 ft ²)	203 (6)
Apparent Opening Size (US Sieve)	ASTM D4751	1 per 50,168 m ² (540,000 ft ²)	70
Permittivity(sec ⁻¹)	ASTM D4491	1 per 50,168 m ² (540,000 ft ²)	1.1

Property	Test Method	Testing Frequency	MARV
Grab Tensile N (lb)	ASTM D4632	1 per 9290 m ² (100,000 ft ²)	712 (160)
Puncture Strength N (lb)	ASTM D4833	1 per 9290 m ² (100,000 ft ²)	400 (90)

1. Component properties prior to lamination.

(b) Biaxial Geogrid for Roadway Reconstruction.

- (1) Biaxial geogrid shall be a contiguous grid structure formed by biaxially drawing a continuous sheet of polypropylene.
- (2) The biaxial geogrid shall have properties meeting the minimum requirements of Table 6.
- (3) Manufacturer's Certification. The Contractor shall furnish the geomembrane manufacturer's certified test results attesting that the geomembrane and all factory seams meet the requirements stated in these specifications. A Type D Certification shall be furnished that provides the information required under Subsection 700.02, including minimum average roll values for each type of geocomposite used. The test results shall include roll numbers and identification, sampling procedures, and a description of test methods used.

Table 6 - MARV for Biaxial Geogrid

Property	Test Method	MARV
Tensile Strength		
2% Strain* kg/m (lb/ft)	ASTM D6637-01*	MD = 417 XMD = 670 (MD = 280 XMD = 450)
5% Strain* kg/m (lb/ft)	ASTM D6637-01*	MD = 863 XMD = 1369 (MD = 580 XMD = 920)
Ultimate kg/m (lb/ft)	ASTM D6637	MD = 1265 XMD = 1934 (MD = 850 XMD = 1300)
Rib Thickness mm (in)	--	0.762 (0.03)
Junction Efficiency, %	GRI-GG2-87	93
Flexural Stiffness N-m (lb-in)	ASTM D5732-95	0.025 (0.22)
Ultraviolet Stability %	ASTM D4355	98

Property	Test Method	MARV
Carbon Black %	ASTM D4218	2

*No preloading of the specimen shall be allowed. The values reported shall include the entire load-strain curve including the slack displacement (d_0) and slack tension (T_0) and starting from zero tension and zero displacement.

- (c) Anchor Trench Backfill. Anchor trench backfill material shall consist of silty clay or clay and shall be compacted to provide a uniform density to the satisfaction of the Engineer.
- (d) Certification. A Type D Certification shall be furnished in accordance with Subsection 700.02 for all materials listed under this specification.
- xx. EQUIPMENT. Welding equipment and accessories shall comply with manufacturer installation guidelines.
- xx. SUBMITTALS.
- (a) Prior to Material Delivery. No material shall be delivered to the site until the material and performance documentation and certifications have been received and reviewed by the Engineer. Documentation shall include quality control test results on the manufactured materials.
- (b) Prior to Material Installation. A minimum of two weeks prior to installation, the Contractor shall supply shop drawings that include, as a minimum, a panel layout diagram with details (i.e. seaming process) for approval. This approval will be for concept only and actual panel layout will be determined by site conditions. This diagram should be in sufficient detail to provide an accurate representation of the field seaming that will be completed. Any revisions to the panel diagram shall be approved by the Engineer prior to further installation operations.
- The proposed layout of the panels shall be set and approved, assuring efficiency of material, minimization of field seams, and proper placement of field seams. Field seams should be placed where normally applied stress will be minimal.
- (c) During Installation.
- (1) Subgrade Acceptance Forms.
 - (2) All QA/QC documentation and Field Testing Results.

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- (3) The Contractor shall maintain daily report forms and copies shall be provided to the Engineer.

xx. QUALITY ASSURANCE. The Contractor shall have at least five years experience working with HDPE Geomembrane materials. In addition, the Contractor shall have completed a minimum of five projects with the same material, and of similar scope, to that specified for this project. The Contractor shall have a successful installation and maintenance record of in-service performance.

xx. MATERIAL LABELING, DELIVERY, STORAGE, AND HANDLING.

(a) Labeling. Each roll of geosynthetic delivered to the site shall be labeled by the manufacturer. The label shall clearly state the manufacturer's name, product identification, thickness, length, width, and roll number. The label shall be found on either of the end caps, an inside edge of the core, and outside the core.

(b) Delivery. The rolls shall be packaged and shipped by appropriate means to prevent damage to the material and to facilitate off-loading.

(c) Storage. The Contractor shall provide a suitable storage site which will protect the geosynthetic from punctures, abrasions, excessive moisture, and dirt. The on-site storage location for the geosynthetic material should be level, smooth, elevated, and dry. The storage place should be protected from theft and vandalism, and if possible should be adjacent to the area to be lined to facilitate installation and minimize handling.

(d) Handling. The materials are to be handled so as to prevent damage. Instructions for moving rolls shall be provided by the manufacturer upon request.

xx. CONSTRUCTION REQUIREMENTS.

(a) Ditch Lining Geomembrane Preparation.

(1) The Contractor and the Engineer shall approve the subgrade prior to geomembrane installation. No geosynthetic shall be placed on unsuitable subgrade. No stones or sharp objects shall be present on the surface to be lined. Documentation of subgrade acceptance shall be provided to the Engineer prior to liner deployment.

(2) Surface moisture shall not be excessively wet or dry or in any condition which will impede proper installation. Under no condition shall the geomembrane be placed over standing water on the subgrade.

(3) The anchor trench must be excavated at the location and to the dimensions as shown in the Contract Documents.

(4) Deployment.

- a. Assign each panel a simple and logical identifying code. The coding system shall be subject to approval and shall be determined at the job site.
- b. Visually inspect the geomembrane during deployment. Textured geomembrane shall generally have uniform texturing appearance. It shall be free from agglomerated texturing material and such defects that would affect the specified properties of the geomembrane. Such defects or suspect areas shall be marked and repaired, if necessary.
- c. Unroll the geomembrane panels using methods that will not damage the geomembrane and will protect the underlying surface from damage (i.e., spreader bar - protected equipment bucket). No equipment used shall be allowed to damage the geomembrane by handling, trafficking, leakage of hydrocarbons, or other means.
- d. Do not allow heavy vehicular traffic directly on the geomembrane. Rubber-tired ATV's and trucks are acceptable if wheel contact is less than 34 KPa (5 psi).
- e. The method used to place the geomembrane shall minimize wrinkles (especially differential wrinkles between adjacent panels or sheets).
- f. Adequate loading (such as sand bags, tires, or similar items that will not damage the geomembrane) shall be placed on the geomembrane to prevent uplift in case of high winds. Continuous loading is recommended along edges to minimize risk of wind flowing under the geomembrane.
- g. All penetrations (i.e. catch basin) through the geomembrane shall be sealed with a polyisoprene gasket (or approved equal) and batten strip as shown in the Contract Documents.
- h. Sufficient material (slack) shall be provided to allow for geomembrane expansion and contraction.

(5) Field Seaming.

- a. To the maximum extent possible, orient seams parallel to line of slope (i.e., down and not across slope).
- b. Minimize number of field seams in corners, odd-shaped geometric locations, and outside corners.
- c. Seams shall overlap a minimum of 152 mm (6 inches).
- d. Seaming shall not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the liner installation. The Contractor shall demonstrate that acceptable seaming can be achieved by completing acceptable trial welds.

(6) Welding.

- a. Provide at least one welder who has completed a minimum of 92,900 square meters (1,000,000 square feet) of geomembrane seaming work and who shall provide direct supervision over other welders.
- b. Extrusion Welding.
 1. Hot-air bond adjacent pieces together using procedures that do not damage geomembrane.
 2. Purge welding apparatus of heat-degraded extrudate before welding.
 3. Clean geomembrane surfaces by disc grinder or equivalent.
- c. Hot Wedge Welding.
 1. Welding apparatus shall be a self-propelled device equipped with an electronic controller which displays applicable temperatures.
 2. Protect against moisture build-up between sheets.
 3. Clean seam area of dust, mud, moisture, and debris immediately ahead of the hot wedge welder.

(7) Trial Welds.

- a. Complete trial welds on geomembrane samples to verify welding equipment is operating properly.

- b. No welding equipment or welder shall be allowed to complete production welds until equipment and welders have successfully completed trial welds.
- c. Minimum of two trial welds per day, per welding apparatus, one made prior to the start of work and one completed at mid shift.
- d. Make trial welds under the same surface and environmental conditions as the production welds (i.e., in contact with subgrade and similar ambient temperature). Trial seams shall be a minimum of 1.5 meters (five feet) long and 305 mm (twelve inches) wide (perpendicular to the seam).
- e. Cut five, 25 mm (1 inch) wide by 152 mm (6 inches) long test strips from the trial weld. Quantitatively test three specimens for peel adhesion (peel), and then two specimens for bonded seam strength (shear).
- f. A trial weld specimen shall pass when the results shown in Table 7 are achieved in both peel and shear test and under the following conditions:
 - 1. The break, when peel testing, occurs in the liner material itself, not through peel separation (FTB).
 - 2. The break is ductile.

Table 7 - Minimum Weld Values for
Coextruded Textured HDPE Geomembranes

Property	Test Method	1.0 mm (40 mil) Values
Peel Strength (fusion) g/cm (lb/in)	ASTM D6392	10,716 (60)
Peel Strength (extrusion) g/cm (lb/in)	ASTM D6392	9287 (52)
Shear Strength (fusion & extrusion) g/cm (lb/in)	ASTM D6392	14,288 (80)

- g. Repeat the trial weld, in its entirety, when any of the trial weld samples fail in either peel or shear.

(8) Defects and Repairs.

- a. Examine all seams and non-seam areas of the geomembrane for defects, holes, blister, undispersed raw materials, and any sign of contamination by foreign matter.
- b. Repair and non-destructively test each suspect location in both seam and non-seam areas. Do not cover geomembrane at locations which have been repaired until test results with passing values are available.

(9) Field Quality Control.

- a. The Contractor and the Engineer shall visually inspect in place all seams and geomembrane panels for holes, blemishes, pores, penetrations, or other detrimental defects
- b. Repair and non-destructively test each suspect location in both seam and non-seam areas. Do not cover geomembrane at locations which have been repaired until test results with passing values are available.
- c. All field seams shall be non-destructively tested over their full length using a vacuum test (for extrusion welded seams) and air pressure test (for fusion welded seams), or other approved methods. Non-destructive testing may be completed as the seaming progresses or at completion of all field seaming.

e. Trial Weld.

- 1. Trial welds from each welding machine and operator shall be completed for the following:
 - i. A minimum of two times per day (before welding the liner in the morning and in the middle of the work day).
 - ii. Whenever welding machines are shut off and allowed to cool down.
 - iii. If the ambient air temperature drops 11°C (20°F) or more in 2 hours or less.
 - iv. When seam material type changes, i.e., smooth-to-smooth versus smooth-to-textured seams.

2. Make trial welds under the same surface and environmental conditions as the production welds (i.e., in contact with subgrade and similar ambient air temperature). Trial seams shall be a minimum of 1.5 m (5 feet) long and 305 mm (12 inches) wide (perpendicular to the seam). Test strips should be at least 152 mm (6 inches) on each side of the seam.
 - i. Trial welds shall be marked with date, ambient air temperature, welding machine number, and operator.
 - ii. Cut five test strips, 25 mm (1 inch) wide by 25 mm (1 inch) wide by 152 mm (6 inches) long from the trial weld. Quantitatively test three specimens for peel adhesion (peel), and then two specimens for bonded seam strength (shear).
 - iii. A trial weld specimen shall pass when the test results shown in Table 7 are achieved in both peel and shear. In addition, the following conditions shall be met:
 - a. Peel shall exhibit film tearing bond (FTB) with no brittle cracking.
 - b. Shear shall exhibit necking of the parent material prior to any necking or splitting of the weld.
3. Repeat the trial weld, in its entirety, when any of the trial weld samples fail in either peel or shear.
4. No welding equipment or welder shall be allowed to complete production welds until equipment and welders have a successfully completed trial weld.
5. Seaming shall not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the liner installation. The Contractor shall demonstrate that acceptable seaming can be achieved by completing passing trial welds.

f. Non-Destructive Testing.

1. Vacuum Test.
 - i. The equipment shall consist of the following:
 - a. A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft gasket attached to the bottom or valve assembly, and a vacuum gauge.
 - b. A vacuum pump assembly.
 - c. A soapy solution.
 - ii. The test procedure is completed as follows:
 - a. Apply soapy solution to the seam.
 - b. Place vacuum box assembly over the entire wetted seam area ensuring that a leak-tight seal is created.
 - c. Apply a vacuum of at least 34.5 KPa (5 psig).
 - d. Examine the extrusion seam through the viewing window for the presence of soap bubbles in rapid succession for a minimum of ten seconds. The presence of soap bubbles in rapid succession is indicative of a leak.
 - e. All areas where soap bubbles appear in rapid succession shall be marked, repaired, and retested. Repairs to be completed in accordance with these provisions.
2. The Contractor shall complete vacuum tests on all extrusion welds (i.e., patches, pipe boots, etc). Vacuum testing shall conform to ASTM D 5641 and be completed as specified. In addition, the Contractor shall repair and test all repairs resulting from any unsatisfactory

geomembrane or seam area which failed the vacuum testing.

3. Air Pressure Test.

- i. The equipment shall consist of the following:
 - a. An air pump or tank equipped with pressure gauge capable of generating and sustaining pressure over 206.8 KPa (30 psig).
 - b. A sharp, hollow needle, or other approved pressure feed device, equipped with a pressure gauge.
 - c. Utility knife with hook blade, hot air gun, or other device and clamp to seal the ends of the air channel. Utility knife will also be used to puncture opposite end of seam after testing.
- ii. The test procedure is completed as follows:
 - a. Delineate seam to be tested by making cuts through the seam at both ends with the hook blade utility knife.
 - b. Seal both ends of seam to be tested, insert air needle into the air channel, and pressurize to at least 241.3 KPa (35 psig).
 - c. Allow pressure in air channel to stabilize, at no lower than 206.8 (30 psig). Once stabilized, pressure in air channel can be reduced to a minimum of 206.8 (30 psig) to start the test. Test period is a minimum of five minutes.
 - d. If the pressure loss is greater than three psig in five minutes or does not stabilize after five minutes, locate faulty area where leak is occurring, repair, and retest.

- e. If the pressure loss is less than or equal to the 20.7 KPa (3 psig) within the five minute test period, puncture the opposite end of seam to release the air, confirming that the entire seam length had been tested. If air is not released once channel has been punctured a blockage is present. Locate faulty area where the blockage is and retest seam on both sides of blockage. A pressure gauge at both ends of the seam will also be acceptable.
 - f. Remove needle or other approved pressure feed device and seal penetration holes by extrusion welding.
 - g. All leaks, holes made by the needle, or other damage resulting from the testing procedure shall be repaired in accordance with these provisions.
4. The Contractor shall complete air pressure tests on all field seams constructed using a double seam fusion wedge welder. The double seam fusion wedge welder creates two fusion welds separated by a channel. This channel is used for air pressure testing the field seam. Air pressure testing shall conform to ASTM D 5820 and be completed as specified. In addition, the Contractor shall repair and test all repairs resulting from any unsatisfactory geomembrane or seam area which failed the air pressure testing.

(10) Repair Procedures.

- a. Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.
- b. Repair any portion of unsatisfactory geomembrane or seam area failing a non-destructive test. The Contractor shall be responsible for repair of damaged or defective areas. Agreement upon the appropriate repair method shall be decided between the Engineer

and the Contractor. Procedures available include the following:

1. Patching. Used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter.
2. Abrading and Re-welding. Used to repair small seam sections.
3. Spot Welding. Used to repair pinholes, other localized flaws (minor), or where geomembrane thickness has been reduced.
4. Capping. Used to repair large lengths of failed seams.
5. Flap Welding. Used to extrusion weld the flap (excess outer portion) of a fusion weld in lieu of a full cap.
6. Seam Replacement. Removing the unacceptable seam and replacing with new material.

- c. Surfaces of the geomembrane which are to be repaired by extrusion welds shall be lightly abraded with disc grinder or equivalent to assure cleanliness.
- d. All geomembrane surfaces shall be clean and dry at the time of repair.
- e. Extend patches or caps at least 152 mm (6 inches) for extrusion weld and 102 mm (4 inches) for wedge weld beyond the edge of the defect. Round all corners of patch material.
- f. Non-destructively test each repair using methods specified in these provisions.

(b) Ditch Lining Geocomposite Drainage Layer Preparation.

- (1) Surface Preparation. Prior to implementing any work the Contractor shall carefully inspect the deployment surface (geomembrane) and verify that it is clean of all soil, rock, water, and other material which could damage the geocomposites. The Contractor shall verify that all work is complete to the point where installation of the geocomposite may properly commence without adverse impact.

(2) Placement.

- a. The geocomposite rolls should be installed in the direction of the slope and in the intended

direction of flow unless otherwise directed by the Engineer.

- b. The geocomposites shall be unrolled down slope keeping the net in slight tension to minimize wrinkles and folds.
 - c. The Contractor shall deploy geocomposites ensuring that the geocomposite and underlying materials are not damaged. Faulty or damaged geocomposites shall be replaced or repaired as specified herein.
 - d. At anchor trenches the geocomposites shall be properly anchored to resist sliding. Anchor trench compaction equipment shall not come into direct contact with the geocomposites.
 - e. The geocomposites shall be maintained free of dirt, mud, or any other foreign materials at all times during construction. Rolls which are contaminated with these materials shall be cleaned or replaced.
 - f. Adequate ballast (e.g. sandbags) shall be placed to prevent uplift by wind.
- (3) Overlap and Fasteners. Adjacent rolls shall be overlapped a minimum of 6 inches. Fasteners, as recommended by the manufacturer and approved by the Engineer, shall be used to join adjacent rolls. Metallic fasteners will not be allowed. Fasteners shall be spaced a maximum of 1.5 m (5 feet) along down slope roll overlaps, a maximum of 610 mm (2 feet) along cross slope roll overlaps and a maximum of 152 mm (6 inches) in an anchor trench. Fasteners shall be of contrasting color from the geocomposite to facilitate visual inspection.
- (4) Seams. The upper geotextile on adjacent panels of geocomposite shall be sewn together with a continuous seam. All overlaps shall be installed such that the upslope sheet is placed over the downslope sheet.
- (5) Repairs. Holes or tears in the geocomposite shall be repaired by placing a patch of geocomposite extending a minimum of 610 mm (2 feet) beyond the edges of the hole or tear. Approved fasteners, spaced every 152 mm (6 inches) around the patch, shall be used to fasten the patch to the original roll.
- (6) Penetrations. Geocomposite penetration details shall be as recommended by the manufacturer and as approved by the Engineer.
- (c) Biaxial Geogrid for Roadway Reconstruction.

- (1) The subgrade soil shall be prepared as indicated in the Contract Documents or as directed by the Engineer. Foundation soil shall be excavated to the lines and grades as shown in the Contract Documents or as directed by the Engineer.
- (2) Geogrid shall be laid as shown in the Contract Documents or as directed by the Engineer. Geogrid shall be placed in accordance with the manufacturer's recommendations.
- (3) The Contractor shall limit to the extent possible waste of the geogrid materials.
- (4) Any geogrid damaged during installation shall be replaced by the Contractor at no additional cost to the Agency.
- (5) The Contractor shall take all necessary precautions to prevent damage to underlying materials during placement of the geogrid.
- (6) Geogrid shall be cut using scissors only. If in place, special care shall be taken to protect other materials from damage which could be caused by the cutting of the geogrid.

xx. METHOD OF MEASUREMENT. The quantities of Special Provision (Biaxial Geogrid for Roadway Reconstruction), Special Provision (Geosynthetic for Ditch Lining, Geocomposite), and Special Provision (Geosynthetic for Ditch Lining, Geomembrane) to be measured for payment will be the number of square meters (square yards) placed in the complete and accepted work. Slope measurements will be used in computing the area. Measurement will not be made for material used for repairs, seams, or overlaps. Measurement will not be made for material used to replace an installation of geosynthetic that has become damaged, destroyed, lost, washed away, or otherwise ineffective unless authorized by the Engineer.

xx. BASIS OF PAYMENT. The accepted quantities of Special Provision (Biaxial Geogrid for Roadway Reconstruction), Special Provision (Geosynthetic for Ditch Lining, Geocomposite), and Special Provision (Geosynthetic for Ditch Lining, Geomembrane) will be paid for at the Contract unit price per square meter (square yard). Payment will be full compensation for furnishing, transporting, storing, handling, maintaining, placing, and removing the materials specified; for making required submittals; for providing required testing, monitoring, and inspection services; and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work.

The cost for inspecting the existing concrete apron and for excavation, backfill, and compaction of the anchor trench will not be paid for directly, but will be considered incidental to the Section 900 Geosynthetic Contract items.

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Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
900.675 Special Provision (Biaxial Geogrid for Roadway Construction)	Square Meter (Square Yard)
900.675 Special Provision (Geosynthetic for Ditch Lining, Geocomposite)	Square Meter (Square Yard)
900.675 Special Provision (Geosynthetic for Ditch Lining, Geomembrane)	Square Meter (Square Yard)