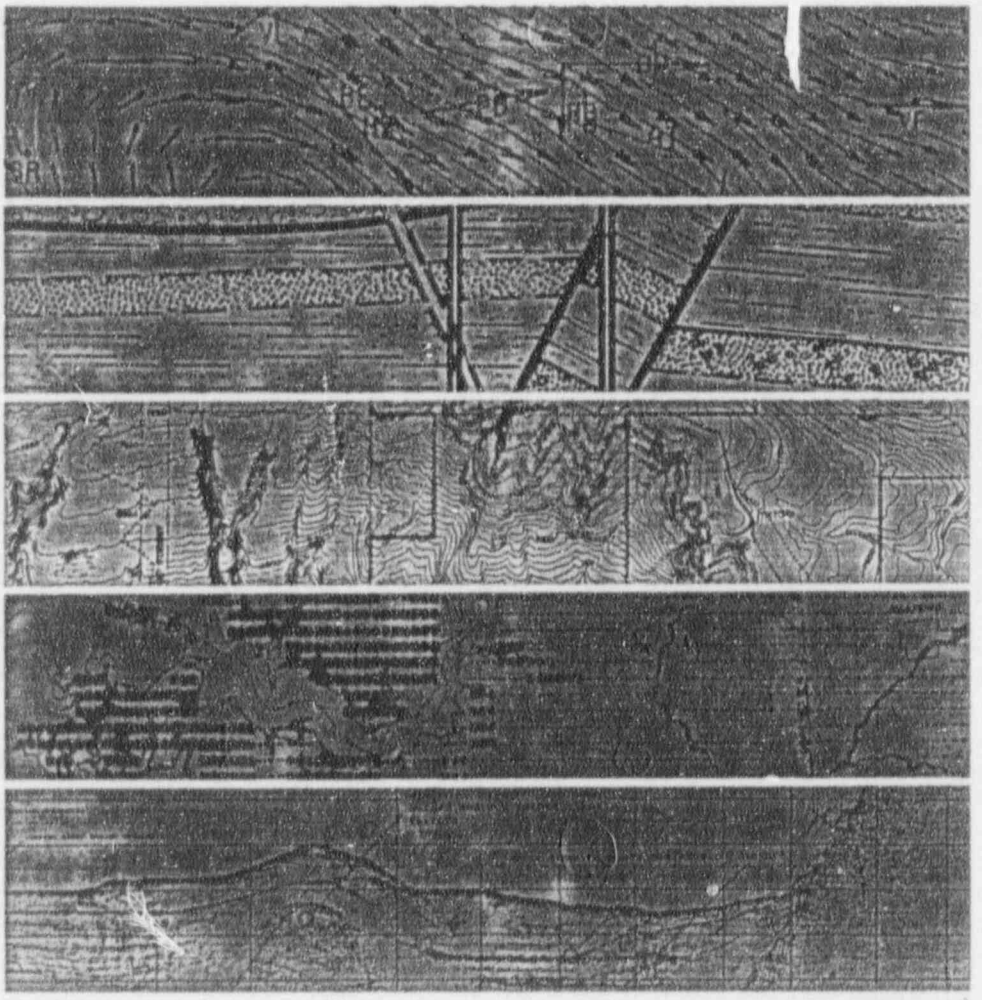

DAMES & MOORE

CONTRACT DRAWINGS AND
TECHNICAL SPECIFICATIONS

SCHOTT GLASS TECHNOLOGIES INC.
DURYEA, PENNSYLVANIA

JOB. NO. 21216-002-032
SEPTEMBER 27, 1991

DAMES & MOORE

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DIVISION 1
GENERAL REQUIREMENTS

SECTION 01010
SUMMARY OF WORK

PART 1 GENERAL

1.01 GENERAL

These Specifications cover the technical requirements for furnishing all labor, material, transportation, and equipment necessary to construct a multi-layer cover over the fill area at the Schott Glass Technologies Inc., facility in Duryea, Pennsylvania.

1.02 WORK INCLUDED

A) The Work shall include, but not be limited to, the following:

1) Clearing the site of brush, trees and miscellaneous debris (i.e., fire brick, plaster, and glass scrap) that may damage cover materials.
2) Removal and reinstallation of the existing fence.
3) Scraping area along stormcut and placement on fill area.
4) Grading of the fill area to the elevations shown.
5) Construction of anchor trenches.
6) Installation of geofabric materials, liner, and geocomposite drainage layer.
7) Backfilling of liner anchor trenches.
8) Placement of granular drainage layer and vegetative soil layer.
9) Installation of bituminous pavement and associated base course materials.
10) Transition of existing slopes around the fill area to provide proper drainage.
11) Seeding and mulching of the fill areas excluding pavement area.
12) Installation of the gabion-lined mattresses and forming of the ditch.

B) Items not specifically mentioned in the Specifications or shown on the Drawings, but which are inherently necessary to make a complete working installation, shall be included.

1.03 INTENT OF CONTRACT DOCUMENTS

A) The use of the word (or words):

1) "provide" means furnish, install, and connect ready for use.
2) "furnish" means supply and deliver to job or where directed.
3) "as approved" or "approved" means **Engineers'** approval.
4) "as directed" means **Engineers'** or **Owner's** direction or instruction.
5) "to do", "provide", "furnish", "install", etc., in these Specifications or on Drawings are directions given to the **Contractor**.
6) "**Owner**" and "Company" shall mean Schott Glass Technologies, Inc. (Schott Glass).
7) "Bidder" shall mean the company submitting a bid.
8) "**Contractor**" shall mean the successful Bidder under contract to do the work covered by these Specifications.
9) "Agreement" is a reference to the standard construction contract form.
10) "Work" shall mean labor, services, equipment, and material as set forth in the Contract Document.
11) "Equal" shall mean a satisfactory equivalent accepted by the Supervising **Engineer**.
12) "Contract Document" shall mean all Drawings, Specifications, Addenda, and Revisions thereto; Purchase Order and Supplements to the Purchase Order; Supplier's Drawings as

accepted by the Company: all of which are a part of the successful Bidder's contract with the Company.

13) "Certified" shall mean that the particular documents are signed and dated as being in conformance with the appropriate Specifications, codes, and standards by an authorized employee of the certifying organization. The authorized employee shall occupy a more senior position in the certifying organization than those who performed the work that is being certified and shall be technically conversant with the work that is being Certified.
14) "Others" shall refer to any firm exclusive of the **Contractor**.

B) The Contract Documents are complementary, and what is called for by any one shall be as binding as if called for by all. The intention of the documents is to include all labor and materials, equipment, and transportation necessary for the proper execution of the work.

C) All apparent discrepancies between the Drawings and Specifications, or errors or omissions or mis-descriptions in either the Drawings or Specifications, shall be referred to the **Owner** and **Engineer** for interpretation and adjustment prior to the time of bidding.

Any such omissions from the Drawings or Specifications, or the mis-description of details or work which are manifestly necessary to carry out the intent of the Drawings or Specifications, or which are customarily performed, shall not relieve the **Contractor** from performing such omitted or mis-described details of work, but they shall be performed as if fully and clearly set forth and described in the Drawings and Specifications. The risk and expense of proceeding without prior interpretations and adjustment by the **Owner** shall rest with the **Contractor**.

D) The Drawings are not to be scaled, except to locate the approximate limit of fill area delineated on the Drawings. The dimensions called out on the Drawings shall in all cases be followed. The absence of required information shall be brought to the attention of the **Owner** and **Engineer**, and the work shall proceed only when such information has been supplied. All dimensions shall be checked in the field by the **Contractor**.

E) In addition to complying with all pertinent codes and regulations, it is the **Contractor's** responsibility to determine and comply with all Occupational Safety and Health Administration (OSHA), National Electric Safety Code (NESC), local, state, and federal regulations or any other personnel safety codes with respect to this job.

F) Reference to a technical society, institution, association, or government authority is in accordance with following abbreviations:

1)	AGCA	Associated General Contractors of America, Inc.
2)	ANSI	American National Standards Institute
3)	ASTM	American Society for Testing Materials
4)	UL	Underwriters' Laboratories, Inc.
5)	AASHTO	American Association of State Highway and Transportation Officials
6)	NFGS	Naval Facilities Engineering Command Guide Specifications
7)	PennDOT	Pennsylvania Department of Transportation

G) All references to codes, Specifications and standards referred to in the Specifications and on the Drawings shall mean, and are intended to be, the latest edition, amendment and/or revision of such reference standard in effect as of the date of these Contract Documents.

H) The **Contractor** shall perform and install all Work in compliance with:

1) Pennsylvania State Building Code
2) OSHA
3) All local ordinances
4) Plans and Specifications in excess of code requirements and not contrary to same

I) Apply for and obtain all required permits and inspections, pay all fees and charges for same, include all service charges, pavement cuts and repairs.

1.04 USE OF SITE

A) The **Contractor** shall safeguard the use by the public and **Owner** of all adjacent highways, roadways and footpaths, and shall conform to all laws and regulations concerning the use thereof, especially limitations on traffic and the movement of heavy equipment. Access to the site for delivery of construction materials and/or equipment shall be made only at the locations shown in the Contract Documents or approved by the **Engineer**.

B) The **Contractor** shall limit the extent of his activities to that area of the site shown on the Contract Drawings.

C) All portions outside the fill and pavement areas of the site shall be returned to their original condition after completion of Work. Such repair work shall include re-seeding, if required.

D) Parking for the **Contractor**'s employees will be in a designated area to be assigned by the **Owner**.

E) In no case shall the **Contractor** permit his work, equipment, or material to interfere with the operation of the existing facility. Particular attention is directed to the fact that the existing facility is and will be in continuous operation throughout the progress of the work of the contract.

1.05 SITE VISITS

The undertaking of periodic site visits by the **Engineer** or **Owner** shall not be construed as supervision of actual construction, or make them responsible for the safety of persons; or make them responsible for means, methods, techniques, sequences, or procedures of construction selected by the **Contractor** or his Subcontractors; or make them responsible for safety programs and precautions incidental to the Work.

1.06 EQUIPMENT INSTALLATION

Contractor shall furnish all materials to meet all requirements of the Contract Documents.

1.07 OBSTACLES, INTERFERENCE, AND COORDINATION

General

A) Plans show general design arrangement. Install work substantially as indicated and verify exact location and elevations of job.

B) Due to small scale of Drawings, it is not possible to indicate all offsets, fitting, changes in elevations, interferences, etc. Make necessary changes in the Work, equipment locations, etc., after notification is given to the **Owner** and **Engineer** and approval is received to proceed.

1.08 EXAMINATION OF PREMISES, DRAWINGS, ETC.

A) Before Submitting Proposal

1) Examine all Drawings and Specifications relating to Work of all trades to determine scope and relation to other work.
2) Examine all existing conditions affecting compliance with Drawings and Specifications by visiting site and/or building
3) Ascertain access to site, available storage and delivery facilities.

B) Before Commencing Work on Any Phase or in any Area

1) Verify all governing dimensions at site.
2) Inspect all adjacent work.

C) Tender of Proposal Confirms Agreement

1) All items and conditions referred to herein and/or indicated on accompanying Drawings.
2) No consideration, additional monies or time extensions will be granted for alleged misunderstanding.

1.09 TEMPORARY FIRST-AID FACILITIES

The **Contractor** shall furnish and maintain, at his expense, proper first-aid facilities during the work of this Contract unless given express consent to use the **Owner's** on-site first-aid facilities.

1.10 TEMPORARY CONSTRUCTION AND CONSTRUCTION AIDS

A) The **Contractor** shall furnish, install, and maintain such temporary weathertight protective coverings as may be required to properly protect his materials from the weather, and he shall remove such protective coverings at the close of the work, to the satisfaction of the **Owner**.

B) The **Contractor** shall provide and maintain all necessary construction equipment, tools, hoists, staging, scaffolding, ladders, planking, runways, guards, and other arrangements necessary for the proper execution of his work or required by law, and shall remove them when they are no longer required, or when so directed by the **Owner**.

1.11 PROTECTION OF WORK AND PROPERTY

A) The **Contractor** will, during the performance of said work, obey and comply with the provisions of Workers' Compensation Laws and all lawful requirements, regulations, laws, and ordinances of all legally constituted authorities, in any way affecting the performance of this Agreement, said premises and the buildings, structures, and equipment to be constructed hereunder.

B) The shall be responsible for the proper protection of his work, property and equipment, his workmen and other persons. He will construct, place and maintain all necessary fences and other safeguards for the prevention of accidents and injuries to persons and other property. He shall secure his work from injury and/or damage by storm, wind, freezing water, fire and by any other cause which may be occasioned by or in connection with the doing of said work until completion and acceptance thereof. He shall remove and replace so as to comply fully with the plans and Specifications, any work so injured, damaged, or destroyed, without expense to the **Owner**.

C) The **Contractor** shall have a sufficient number of fire extinguishers on hand during the progress of the work to extinguish fires caused by any operation in the carrying out of this work.

1.12. CLEAN-UP

A) Periodic cleaning: The **Contractor** at all times during the progress of the Work shall keep the site free from accumulation of waste matter or rubbish and shall confine his apparatus, materials and operations of his workmen to the limits prescribed except as the latter may be extended with the approval of the **Owner**. **Contractor** shall at all times keep access roads and public roads clean of mud and construction debris.

B) Final clean-up: Upon completion of the work covered by the Contract the **Contractor** shall leave the completed project ready for use without the need of construction activities. In addition, upon completion of all Work the **Contractor** shall remove from the vicinity of the Work all plant, buildings, rubbish, unused materials, and other materials belonging to him or used under his direction during construction or impairing the use or appearance of the property and shall restore such areas affected by the work to their original condition, and, in the event of his failure to do so, the same shall be removed by the **Owner** at the expense of the **Contractor**, and he and his surety shall be liable therefore.

1.13 CONSTRUCTION SCHEDULE

A) The **Contractor** shall provide, with his bid, a bar chart network diagram indicating major activity interrelationships along with projected start and completion dates for each activity.

B) The **Contractor** shall notify the **Owner** and **Engineer** whenever there is a deviation from the current project schedule. The **Contractor** shall then provide sufficient information as to the impact of the work activities relative to the stated modifications.

C) The **Contractor** shall report weekly progress on work activities relative to the current project schedule agreed upon by the **Owner**.
   1) This weekly progress report shall be transmitted directly to the **Owner**.
   2) If major changes occur which affect the original project completion date due to deviations, the **Contractor** shall submit a revised schedule within one (1) week to reflect all changes and their impacts to the total project schedule.
   3) All scheduling material or correspondence shall be distributed with five (5) copies.

D) The **Contractor** shall schedule his work so as not to interfere with the ongoing work of the plant.

E) The sequence of the work for the Contract shall be carried on in a manner satisfactory to the **Owner**.

1.14 SUPERVISION

A) Supervision: The **Contractor** shall give the work proper supervision, and keep on the job during all working hours a competent superintendent satisfactory to the **Owner**.

B) The **Contractor** shall submit with his proposal a resume stating past experience of the construction superintendent. The superintendent shall be subject to the **Owner**'s approval.

1.15 HEALTH & SAFETY

Before commencing work on site, the **Contractor** shall submit for approval a Health and Safety Plan to the **Owner** which identifies details safety procedures for site work, including field monitoring, protective gear for site workers, site waste characteristics, evaluation of potential site hazards, decontamination procedures, emergency procedures, and identification of the site safety officer.

DIVISION 2
SITEWORK

SECTION 02100
SITE PREPARATION

PART I GENERAL

1.01 WORK INCLUDED

Preparing the site for the proposed construction as shown on the Drawings.

PART II MATERIALS

Not Used.

PART III EXECUTION

3.01 VERIFY LIMITS OF FILL AREA

Using the Contract Drawings, the **Contractor** shall establish the approximate limits of the fill area at the site. Upon establishing the approximate limits, the **Contractor** shall excavate 18-inch deep borings or trenches (using a hand auger, small backhoe, etc.) immediately outside each corner of the approximate fill area, and every 100 feet along the perimeter of the fill area, to verify no fill material exists outside these limits. If fill material is observed in the excavations, the **Contractor** shall inform the **Owner** and **Engineer** and the limits of the fill area will be adjusted by the **Engineer** accordingly.

3.02 GENERAL CLEARING

A) The **Contractor** shall proceed to clear the entire work area of brush, shrubs, and small trees. Vegetation can be removed utilizing hand or power-operated equipment.

B) All vegetation shall be cut above the ground surface within the limits of the fill area. There shall be no grubbing permitted within the limits of the fill area.

C) Prior to site clearing, the **Contractor** shall install silt fences (i.e., hay-bales) to control the transport of sediment beyond the construction limits. At a minimum, silt fences shall be installed along all ditches, swales, or channels that are located around the fill area.

D) Removed vegetation shall be piled onsite, beyond the limits of the fill area, at a location to be designated by the **Owner**.

E) The **Contractor** should also be aware that fire brick, plaster, and glass scrap is randomly scattered throughout the site and should exercise extreme caution. Such exposed materials shall be removed and/or covered by fill soil to prevent damage to any liner or geofabric material.

3.03 FENCING REMOVAL

During site clearing, the **Contractor** shall remove and salvage the existing fencing located within the proposed cover system limits as shown on the contract Drawings. The fencing shall be stored on site at a location to be designated by the **Owner**.

PART IV MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT

Payment for the site preparation will be made at the contract lump sum price as shown in the schedule of items and values. Such payment will constitute full payment for all materials, labor, and equipment necessary and/or incidental to preparing the site for construction and disposing of the removed fencing materials.

DIVISION 2
SITEWORK

SECTION 02180
EXCAVATION, BACKFILL, AND GRADING

PART I GENERAL

1.01 WORK INCLUDED

A) Construct temporary dikes with soil and clay to control storm water runoff.

B) Purchase and place borrow material.

C) Scrape along stormcut and use this as fill soil.

D) Construct the anchor trench.

E) Install the geofabric and HDPE liners.

F) Backfill liner anchor trenches.

G) Backfill, compact, and grade the granular drainage layer.

H) Install coarse granular material at the toe of the slopes.

I) Place and grade final vegetative soil layer.

J) Excavate gabion-lined ditch.

K) Install the gabion mattresses with stones along the ditch.

L) Excavate or fill, as required, outside the limits of fill area to transition the existing grades to match proposed.

1.02 RELATED WORK

A) Section 02485 - Seeding and Mulching

B) Section 13000 - HDPE Liner

C) Section 13225 - Geofabric

1.03 REFERENCES

A) ASTM D 2922 - Standard Test Methods for Density of Soil and Soil- Aggregate in Place by Nuclear Methods (shallow depth)

B) ASTM D 1556 - Standard Test Method for Density of Soil in Place by the Sand Cone Method

C) ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils

D) ASTM D 698 - Standard Test Method for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-pound Rammer and 12-Inch Drop.

E) ASTM D 2434 - Standard Test Method for Permeability of Granular Soils (constant head).

F) ASTM D 422 - Standard Method for Particle-Size Analysis of Soils

PART II MATERIALS

2.01 MATERIALS

A) Soil fill is material taken from the soil borrow site and stormcut areas used to construct the multi-layer liner subgrade and vegetative soil layers.

B) The granular drainage layer shall consist of material meeting the following requirements:

1) The drainage fill shall be well graded and contain no more than 5 percent passing the number 16 sieve.

2) The maximum size particle shall not exceed 1/2 inch.

3) The drainage fill shall be composed of hard non-friable particles and shall be approved by the **Engineer**.

4) No more than 15 percent by weight of the material shall be retained on a 3/8-inch sieve.

5) Washed river gravel meeting Pennsylvania Department of Transportation (PennDOT) requirement for No. 7 or No. 8 Coarse Gravels, shall be acceptable providing it meets the requirement set forth in Item 3 (above).

C) Coarse granular material shall consist of rock meeting the following requirements:

1) No shale seams.

2) Hard and angular shaped rock with neither width nor thickness less than one-third its length.

3) Minimum specific gravity of 2.5, as determined in accordance with PTM NO. 506, bulk-saturated, but surface-dry basis.

4) Each load of rock shall be well-graded, from the smallest to the largest size.

5) The maximum size of rock shall not exceed six inches and not more than 15 percent by weight of the material shall be smaller than 2 inches.

6) Rock meeting PennDOT requirements for Class R-3 Rock Linings, shall be acceptable providing it meets items 1 through 4 above.

D) Stones used to fill the gabion mattresses shall meet the following requirements:

1) Shall be material meeting the requirements of PennDOT Specifications, Type A Aggregate.

2) The minimum aggregate size shall be 3 inches and the maximum aggregate size shall be 5 inches measured along the greatest dimension.

E) Soil used for the vegetative soil layer shall meet the following requirements:

1) Acceptable friable loam that is reasonably free of subsoil, clay lumps, brush, roots, weeds, other objectionable vegetation, stones, other foreign material larger than 2 inches in any dimension, and/or other material unsuitable or harmful to plant growth.

2) Must not contain less than 2.0 percent nor more than 10.0 percent organic matter.

3) Must be obtained from offsite sources.

4) Meet the following gradation:

Sieve	Minimum Percent Passing
2 inches	100%
No. 4	75%
No. 10	60%

F) Gabion cages must have the following properties:

1) Wire mesh shall be galvanized steel, minimum No. 13 gage, with tensile strength of at least 60,000 psi in accordance with ASTM A392.

2) Maximum linear dimension of the mesh opening shall not exceed 3-1/4 inches and mesh opening area shall not exceed 6 square inches for baskets 6 inches in height. Dimensions may vary, subject to a tolerance limit of 3% of the manufacturer's stated sizes.

3) Baskets shall be of single-unit construction.

4) Weave base, lid ends, and sides either into a single unit or with 1 edge of those members connected to the base section of the basket, so the strength and flexibility at the point of connection is at least equal to the mesh.

4) Join the mesh perimeter forming the basket so the joints formed have at least the same strength as the mesh body.

6) Provide four internal connection wires in each cell (two across the width and two across the length) at a level of one-third the cell height and at a level of two-thirds the cell height.

7) Use the same type connecting wire as the wire in the mesh, except do not exceed the wire mesh diameter by more than 2 gauges. The baskets shall be fabricated so the wire mesh is nonraveling, which is the ability to resist pulling apart at the twists or connections forming the mesh when a single wire in a mesh section is cut.

G) Fill materials shall contain no sod, brush, stumps, logs, roots, frozen or other perishable materials. Rock particles larger than 5 inches shall be removed prior to compaction of the fill.

H) The **Contractor** may stockpile materials that are to be used to construct the fill areas, but such stockpiles must have stable slopes, be evenly graded, and be self draining.

I) Materials throughout each layer shall be essentially uniform, and the fill shall be free from lenses, pockets, streaks or layers of material differing substantially in texture or gradation from the surrounding material.

PART III EXECUTION

3.01 LIMITS

A) Excavation shall be in accordance with the lines and depths shown on the construction Drawings or as established by the **Engineer**.

B) Excavation elevation tolerances shall be maintained within plus or minus 2 inches.

3.02 TEMPORARY SLOPES

The **Contractor** shall be responsible for ensuring the stability of any temporary or construction excavation slopes and the safety of personnel working on or near such slopes.

3.03 FOUNDATION PREPARATION FOR BACKFILL

A) Foundations for fill shall be cleared as specified.

B) Earth foundation surfaces shall be graded to remove surface irregularities.

C) All soils underlying the liner shall be free of ponded water.

3.04 PLACEMENT OF FILL

A) Fill shall not be placed until the required excavation and foundation preparation have been completed and the foundation has been approved by the **Engineer**. Fill shall not be placed upon a frozen surface or standing water, nor shall snow, ice, or frozen material be incorporated in the fill.

B) Fill shall be placed in approximately horizontal layers. The thickness of each layer shall not exceed 8 inches before compaction, unless otherwise approved by the **Engineer**. Hand compacted fill, including fill compacted by manually directed power tampers, shall be placed in layers not exceeding 4 inches before compaction. In all areas fill shall be placed 4 inches higher than the final grade, then trimmed to provide a continuous, smooth, compacted surface.

C) The granular drainage layer shall be placed to a minimum thickness of 12 inches. Care shall be taken not to damage the liner or protective geofabric. The **Contractor** shall use only low ground pressure earthwork equipment sufficient to place and spread the granular material to the required thickness. Earthwork equipment shall not be operated above the liner or protective geofabric until there is a minimum of 12 inches of soil or granular drainage material over the liner or protective geofabric.

D) The **Contractor** shall place all cover soil in such a manner as to ensure that underlying materials are not damaged. During installation of the 18-inch minimum vegetative soil layer, the **Contractor** shall use only low ground pressure earthwork equipment sufficient to achieve required compaction but not damage the underlying materials.

E) Care shall be taken to avoid damage to the geofabric, liner and/or the cover membrane. Any damaged liner or geofabric shall be replaced in accordance with Sections 13000 and 13225.

F) No traffic will be permitted on the unprotected geofabric.

G) Backfill in liner anchor trenches shall be placed immediately following placement of the liner.

3.05 PLACEMENT OF GABION CAGES, STONES, AND COARSE GRAVEL MATERIAL

A) Fabricate the gabions in compliance with manufacturer's instructions.

B) Set empty baskets to line and grade, as indicated. Join the units together with connecting wire. Space uniformly, then securely fasten the internal tie wires in each outside cell of the structure, or as directed. Fill gabions by hand placement of the aggregate, at least along the exposed faces, for a uniform appearance or as per manufacturer's instructions. After a basket has been filled, bend the lid over until it meets the sides and edges. Secure the lid to the sides, ends, and diaphragms, using connecting wire.

3.06 CONTROL OF MOISTURE CONTENT

A) The moisture content of the soil fill being placed shall be maintained within plus or minus 3 percent of optimum moisture content.

B) Uniform moisture distribution shall be obtained by discing, blading, or other approved methods prior to compaction of the layer.

C) Fill material which contains excessive moisture shall either be removed or be dried to the specified moisture content prior to compaction.

D) Stringent control of moisture will not be required for the granular drainage layer or the coarse granular material.

3.07 COMPACTION

A) When each layer of soil fill has been conditioned to have an acceptable moisture, it shall be compacted. The **Engineer** will observe compaction techniques in order to evaluate the equipment and methods.

B) The existing surface to receive fill and the 12" compacted soil liner foundation fill shall be compacted using typical compaction equipment (e.g. sheepsfoot roller).

C) The coarse granular material at the toe of the slopes and granular drainage material will not require compaction in addition to proper placement.

D) The vegetative soil layer shall be compacted to minimize potential settling, rutting, or erosion of the soils.

E) All other fill placed outside the fill area shall be compacted in accordance with item D.

3.08 TESTING

A) The **Engineer** reserves the right to perform such tests as are required to identify materials, and to determine compaction characteristics, moisture content, and density of fill in place to evaluate the effectiveness of the compaction techniques being employed. Tests performed by the **Engineer** may be used to evaluate whether the fill conforms to the requirements of the Specifications. Such tests are not intended to provide the **Contractor** with the information required by him for the proper execution of the work.

B) Approved Test Procedures

Test	Designation	Method
DENSITY	ASTM D 2922	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (shallow depth)
	ASTM D 1556	Standard Test Method for Density of Soil in Place by the Sand-Cone Method
	ASTM D 698	Standard Test Method for Moisture-Density Relations of Soils- Aggregate Mixtures Using 5.5-pound Rammer and 12 inch Drop
	ASTM D 422	Standard Method for Particle-Size Analysis of Soils
PLASTICITY	ASTM D 4318	Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils

3.09 REMOVAL OF DEFECTIVE FILL

Soil fill placed not conforming to the requirements of the Specifications shall be reworked to meet the requirements or removed and replaced by acceptable fill.

PART IV MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

The volume for soil, granular drainage fill, and coarse granular material will be based upon the volume of material delivered to the site as recorded by the **Engineer**. A delivery ticket describing the volume of material within shall accompany each truck delivering the material to the site. The tickets will be signed and maintained by the **Engineer** to establish the volume of fill delivered.

4.02 PAYMENT

A) Payment for fill material to be used as the soil backfill shall be at the cubic yard contract price for soil backfill, complete. Such payment shall be for the placing and compacting of the soil fill. Payment shall only be made for fill to the proposed grades as designated on the Drawings or as directed by the **Engineer**. There will be no payment made for excavation, or for fill in excess of that depicted on the Drawings, unless approved by the **Owner**.

B) Payment for fill material to be used for the granular drainage layer shall be at the cubic yard (or ton) contract price for granular drainage layer fill, complete. Such payment shall be for the placing of the granular material to the proposed grades and thickness as designated on the Drawings or as directed by the **Engineer**.

C) Payment for coarse granular material shall be at the cubic yard contract price for coarse granular material, complete. Such payment shall be for the placing of the material to the dimensions shown in the contract Drawings.

D) Payment for gabion mattresses shall be at the cubic footage contract price for gabion mattresses, complete and shall include all fabrication and placement, etc. necessary to make the gabion mattresses and stones, complete. The volume will be based on the calculated volume of the mattresses shown on the contract Drawings.

E) There will be no separate payment made for excavation. Any payment for excavation shall be included under the associated fill item.

F) There will be no payment made for fill in excess of that depicted on the Drawings unless approved by the **Engineer**.

DIVISION 2
SITEWORK

SECTION 02485
SEEDING AND MULCHING

PART I GENERAL

1.01 WORK INCLUDED

This item shall consist of furnishing all seed, lime, a commercial fertilizer, mulching material, geotextile netting, water, placing and incorporating and monitoring as specified in the plans and this Specification. This includes all areas outside of specified limits where the vegetative growth has been injuriously disturbed or destroyed by the **Contractor**.

1.02 STORAGE AND HANDLING

A) Grass seed, lime, fertilizer, and mulching shall be stored inside a building to minimize exposure to the elements and elevated so that it does not come into contact with accumulated moisture on the floor.

B) Geotextile netting torn or otherwise damaged during handling shall not be utilized. The netting shall be covered and protected from sunlight and raised off the floor protected from accumulated moisture.

PART II MATERIALS

2.01 MATERIALS

A) Fertilizer used for the cover seeding shall be 20-15-15 analysis in the spring, or 12-20-20 analysis in the fall.

B) The soil cover, in order to guarantee correct seed growth and pH properties, shall receive an application of lime, the quantity of which will conform to the requirements indicated by agronomic testing of the soil cover as described in Section 2.03.

C) The standard mixture of seeding for the cover shall consist of Perennial Ryegrass, Kentucky #31 Fescue, Redtop, and Alsike Clover. The relative poundage of each is shown in Table 1

D) An organic mulch shall be placed over the seed as a moisture holding medium. Materials used for mulching shall be straw or hay. They shall be reasonably free of weed seed and such foreign materials as may detract from their effectiveness as a mulch or injurious to desired plant growth.

E) Geotextile netting of a polypropylene or polyethylene type shall be applied over the mulch as designated in Section 3.02 of this Specification.

TABLE 1

Standard Seed Mixture	PLS[a] Seeding (lbs/acre)	Time of Seeding
Perennial Ryegrass	24	February - May or
Kentucky #31 Fescue	18	late August - October
Redtop	18	
Alsike Clover*	48	
	Total 108 preferred rate	

PLS[a] = pure live seed. Note: Use only a high-purity seed with high germination percentage.
*And appropriate rhizobium inoculant.

2.02 ACCEPTABLE MANUFACTURERS

A) A list of suppliers of fertilizer, lime, and seeding shall be given to the **Engineer** by the **Contractor**. This list shall be approved by the **Engineer** before the shipment of materials.

B) Geotextile netting shall be AMXCO erosion control netting manufactured by the American Excelsior Company, Arlington, Texas. Similar products may be substituted upon written permission of the **Engineer** prior to delivery.

2.03 AGRONOMIC TESTING

After the cover soil has been placed, it shall be tested to determine its specific lime requirements.

PART III EXECUTION

3.01 FOUNDATION AND PREPARATION

Seeding and mulching will be delayed until construction has been completed. The **Contractor** shall be prepared to seed and mulch disturbed areas immediately following construction upon request of the **Engineer**.

3.02 INSTALLATION

A) *Surface Profile Mixing:* The soil material shall be disced with ordinary field-finishing implements such as tandem spring rake or tandem disk harrow provided the equipment can mix at a consistent 5 or 6 inch depth. Mixing should be done when the clean fill is in a dry or semi-dry consistency. Mixing should not be attempted after a rain to avoid incomplete mixing of the cover soil material.

B) *Fertilizer Application:* Application of fertilizer over the area should be done at the rate of 365 pounds per acre of 20-15-15 analysis (spring application) or 12-20-20 analysis (fall application) fertilizer. The fertilizer can be applied from a spreader (hopper) or broadcast as long as a uniform application rate can be maintained.

C) *Lime Application:* Lime to be applied to the soil cover shall consist of agricultural or dolomitic ground limestone or pelletized limestone with a total neutralizing potential (TNP) of 90+. In no circumstances shall hydrated, calcined lime or limestone sludges be substituted for agricultural or dolomitic lime.

The quantity of limestone determined from Part II, Section 2.03 above, shall be uniformly spread over the cover soil area using a limestone spreader (hopper) following an agricultural

tractor. The limestone shall be spread prior to seeding the cover soil, during the active growing season, during dry weather.

Subsequent to surface application, the limestone shall be incorporated into the surface to a depth of 5 inches, with a roller blade disk harrow or a tandem roller harrow. Either implement is satisfactory for cover soil mixing and will prepare the surface for subsequent seeding.

D) *Seeding Mixtures and Application Rates:* The seed shall be spread from a broadcast spreader or hydroseeder as required. The preferred mixture is provided in Table 1 and has been tailored to the conditions of the site.

Legumes should be inoculated immediately prior to seeding with the specific legume inoculate. Seeding shall be accomplished during the periods specified on Table 1.

E) *Mulch Application:* Within 24 hours after seeding, the vegetative mulching material shall be evenly placed over all seeded areas at the rate of approximately 3,500 pounds (1.75 tons) per acre for straw, or 2.5 tons per acre for hay. This is the equivalent of 80.3 pounds of straw per 1,000 sq ft or 115 pounds of hay per 1,000 sq ft.

F) *Use of Geotextile Netting:* Seeded and mulched areas susceptible to storm erosion forces and outslopes having slope gradients equal to or steeper than 4:1 (H:V) shall be covered with geotextile netting of a polypropylene or polyethylene (per Section 2.0) type (3/4 to 1/2 inch mesh weave). The seeding and mulching are to be completed within 24 hours of the final grading. If conditions warrant a longer period, then a geotextile netting shall be placed immediately over the entire cover area to protect the soil, seed, and mulch. This netting is placed over the mulch or soil and fastened to the ground with 8-inch wire staples (available through the netting supplier) affixed at 2-foot intervals along the netting rolls.

Once prepared with netting, reseeded areas should be protected from any vehicular traffic which could destroy or degrade the protection provided by the geotextile netting.

G) *Watering:* After completion of installation of fertilizer, lime, seed, mulch, and erosion control netting, the newly-seeded area will be watered. Watering of the seeded area will be accomplished using either canvas "soaker" hoses laid in parallel strips across the seeded area, and connected to a source of potable water, or the flat ribbon "spray" hoses connected to a source of potable water. The site will be watered sufficiently to provide at least 1-1/2 inches of water per week during the first 3 weeks of cover vegetation establishment. An estimate of the amount of water delivered to the seeded area will be obtained using a plastic rain gauge to collect water placed on the seeded portion of the site. Care should be taken during watering to prevent complete soil saturation from occurring. Generally, more frequent watering of short time duration is more successful than prolonged watering periods. Avoid watering from mid-day to late afternoon to avoid scorching the germinated seedlings.

3.03 MAINTENANCE PROGRAM

The cover soil area of the site will be inspected biweekly for the first full growing season to determine the extent of vegetation cover and establishment. Areas of poor vegetation growth, or of erosion action, will be promptly repaired and reseeded. The seed, fertilizer, lime, and mulch Specifications detailed in this section will be used in repairing any site areas requiring maintenance.

PART IV MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

Seeding and mulching shall be measured for payment to the nearest square yard in place and verified by calculating the estimated disturbed area indicated in the contract Drawings.

4.02 PAYMENT

Payment for the surface preparation, testing, liming, fertilizing, seeding, sodding, and mulching is included in the contract unit price per square yard for site restoration as described in the Schedule of Items and Values.

DIVISION 2
SITEWORK

SECTION 02500
PAVING AND SURFACING

PART I GENERAL

1.01 WORK INCLUDED

The installation of pavement following completion of the fill area.

1.02 RELATED WORK

A) Section 02180 - Excavation, Backfill, and Grading
B) Section 13225 - Geofabric

1.03 REFERENCES

Commonwealth of Pennsylvania Department of Transportation Specifications for Construction (PennDOT Specifications).

PART II MATERIALS

2.01 COARSE AGGREGATE

All materials used for the 4-inch coarse aggregate base shall conform to the PennDOT Specifications Number 2A for coarse aggregate.

2.02 BITUMINOUS CONCRETE BASE COURSE

All materials used for the 4-inch Bituminous Concrete Base Course shall conform to the PennDOT Specifications Section 305 and other references sections as specified.

2.03 BITUMINOUS SURFACE COURSE AND ASPHALT CURB

The materials used for the 1-1/2-inch Bituminous Surface Course and asphalt curb shall comply to the PennDOT Specifications. The asphalt paving and curb shall be constructed using bituminous mixture (composition) No. ID-2W.C. Job mix formula and the uniformity of the bituminous surface coarse shall conform to PennDOT Specification Section 401.

PART III EXECUTION

3.01 SUBBASE PREPARATION

Disturbed granular drainage material or fill beneath all areas to be paved shall be smoothed, compacted, and graded to provide a suitable subbase for pavement construction. In addition, all disturbed soils located within 4 feet of the proposed pavement surface shall be compacted, in 6-inch maximum lifts, to achieve 95 percent of the material's Standard Proctor (ASTM D-698) maximum dry density.

3.02 COARSE AGGREGATE BASE COURSE

Coarse aggregate shall be compacted, in 6-inch maximum loose lifts, to achieve 95 percent of the material's Standard Proctor (ASTM D-698) maximum dry density.

3.03 BITUMINOUS CONCRETE BASE COURSE AND BITUMINOUS SURFACE COURSE

A) The Bituminous Concrete Base Course and the Bituminous Surface Course shall be placed, spread, and compacted in accordance with PennDOT Specifications Sections 305 and 401 respectfully. All references to the District **Engineer** shall mean the **Engineer** for the subject project. Testing will be by the **Engineer** and if desired, will be in conformance with these sections. The **Contractor** shall not place these materials between the dates of October 31 and April 1, unless otherwise permitted by the **Engineer** in writing. A temporary cover may be necessary if pavement cannot be placed between October 31 and April 1.

B) The bituminous courses shall be spread such that the variation of the surface from the edge of a 10-foot straight rule shall not exceed 1/4 inch. Variations in excess of surface tolerances shall be corrected by adding or removing material in a manner satisfactory to the **Engineer**.

C) The **Contractor** shall repair any damage to the separator geofabric due to his neglect or placement operations.

PART IV MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

The quantity of PennDOT Type 2A coarse aggregate, Bituminous Concrete Base Course, and ID-2 W.C. Bituminous Surface Course, and asphalt curb will be measured and commuted to the nearest unit measurement indicated in the following:

PennDOT type 2A Coarse Aggregate	Square Yard
Bituminous Concrete Base Course	Square Yard
Bituminous Surface Course	Square Yard
Asphalt Curb	Linear Foot

4.02 PAYMENT

Payment will be made at the contract unit price per unit measurement given in the Schedule of prices and values for each and shall constitute fill compensation for all labor, material, equipment and other items necessary and incidental to the performance of the work. No payment will be made for work outside the areas indicated on the contract drawings.

DIVISION 13
SPECIAL CONSTRUCTION

SECTION 13000
HDPE LINER

PART I GENERAL

1.01 WORK INCLUDED

Furnishing and installing a smooth and textured 40-mil high density polyethylene (HDPE) liner system and geocomposite drainage material as shown on the construction Drawings.

1.02 RELATED WORK

Section 02180 - Excavation, Backfill, and Grading
Section 13225 - Geofabric

1.03 LINER INSTALLATION MEETINGS

Parties involved with the installation shall attend a meeting prior to installation of any HDPE liner (liner). The purpose of this meeting is to define the responsibilities of each party and establish lines of authority and lines of communication. The intent of the meeting also covers establishing site-specific quality control, monitoring procedures, and defining the method of acceptance of the completed liner. The meeting shall be documented and minutes transmitted to all parties.

1.04 EXPERIENCE AND QUALIFICATIONS NECESSARY FOR LINER INSTALLATION

The liner manufacturer, fabricator, and installer shall provide experience qualifications to the **Engineer** with at least three projects totaling a minimum of 2 million square feet for which they supplied high density polyethylene (HDPE). The following information shall be provided for each project: name and purpose of project, location, date, name of the **Engineer**, designer, fabricator and installer, thickness, surface area, and available written information on the performance of the project.

1.05 DOCUMENTATION FOR LINER INSTALLATION

A) The quality control certificates pertaining to raw materials, manufactured liner rolls, and compliance to applicable ASTM requirements shall be provided by the liner manufacturer to the **Engineer** prior to installation. The **Engineer** shall review the test results for completeness and for compliance with the required minimum properties for both the raw materials and manufactured liner rolls. Materials and rolls which are in noncompliance with the minimum required properties shall be rejected.

B) The liner installer shall provide the certification of acceptance of surface preparation to the **Engineer** prior to any liner installation. Thereafter, the installer shall provide the **Engineer** written acceptance daily for the surface to be covered by liner in that day's operation.

C) The liner fabricator shall provide the **Engineer** with daily reports addressing (as necessary): (1) the total amount of liner seamed; (2) identifiers of rolls and fabricated blankets; (3) quality control tests of materials used during the day; (4) seaming equipment and products used; (5) names of seamers; and (6) seam testing performed.

D) The liner installer shall provide the **Engineer** with daily reports of: (1) the total amount and location of liner placed; (2) total amount and location of seams completed and seamer and units used; (3) changes in layout Drawings; (4) results of test seams; (5) location and results

of non-destructive testing; (6) location and results of repairs and; (7) location of destructive test samples.

1.06 RECORD DRAWINGS FOR LINER INSTALLATION

The installer shall have one complete set of contract Drawings designated just for as-built Drawings. The liner installer shall ensure that as soon as change or addition is made in construction it is noted on the as-built Drawings. All changes shall be approved by the **Engineer**

1.07 LINER ACCEPTANCE

The liner shall be accepted by the **Engineer** when (1) the installation is completed; (2) copies of all documentation of installation have been submitted to the **Engineer**; and (3) verification of the adequacy of all field seams and repairs, and associated testing is complete.

1.08 REFERENCES

A) ASTM D 638 - Standard Test Method for Tensile Properties of Plastics

B) ASTM D 746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

C) ASTM D 792 - Standard Test Methods for Specific Gravity and Density of Plastics by Displacement

D) ASTM D 1203 - Standard Test Methods for Volatile Loss from Plastics Using Activated Carbon Methods

E) ASTM D 1238 - Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer

F) ASTM D 1505 - Standard Test Method for Density of Plastics by the Density-Gradient Technique

G) ASTM D 1603 - Standard Test Method for Carbon Black in Olefin Plastics

H) ASTM D 2103 - Standard Specification for Polyethylene Film and Sheeting

PART II MATERIALS

2.01 DEFINITIONS

A) Field Seam - Seam welded during liner installation. All field seams shall be welded.

B) Factory Seam - Seam made during factory fabrication of the sheeting. Factory seams shall have tensile strength properties equal to or greater than the parent material. Bidders shall submit a sample of a factory seam, if applicable, with their bid.

C) Panel - a single factory fabricated section of the liner membrane.

D) Textured HDPE Liner - A textured surface is added to the standard HDPE (smooth) liner to increase friction between the liner and adjacent materials, and is used for slopes of varying steepness.

E) Geocomposite Drainage Material - Non-woven geofabric heat bonded to each side of HDPE drainage media (netting).

2.02 DELIVERY AND PROTECTION

A) Liner rolls shall be packaged and labeled prior to shipment to the site. The label shall indicate the liner manufacturer, liner fabricator, type of liner, thickness, and roll number. During transportation the rolls shall be handled so that no damage is caused. Wooden cases or other liner containers shall be strong enough to withstand impact and rough handling without injury. The liner manufacturer shall be responsible for the liner transportation if fabrication is not required. If fabrication is required, then the responsibility falls upon the liner fabricator.

B) The storage of the liner is the responsibility of the installer. The liner shall be protected from direct sunlight and heat to prevent degradation of the liner material and adhesion of individual sheets of the roll. Adequate measures shall be taken to keep the liner away from deteriorating sources such as theft and vandalism. Onsite handling of the liner is the responsibility of the liner installer. Appropriate equipment shall be used in moving the rolls and instructions for moving the rolls shall be reviewed with the workers and approved by the **Engineer**.

C) Care shall be taken to keep the geocomposite drainage material clean and free from debris prior to installation. If the geocomposite drainage material is not free of soil and debris before installation, it shall be cleaned by the **Contractor** just prior to installation to the satisfaction of the **Engineer**.

2.03 MATERIALS OF THE HDPE LINER

A) The HDPE textured and smooth membranes shall meet or exceed the following physical properties:

RECOMMENDED TEST

Property	Method	Textured Membrane Value	Smooth Membrane Value
Density	ASTM D792 or ASTM D1505	0.94	0.94
Tensile properties	ASTM D638 - Type IV dumbbell at 2 ipm		
Tensile strength at break	Same as above	23 lb/in.	120 lb/in.
Elongation at break	Same as above	>150 percent	>500 percent
Tensile strength at yield	Same as above	84 lb/in.	70 lb/in.
Elongation at yield	Same as above	>12 percent	>10 percent
Low temperature	ASTM D746	-60°F	-40°F
Tear resistance	ASTM D1004 die C	26 lbs	20 lbs
Carbon black content	ASTM D1603	>2 percent	>2 percent
Thickness	ASTM D2103	Average required thickness is 40-mil for both the textured and smooth HDPE membrane. Minimum acceptable thickness is 90% of thickness specified on the Drawing	

B) Testing Frequency

Density	1 per resin batch number
Tensile properties sheet	1 per 29,000 sq ft of manufactured
Carbon black	1 per resin batch number
Thickness	1 test (15 measurements per roll:)
Low temperature each resin batch	Certification by resin supplier with
Volatile loss each resin batch	Certification by resin supplier with

C) Test results shall be submitted to the **Engineer** for approval prior to delivery of the HDPE membrane to the job site. Alternate testing methods may be used with prior approval by the **Engineer**.

D) Prior to contract award, a peel strength value and the test procedure used to determine the peel strength for both smooth and texturized membrane shall be submitted to the **Engineer** for approval. These values will be used to evaluate field seam quality.

2.04 LINER QUALITY

A) The liner shall be manufactured of first quality, newly produced raw materials. The use of reclaimed polymers and similar materials shall not be permitted. Recycling of materials containing reinforcing scrim shall not be permitted. Recycling scrap that does not contain scrim may be permitted.

B) The liner material shall be so produced as to be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter.

2.05 ACCEPTABLE MANUFACTURERS

A) Gundle Lining Systems, Inc., 1340 East Richey Road, Houston, Texas, 77073.

B) National Seal Company, 600 North 1st Bank Drive, Palatine, Illinois, 60067.

C) Poly-America, Inc., 2000 West Marshall Drive, Grand Prairie, Texas 75051.

D) Similar products may be substituted subject to approval by the **Engineer**.

2.06 GEOCOMPOSITE DRAINAGE MATERIAL

A) Geocomposite drainage material shall consist of non-woven geofabric heat bonded to each side of HDPE drainage media (netting) such as NSC TEX-NET with Poly-net drainage net PN-3000 and geotextile filter fabric Trevira 1120, Gundle Fabrinet DS66, or **Engineer** approved equal.

B) Geocomposite drainage material shall have transmissivity greater than 1.4×10^{-3} square meters per second.

C) The bond of the HDPE drainage media to the geofabric shall be capable of resisting transverse shear stresses of at least 500 pounds per square foot (3.47 pounds per square inch).

PART III EXECUTION

3.01 FOUNDATION PREPARATION FOR THE LINER

The installation **Contractor** shall certify in writing daily that the surface on which the membrane is to be installed is acceptable. No installation of the liner shall commence until this certification is furnished to and accepted by the **Engineer**. No liner shall be placed in an area which has become softened by precipitation (unconfined compressive strength less than 1000 psf).

3.02 ENHANCED FRICTIONAL RESISTANCE

A) **Contractor** shall submit laboratory testing results demonstrating that the interface between the proposed liner and geocomposite drainage material is an effective friction angle of at least 26.5 degrees. In addition, the **Contractor** shall submit laboratory results indicating that the interface between representative samples of the proposed vegetative soil layer and geocomposite drainage material shall exhibit an effective friction angle of at least 26.5 degrees. All testing shall be performed on saturated materials and at normal stresses less than 1,000 pounds per square inch.

B) Documentation of the material's frictional efficiency submitted to the **Engineer** at least 7 days prior to delivery of materials.

3.03 INSTALLATION OF HDPE LINER

A) Textured 40-mil HDPE liner is to be installed along all sloped fill area portions exceeding a 5 horizontal to 1 vertical slope and as shown on the contract Drawings. The smooth HDPE is to be installed along the relatively flat portions of the fill area to the limits shown.

B) The field-erection Drawings showing liner panel layout shall be submitted by the liner installation **Contractor** and approved by the **Engineer** prior to liner installation.

C) Individual panels of liner material shall be laid out and overlapped by a minimum of 3 inches prior to welding. Extreme care shall be taken by the installer in the preparation of the areas to be welded. The area to be welded shall be cleaned and prepared according to installation procedures provided by the material manufacturer and be subject to approval by the **Engineer**.

D) All welding material shall be of a type recommended and supplied by the manufacturer and shall be delivered in the original sealed containers - each with an indelible label bearing the brand name, manufacturer's mark number, and complete directions as to proper storage.

E) The welding equipment used shall be capable of continuously monitoring and controlling the temperature of the zone of contact where the machine is actually fusing the lining material so as to ensure that changes in environmental conditions will not affect the integrity of the weld.

F) All welds on completion of the work shall be tightly bonded. Any membrane area showing injury due to excessive scuffing, puncture, or distress from any cause shall be replaced or repaired with an additional piece of HDPE membrane.

G) No "fish mouths" shall be allowed within the seam area. Where "fish mouths" occur, the material shall be cut, overlapped and an overlapping extrusion weld shall be applied.

H) Liner placement shall stop at an ambient temperature below 41°F or above 95°F. Unless otherwise specified weather conditions required for seaming are as follows: (1) no weld shall be done below 34°F; (2) between 34°F and 50°F, seaming is possible if the liner is pre- heated by either sun or hot air device, and if there is not excessive cooling resulting from wind as

determined by the **Engineer**; and (3) above 50°F, no preheating is required. In all cases, the liner shall be dry.

I) Anchor trench shall be backfilled with random fill. Installer shall be responsible for excavating the anchor trench, placing the liner, and filling the trench with sufficient random fill to assure anchoring of the liner.

3.04 INSTALLATION OF GEOCOMPOSITE DRAINAGE MATERIAL

A) The geocomposite drainage material shall be placed over the HDPE liner system along all slopes as shown on the contract Drawings.

B) Adjacent rolls of the geocomposite drainage material shall be overlapped approximately 2-4 inches and secured by plastic ties approximately every five (5) feet along the roll length. Plastic ties shall be white or another bright color for easy inspection. Metallic ties shall not be allowed. The geotextile will then be either overlapped, sewn, or heat tacked in accordance with the manufacturer's recommendations. The geocomposite drainage material shall not be welded to the HDPE liner.

C) The **Contractor** shall handle all geocomposite drainage material rolls in such a manner as to ensure they are not damaged in any way. The geocomposite drainage material shall be placed on all side slopes as shown on the contract Drawings. The geocomposite drainage material shall be secured at the top of the slope and then rolled down the slope over the "textured" HDPE in such a manner as to continually keep the geocomposite drainage material in tension. If necessary, the geocomposite drainage material shall be positioned by hand after being unrolled to minimize wrinkles. The geocomposite drainage material cannot be placed in the horizontal direction (i.e., across the slope).

D) In the presence of wind, all geocomposite drainage material rolls in place shall be weighted with sandbags or the equivalent. Such sandbags shall be installed during placement and shall remain until replaced with cover material.

E) The **Contractor** shall place all cover materials in such a manner as to ensure the geocomposite drainage material and underlying materials are not damaged. During installation of the 18-inch minimum vegetative soil layer, the **Contractor** shall use only low ground pressure earthwork equipment sufficient to achieve required compaction but that will not damage geocomposite drainage material and underlying materials.

3.05 FIELD SEAM TESTING/QUALITY CONTROL OF LINER

A) The installer shall be responsible for all labor, equipment, and supplies necessary to perform all field and laboratory inspection, sampling, and testing of the liner and seams. All personnel shall be fully qualified and all equipment and procedures shall meet applicable standards.

B) The installer shall employ on-site physical non-destructive continuous testing on all welds to ensure watertight homogenous seams. Acceptable methods are:

1) Acoustic Method - ultrasonic pulse echo
2) Acoustic Method - continuous wave resonant frequency
3) Vacuum Chamber
4) Double Seam Pressurization

C) A quality-control technician shall inspect each seam. Any area showing a defect shall be marked and repaired in accordance with **Engineer**-approved procedures. The locations and types of defect shall be indicated on the field erection Drawings.

D) A test weld 3 feet long from each welding machine shall be run each day prior to liner welding and under the same conditions as exist for the liner welding. The test weld shall be marked

with date, ambient temperature, and welding machine number. Samples of weld 1 inch wide shall be cut from the test weld and pulled in shear and peel. The tensile yield strength of the seam should be a minimum of 90 percent of the tensile yield strength of the parent material. The peel adhesion strength of the seam should be greater than the strength of the liner which can be observed if the seam experiences Film Tear Bond (FTB). Test procedures and performance shall be as recommended in the NSF Standards for Flexible Membrane Liners. Random weld samples will be removed from the installed welded sheeting at an average frequency of 1 per 2,000 feet of weld at locations designated by the **Engineer**. A minimum of one sample per day or three samples per eight hours of welding shall be tested to determine seam tensile properties and peel strength.

3.06 WARRANTY AND GUARANTEE

The manufacturer/installer shall provide a written 5-year guarantee during which the liner and geocomposite drainage material materials and workmanship specifically provided or performed under this project shall be free from any significant defects that will affect their performance. Such written guarantee shall provide for the total and complete repair or replacement of the defect or defective area of lining and geocomposite drainage material upon written notification and demonstration by the **Engineer** of the specific non-conformance of the materials or installation with the project Specifications. Such defects or non-conformance shall be repaired or replaced in a timely fashion at no cost to the **Owner**. Repair and replacement shall include all earthwork, seeding, mulching, and any other work necessary to repair or replace.

PART IV MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT

Payment for HDPE liner and geocomposite drainage material will be made at the contract unit prices for HDPE liner and geocomposite drainage material complete in place. Liner and geocomposite drainage material shall be measured for payment by square yard in place. Measurement will be to the nearest square yard. No allowance will be made for material in lap and seams. Payment shall constitute full compensation for all labor, material, equipment, and performance of operations in connection with placing the liner and geocomposite drainage material as shown on the contract plans. No measurement or payment will be made for loss due to either contamination or damage of either material due to either the fault or negligence of the **Contractor**.

DIVISION 13
SPECIAL CONSTRUCTION

SECTION 13225
GEOFABRIC

PART I GENERAL

1.01 WORK INCLUDED

Furnishing and placing the protective and separator geofabric materials as shown on the construction Drawings.

1.02 RELATED WORK

A) Section 02180 - Excavating, Backfill, and Grading

B) Section 13000 - HDPE Liner

PART II MATERIALS

2.01 DEFINITIONS

A) Separator geofabric is that layer of geofabric placed between the vegetative soil layer (or the PennDOT Type 2A Coarse Aggregate for under the pavement) and granular drainage fill.

B) Protective geofabric is that layer of geofabric above the HDPE liner which protect the liner from the adjacent granular drainage layer.

2.02 MATERIALS

A) The separator geofabric shall be a nonwoven fabric with a minimum thickness of 60-mils. The permeability of the separator geofabric shall be greater than or equal to 1×10^{-1} cm/sec.

B) The O_{95} of the separator geofabric shall be less than or equal to 0.2 mm. O_{95} is the opening size so that 95 percent of the openings are smaller than that given size.

C) Minimum strength for both types of geofabric are as follows:

Grab strength - 180 lb	Burst strength - 290 psi
Puncture strength - 80 lb	Trap tear - 50 lb

D) Geofabric which is to be exposed to sunlight for longer than 48 hours shall be ultraviolet-resistant. Ultraviolet resistant material shall be capable of maintaining at least 85 percent of its original strength after 500 hours of exposure.

2.03 ACCEPTABLE MANUFACTURERS

A) Mirafi, manufactured by Celanese Fibers Marketing Company, P.O. Box 32414, Charlotte, North Carolina, 28232.

B) Trevira, manufactured by Hoeschst Fibers Industries, P.O. Box 5887, Spartanburg, South Carolina, 29304.

C) Similar products may be substituted for protective geofabric, subject to approval by the **Engineer**.

PART III EXECUTION

3.01 STORAGE AND HANDLING

A) Geofabrics torn or otherwise damaged during handling shall not be utilized.

B) Geofabrics in storage shall be covered and protected from sunlight.

C) Stored geofabrics shall be raised off the floor protected from accumulated moisture.

3.02 PLACEMENT

A) The geofabric shall not be placed until the underlying material has been approved by the **Engineer**.

B) The separator geofabric shall be unrolled across the **Engineer**-approved surface and loosely laid in such a manner that it will conform to irregularities of the surface.

C) The protective geofabric shall be unrolled across the approved installed liner surface and loosely laid (not stretched) in such a manner that it will conform to irregularities of the surface.

D) Geofabric panels shall be sewn or otherwise connected according to manufacturers' specifications and recommendations.

E) Geofabric panels placed on flat surfaces may be overlapped along all edges a minimum of 18 inches in lieu of sewing.

PART IV MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT

Payment for geofabric will be made at the contract unit price for geofabric, complete in place. Geofabric shall be measured for payment to the nearest square yard in place. No allowance will be made for material in lap or seams. Payment shall constitute full compensation for all labor, material, equipment, and performance of all operations in connection with placing the geofabric as shown on the contract plans. No measurement of, nor payment for, will be made for geofabric loss due to either contamination or damage due to either the fault or negligence of the **Contractor**.

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