CONSTRUCTION QUALITY ASSURANCE PLAN

AP-3 – INACTIVE SURFACE IMPOUNDMENT

PLANT HAMMOND
FLOYD COUNTY, GEORGIA

FOR

Georgia Power

NOVEMBER 2018

GEORGIA REGISTERED NO. 028622 PROFESSIONAL ENGINEER JOHN A. SPARKMAN
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GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION
Approved
Solid Waste Management Program
Approved By: Keith Stevens Digitally signed by Keith Stevens Date: 2021.06.10 10:16:33 -04'00'

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1. GENERAL

A. The Construction Quality Assurance (CQA) Plan documents the procedures used to provide CQA and Construction Quality Control (CQC) during the closure of Plant Hammond Ash Pond 3 (AP-3). Closure construction efforts followed the procedures and requirements outlined in this CQA Plan which follow the project technical specifications issued with the closure construction drawings and used during construction. Any future work will also follow this CQA Plan. A Construction Certification Report will be submitted under separate cover.

B. The Georgia Environmental Protection Division (EPD) solid waste program will be notified of closure for AP-3. CQA will be provided by a third-party consulting engineering firm specializing in the inspection and testing of soils. Resumes and qualifications, including experience with projects of similar type, size, and complexity, will be provided to Georgia Power Company (GPC) for their review and approval.

C. The services of the CQC and CQA firm will be required during construction as described in this document.

D. The project team will consist of the following:

1. DESIGN ENGINEER: Responsible for providing interpretations and clarifications of the Contract Documents, reviewing and approving shop drawings, authorizing minor variations in the work from the requirements of the Contract Documents, and rejecting defective work. The DESIGN ENGINEER will be a registered professional engineer in Georgia.

2. CQA ENGINEER: Responsible for implementing the quality assurance requirements as stated in the Closure Drawings, this CQA plan and the project objectives; verifying basic data as reasonable and complete; outlining procedures to process data; developing statistical procedures for the analysis of test data; and preparing quality assurance memoranda and quality assurance reports. The CQA ENGINEER will be paid for and report to GPC or Southern Company Services (SCS). This CQA ENGINEER will be a registered professional engineer licensed in Georgia. Reference to the CQA ENGINEER, for the purpose of this document, will include the CQA ENGINEER or his representative.

3. CQC ENGINEER: Responsible for construction quality control monitoring, testing, and documentation for all field work performed during the construction of the facility. The CQC ENGINEER will be paid for and report to the Contractor or GPC/SCS. This CQC ENGINEER will be a registered professional engineer licensed in Georgia. Reference to the CQC ENGINEER, for the purpose of this document, will include the CQC ENGINEER or his representative.

4. ENGINEERING TECHNICIANS: Responsible for field observations, testing, and inspection. ENGINEERING TECHNICIANS will be assigned to the project as deemed necessary by the CQA ENGINEER or CQC ENGINEER and will be responsible to the CQA ENGINEER or CQC ENGINEER. The CQA ENGINEER, CQC ENGINEER, ENGINEERING TECHNICIAN, CQA ENGINEER'S representative or the CQC ENGINEER'S representative will be on-site during all construction activities. Initial evaluation of various soil types by CQA ENGINEER or CQC ENGINEER during construction will be largely visual; therefore, the CQA ENGINEER, CQC ENGINEER, and all

ENGINEERING TECHNICIANS must be experienced with Visual-Manual Procedure for soil description and identification (ASTM D2488). The ENGINEERING TECHNICIANS will report to the CQA ENGINEER firm or CQC ENGINEER firm that has assigned them to the project.

5. AS BUILT SURVEYOR: As-built certification surveys will be performed by a registered professional land surveyor licensed in Georgia on the components of the final cover system.

2. STRUCTURAL FILL

A. GENERAL

The CQC ENGINEER or his representative will observe and document all grading activities and test the placement and compaction of in-situ materials and structural fill. The CQA ENGINEER is responsible for certifying that the materials and construction were in accordance with the Closure Drawings and this CQA Plan.

B. SUBGRADES

During construction, conformance and performance testing of the subgrade soil materials will be performed by the CQC ENGINEER. The CQC ENGINEER will monitor and document proof rolling of areas that are to receive structural fill. Areas of proof rolling or compacted fill that do not conform to this CQA Plan will be delineated and reported to the Contractor. The CQC ENGINEER will document that these areas are reworked by the Contractor and retested until passing results are achieved.

The CQA ENGINEER will monitor and document if the subgrade is damaged by excess moisture (causing softening), insufficient moisture (causing desiccation and shrinkage), or by freezing. When such conditions exist, the CQA ENGINEER will evaluate the suitability of the subgrade by one or more of the following methods:

1. Moisture / density testing;

2. Continuous visual inspection during proof rolling; or

3. Other test methods identified herein.

The CQA ENGINEER will inform the Contractor of the results and will document when the Contractor repairs areas damaged as indicated above. The CQA ENGINEER will retest the repaired areas until passing results are achieved.

C. CONFORMANCE TESTING

The CQC ENGINEER will observe and test the structural fill to ensure uniformity and conformity to the requirements of this CQA Plan. For fill materials obtained from approved borrow areas, visual inspections and conformance tests will be performed by the CQC ENGINEER prior to the materials being used.

Structural earth fill should generally consist of sandy clays (CL), clayey silts (ML), clayey sands (SC), and clayey to silty sands (SC/SM). Unsuitable soils for the general fill are classified as organics, peat, highly plastic clays, and soils that contain roots, logs, wood, or any decomposable materials.

The structural fill will not contain any roots (or other organic matter), clay clods, rocks greater than 3 inches in largest dimension, or any other deleterious debris.

Prior to receiving structural earth fill or ash fill, the foundation area will be scarified by harrowing or other suitable means. Structural fill materials will be placed in uniform layers of eight inches, nominal thickness, loose measurement, for one foot beyond the full width of the fill on each side. The thickness of each layer will be kept uniform with the necessary grading equipment. Upon completion of compaction, the slopes will be cut back to the final slope. Particular care will be used to obtain the required compaction along the edges of the fill slopes. The compacted surface of each lift will provide a proper bonding surface for the succeeding layer.

Prior to hauling off-site borrow area materials to the project site, priority pollutant testing will be performed on the material. The Contractor will notify the CQC ENGINEER at least three weeks prior to hauling activities so soil samples may be collected for chemical analyses. No off-site borrow materials may be brought onto the site until the analytical results have been reviewed by the CQA ENGINEER and the borrow source approved.

D. TEST METHODS AND FREQUENCY

All testing will be conducted in accordance with this CQA Plan. The field-testing methods used to evaluate the suitability of soils during their installation will be performed by the CQC ENGINEER in accordance with current ASTM test procedures indicated in Table 1. The CQC ENGINEER will be responsible for documenting and reporting test results.

Soil testing will be performed to determine soil type (Unified Classification), grain size distribution, moisture content, Atterberg Limits, and moisture-density relationships. Documentation and reporting of the test results will be the responsibility of the CQC ENGINEER.

Testing will be conducted during the course of the Work. The minimum construction testing frequencies are presented in Table 1. The frequency may be increased at the discretion of the CQA ENGINEER or if variability of the materials is observed. Sampling locations will be selected by the CQC ENGINEER. The location of routine in-place density tests will be determined using a non-biased sampling approach.

A special testing frequency will be used at the discretion of the CQA ENGINEER when visual observations of construction performance indicate a potential problem.

Table 1: Testing Requirements

Minimum Testing Requirements for Structural Fill	
Test	**Frequency**
Proof Roll	Prior to placement of earth or ash fill on foundation area
Laboratory Moisture-Density/ASTM D698	Observed change in soil consistency for earth and ash fill (borrow)
Liquid Limit, Plastic Limit, Plasticity Index/ASTMD 4318	Observed change in soil consistency for earth fill (borrow)
Sieve Analysis/ASTM D422	Observed change in soil consistency for earth and ash fill (borrow)
Field Density and Moisture Content/ Sand Cone, ASTM D1556 Drive Cylinder, ASTM D2937 Nuclear, ASTM D6938	1 test / 40,000 sf / lift (approx. 1,000 CY of earth or 1,100 CY of ash) on a maximum 200-ft x 200-ft grid and one test per lift per 200 linear feet of side slope, minimum one test for each lift per each day

E. COMPACTION

The CQC ENGINEER will confirm that structural fill conforms to compaction requirements described in Table 2.

Table 2: Compaction Requirements

Minimum Testing Requirements for Structural Fill		
Description	**Required % Compaction Standard Proctor (ASTM D698)**	**Moisture and Permeability Requirements**
Structural Earth Fill	96	-1% to +3% of Standard Proctor optimum moisture
Ash Fill	95	-3% to +3% of Standard Proctor optimum moisture

If the moisture content is too low, the moisture content will be adjusted to within the above limits prior to compaction. Moisture adjustment will be achieved by sprinkling and disking sufficiently to bring the moisture content within the specified range. Sprinkling and harrowing of the layer will be done after deposition, but before compaction.

If the moisture content is too high, the Contractor will be permitted to disk in place or stockpile and disk the fill material to promote drying to bring it back within the allowable moisture range.

Areas of proof rolling or compacted fill that do not conform to this CQA Plan will be delineated and reworked/retested by the Contractor until passing results are achieved.

F. ANCHOR TRENCH

The anchor trench will be excavated to the lines, grades, and widths shown on the Closure Drawings prior to the liner system placement.

The anchor trench will be left open until seaming is completed.

The geomembrane should cover the entire anchor trench floor. Slightly rounded corners will be provided in anchor trenches where the geomembrane enters the trench so as to avoid sharp bends in the geomembrane. No loose soil (e.g., excessive water content) will be allowed to underlie the anchored components of the final cover system.

Prior to backfilling, the depth of penetration of the geomembrane into the anchor trench will be verified by the CQC ENGINEER at a minimum of 100-foot spacing along the anchor trench. The anchor trench should be filled in the morning when temperatures are coolest to reduce bridging of the geomembrane.

The anchor trench will be backfilled with soil meeting the requirements of structural earth fill with the exception that the maximum particle size will be limited to one-half (1/2) inch in the largest dimension. The excavated walls of the anchor trench will be free of angular stones, particles in excess of one-quarter (1/4) inch in maximum diameter, or other foreign matter that could damage the geomembrane.

Fill material placed in anchor trenches will be placed in uniform lifts, which do not exceed 12 inches in loose thickness and are compacted. In-place moisture/density tests may be taken at the discretion of the CQC ENGINEER to evaluate the quality of the backfill. The test results will not be required as part of the final documentation.

Care will be taken when backfilling the trenches to prevent any damage to the geomembrane. If damage occurs, it will be repaired prior to backfilling and at the Contractor's expense.

3. HDPE GEOMEMBRANE LINER

A. GENERAL

The CQC ENGINEER and the CQA ENGINEER will certify the materials and installation are in accordance with the Permit Drawings and this CQA Plan.

B. MATERIAL

The high density polyethylene (HDPE) liner materials will conform to the requirements in this CQA Plan. The Contractor will provide certification that these requirements are met to the CQC ENGINEER. The geomembrane will be a minimum 60-mil thick, textured on both sides, have a minimum of 22.5 feet seamless width, and supplied and installed by firms approved by GPC.

The textured material will have an interface shear resistance (friction angle plus cohesion) with contiguous liner components as required in this CQA Plan or as directed by the DESIGN ENGINEER. The interface shear strength will be determined by direct shear testing conducted as directed by the DESIGN ENGINEER.

Manufacturer Quality Control will confirm the material meets the minimum physical properties of a 60-mil thick HDPE geomembrane as listed in the latest version of GRI-GM13, "Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes" and as listed in Table 3.

Table 3: Geomembrane Specifications

Property	Test Method	Frequency	Value	Units
Raw Materials:				
Density	ASTM D792 ASTM D1505	Once per 200,000 lbs of resin	≥0.932	g/cc
Melt Index	ASTM D1238	Once per 200,000 lbs of resin	≤ 1.0	g/10 min.
Oxidative Induction Time (OIT)		Once per 200,000 lbs of resin		
Standard OIT	ASTM D3895		100	min (min avg)
Or				
High Pressure OIT	ASTM D5885		400	min (min avg)
Thickness	ASTM D5994	Per roll		
Minimum Average			57	mil nom
Lowest individual of 8 of 10 Readings			54	mil
Lowest individual of 10 Readings			51	mil
Asperity Height[1]	ASTM D7466 GRI GM12	Every 2nd Roll[2]	10	mil
Density	ASTM D1505 ASTM D792	Once per 200,000 lbs of resin	≥0.940	g/cc
Tensile Properties[3]	ASTM D6693	20,000 lbs		
Yield Strength	Type IV		≥126	lb/in

Property	Test Method	Frequency	Value	Units
Break Strength Yield Elongation Break Elongation	Dumbell 2 ipm G.L.=1.3in G.L=2.0in		≥90 12 100	lb/in % %
Tear Resistance	ASTM D1004	45,000 lbs	≥42	lb (min avg)
Puncture Resistance	ASTM D4833	45,000 lbs	≥90	lb (min avg)
Stress Crack Resistance	ASTM D5397	GRI GM-10	≥300	Hr
Carbon Black Content	ASTM D4218[4]	20,000 lbs	2.0 – 3.0	%
Carbon Black Dispersion[5] Categories 1 or 2 Category 3	ASTM D5596	45,000 lbs	 9 1	 - -
Oven Aging @ 85°C Standard OIT (min avg) Retained after 90 days High Pressure OIT (min avg) Retained after 90 days	ASTM D5721 ASTM D3895 ASTM D5885	Per Each Formulation	 55 80	 % %
UV Resistance High Pressure OIT (min avg) Retained after 1600 hrs	GM 11 ASTM D5885	Per Each Formulation	 50	 %

Notes:

1. 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥5 mils.
2. Alternate the measurement side for double sided textured sheet.
3. 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 values.
4. Other methods such as D 1603 (tube furnace) or D 6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established.
5. Dispersion only applies to near spherical agglomerates. 9 of 10 views will be Category 1 or 2. No more than one (1) view from Category 3.

The surface of the geomembrane will not have striations, roughness, pinholes, or bubbles and will be free of holes, blisters, undispersed raw materials, or any contamination by foreign matter, except that if it has been determined that the blemish will not adversely affect properties and use of the liner, the geomembrane may be accepted after sufficient laboratory test data are provided to support such acceptance.

C. GEOMEMBRANE MANUFACTURER AND INSTALLER

The Contractor will submit the qualifications of the Vendor and Installer of the HDPE Geomembrane Liner to the CQC ENGINEER. The Geomembrane Installer will submit the following as obtained from the Geomembrane Manufacturer to the CQC ENGINEER:

1. Production Certification, including project references (at least 5 years continuous experience) in manufacturing polyethylene geomembrane and/or experience totaling one million square feet of manufactured polyethylene geomembrane
2. Testing Program of Compound Ingredients
3. Material Certification
4. Test Data for Material and Resin

All of the above submittals will be reviewed and retained by the CQA ENGINEER.

The Geomembrane Installer will submit the following to the CQC ENGINEER prior to the installation:

1. Qualifications of Geomembrane Installer Superintendent and Foreman
2. Proposed geomembrane panel layout drawing and written installation procedure
3. Qualifications of third-party CQC inspector of the HDPE installation

D. GEOMEMBRANE INSTALLATION

The geomembrane will be packaged and shipped by appropriate means to ensure that no damage is incurred. The geomembrane will be stored to be protected from puncture, dirt, grease, moisture, and excessive heat. Damaged material will be stored separately for repair or replacement. Stacking of the rolls is allowed following manufacturer's recommendations.

The installation of the geomembrane will be in accordance with the manufacturer's recommendations and this CQA Plan. The Contractor will submit a panel layout drawing and a detailed, written installation procedure for the GPC's review fourteen (14) days prior to installation.

The only approved seaming processes are fusion and extrusion welding. On side slopes, seams shall be oriented in the general direction of maximum slope, i.e., oriented down, not across the slope. In corners and odd-shaped geometric locations, the number of field seams shall be minimized. Cross seams will be allowed on slopes provided that cross seams are cut at forty-five degrees (45°) and adjacent cross seams are staggered. Cross seams will be kept to the lower half of the slope and only one cross seam will be allowed per panel slope length.

The Contractor is responsible for ensuring the geomembrane is handled and installed in such a manner that it is not damaged.

Each panel will be marked with an "identification code" (number or letter) consistent with the layout plan. The identification code will be simple and logical. The number of panels deployed in one day will be limited by the number of panels which can be seamed on the same day. All deployed panels will be seamed to adjacent panels by the end of each day.

The Contractor will inspect the subgrade preparation prior to liner installation. Weak or compressible areas which cannot be satisfactorily compacted should be removed and replaced with properly compacted material. All surfaces to be lined will be smooth, free of all foreign and organic material, sharp objects, or debris of any kind. The maximum allowable particle size is one-

quarter (1/4) inch in any dimension. The subgrade will provide a firm, unyielding foundation with no sharp changes or abrupt breaks in grade. The surface will contain no rutting, cracks or tire tracks. Standing water or excessive moisture will not be allowed. The Contractor will install the geomembrane in such a manner as to minimize dragging the textured geomembrane over the accepted subgrade. Any dislodged particles greater than 1/4 inch will be removed prior to continuing installation.

The Contractor, on a daily basis, will approve the surface on which the geomembrane will be installed. After the supporting soil surface has been approved, it will be the Contractor's responsibility to indicate to GPC any changes to its condition that may require repair work.

The Contractor will certify in writing that the subgrade on which the geomembrane is to be installed is acceptable. This written acceptance will be signed by the Contractor, CQC ENGINEER, and CQA ENGINEER. This will be done prior to commencing work.

The rolls will be deployed using a spreader bar assembly attached to a loader bucket or by other methods approved by the CQA ENGINEER. The placement will be observed by the third-party ENGINEERING TECHNICIAN and the CQA ENGINEER. The method used to unroll the panels will not cause scratches or crimps in the geomembrane.

Equipment or tools will not damage the geomembrane during handling, transportation, and deployment.

Personnel working on the geomembrane will not smoke or wear damaging shoes.

Adequate loading (e.g., sand bags or similar items that will not damage the geomembrane) will be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels).

Geomembrane deployment will proceed between ambient temperatures of 32° F and 104° F. Placement can proceed below 32° F only after it has been verified by the ENGINEERING TECHNICIAN that the material can be seamed according to the manufacturer's recommendations. Geomembrane placement will not be performed during any precipitation, in the presence of excessive moisture (e.g., fog, rain, dew) or in the presence of excessive winds, as determined by the installation supervisor.

Field seams will be made in accordance with the manufacturer's recommendations. The Contractor will submit a copy of the proposed seaming procedures for the CQA ENGINEER's review.

No seam of any kind will be closer than five feet from the toe of the slope. Seams will be aligned with the least possible number of wrinkles and "fishmouths". A fishmouth is defined as an area in the seam where one liner panel is first folded over on itself and a second liner panel is placed and welded over this fold. If a fishmouth or wrinkle is found, it will be relieved and cap-stripped.

Geomembrane panels must have a finished minimum overlap of four inches for fusion welding and six inches for extrusion welding.

Cleaning solvents may not be used unless the product is approved by the liner manufacturer.

Generators used to power welding/grinding apparatus will be placed on a rub sheet and/or on a HDPE tub to prevent damages caused by vibrations/equipment leaks and to protect the liner during refueling of these generators.

E. GEOMEMBRANE FIELD TRIAL SEAMS

Field trial seams will be made in accordance with the manufacturer's recommendations. The Contractor will submit a copy of the proposed testing procedures for the CQA ENGINEER's review.

Field trial seams will be conducted on the liner to verify that seaming conditions are satisfactory. Trial seams will be conducted at the beginning of each seaming period and at least once every four hours for each seaming apparatus and personnel used that day.

All trial seams will be made in contact with the subgrade. Welding rod used for extrusion welding will have the same properties as the resin used to manufacture the geomembrane.

The installer will non-destructively test all field seams and repairs over their full length using either Vacuum Box Testing or Air Pressure Testing (for double fusion seams only).

F. FIELD DESTRUCTIVE TESTING

Destructive seam testing should be minimized to preserve the integrity of the liner. In order to obtain test results prior to completion of liner installation, samples will be cut by the installer as the seaming progresses. The installer will record the date, location, and pass or fail description. All holes in the geomembrane resulting from obtaining the seam samples will be immediately patched and vacuum tested.

The Geomembrane Installer will obtain approximately 12-in. x 36-in. long samples of field seams with the seam centered lengthwise, suitable for testing, at an average frequency of one sample per maximum 500 cumulative feet of seam length from a location specified by the inspector. If the amount of extrusion seaming is less than 500 feet, then a minimum of one (1) extrusion destructive test will be performed. The sample will be cut into three (3) equal-length pieces, one each given to the CQA ENGINEER, GPC, and the Geomembrane Installer. The date, time and equipment, and seam number will be marked on each sample and recorded by the CQC ENGINEER.

Seams will be tested according to the requirements shown in Table 5:

Table 5: Geomembrane Seam Testing Requirements

Property	Test Method	Minimum Average Value
Seam Properties	ASTM D 6392	
1. Shear Strength	GM19	120 lb/in
2. Peel Strength		
• Hot Wedge		91 lb/in
• Extrusion Fillet		78 lb/in

GPC or CQA ENGINEER may elect to send seam samples to a laboratory for testing, at their discretion and GPC's expense. The test method and procedures to be used by the independent laboratory will be the same as used in field testing.

G. REPAIR PROCEDURES

All seams and non-seam areas of the geomembrane will be evaluated by the ENGINEERING TECHNICIAN for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane will be clean at the time of inspection.

Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.

Repair any portion of the geomembrane exhibiting a flaw or failing a destructive or non-destructive test. The Installer will be responsible for repair of damaged or defective areas. Agreement upon the appropriate repair method will be decided between the CQA ENGINEER and the Installer. Repair, removal, and replacement will be at the Installer's expense if the damage results from the Installer's activities.

The following repair procedures will apply:

1. Defective seams will be cap stripped or replaced.
2. All holes of any size will be patched.
3. Tears will be repaired by patching. If the tear is on a slope or an area susceptible to stress and has a sharp end, it must be rounded prior to patching.
4. Blisters, large cuts, and undispersed raw materials will be repaired by patches.
5. Patches will be completed by extrusion welding. The weld area will be ground no more than half an hour prior to welding. No more than ten percent of the thickness will be removed by grinding. Welding will commence where the grinding started and must overlap the previous seam by at least two inches. Reseaming over an existing seam without regrinding will not be permitted. The welding will restart by grinding the existing seam and rewelding a new seam.
6. Patches will be round or oval in shape, made of the same geomembrane, and extend a minimum of six inches beyond the edge of defects.
7. All T's and intersections will be patched. Welding the excess overlap is not permitted.

8. Geomembrane surfaces to be repaired will be abraded (extrusion welds only) no more than 30 minutes prior to the repair.
9. All geomembrane surfaces will be clean and dry at the time of repair.
10. The repair procedures, materials, and techniques will be approved in advance of the specific repair by the CQA ENGINEER.
11. Extend patches or caps at least six inches beyond the edge of the defect, i.e., be a minimum of 12 inches in diameter, and round all corners of material to be patched.
12. Bevel the edge of the patch and do not cut patch with repair sheet in contact with geomembrane. Temporarily bond the patch to the geomembrane with an approved method, extrusion weld the patch and then vacuum test the repair

Each repair will be non-destructively tested. Repairs that pass the non-destructive test will be taken as an indication of an adequate repair. Failed tests indicate that the repair will be repeated and retested until passing test results are achieved. The CQC ENGINEER will keep daily documentation of all non-destructive and destructive testing. This documentation will identify all seams that initially failed the test and include evidence that these seams were repaired and successfully retested.

H. FINAL COVER SYSTEM LABORATORY TESTING

Samples of the HDPE geomembrane liner, ash fill, geocomposite drainage media (GDM), and protective soil will be provided by the Contractor/Installer and sent by the CQA ENGINEER to a certified laboratory for large scale direct shear testing to determine the composite strength envelope (combination of internal friction angle and cohesion/adhesion) for the respective components. The CQA ENGINEER will compare the results of large-scale direct shear testing of all critical interfaces following the protocols outlined below:

1. Soil and ash substrates for use in geosynthetic interface testing will be compacted to 90% of maximum dry density at 4% above optimum moisture content as determined by standard proctor ASTM D698.
2. Geosynthetic materials will be oriented in the shear box consistent with the proposed deployment/slope alignment. (Shear in the direction in which material will be deployed.)
3. Normal Loads: 100 psf, 200 psf, 400 psf
4. Shear in a submerged condition following a 24-hour submerged seating period at each respective normal load.
5. Shear Rate: 0.04 in/min

4. GEOCOMPOSITE DRAINAGE MEDIA (GDM)

A. GENERAL

The CQC ENGINEER and the CQA ENGINEER will certify the materials and installation are in accordance with the Permit Drawings and this CQA Plan.

B. MATERIAL

The GDM will consist of one (1) layer of HDPE drainage net (geonet) connected between two (2) layers of geotextile to create a double-sided geocomposite. The drainage net will be manufactured of new first quality polyethylene resin and will be compounded and manufactured specifically for the intended application. The Contractor will provide certification that these requirements are met to the CQA ENGINEER. The minimum average properties of the GDM are shown in Table 5.

Table 5: Minimum Average Geocomposite Properties

Tested Property	Test Method	Frequency	Value[1]	Units
Geonet Core[2]				
Raw Materials: Density Melt Index	 ASTM D792, B ASTM D1505 ASTM D1238	 Per lot Per lot	 0.94 ≤ 1.0	 g/cc g/10 min.
Thickness	ASTM D5199	1/50,000 ft^2	300	mil
Density	ASTM D1505	1/50,000 ft^2	0.94	g/cc
Carbon Black Content	ASTM D4218	1/50,000 ft^2	2.0 – 3.0	%
Tensile Strength	ASTM D5035	1/50,000 ft^2	75	lbs/inch
Transmissivity[3]	ASTM D4716	1/50,000 ft^2	8 x 10^{-3}	m^2/sec
Geotextile (prior to lamination)[4]				
Mass per Unit Area	ASTM D5261	1/100,000 ft^2	8.0	oz/yd^2
Grab Tensile	ASTM D4632	1/100,000 ft^2	160	lbs
Flow Rate	ASTM D4491	1/100,000 ft^2	110	gpm/ft^2
Puncture Strength	ASTM D6241	1/100,000 ft^2	90	lbs
Permittivity	ASTM D4491	1/100,000 ft^2	1.5	sec^{-1}
AOS	ASTM D4751	1/100,000 ft^2	80 sieve	US Sieve
UV Resistance	ASTM D4355	Once per formula	70	%
Geocomposite				
Transmissivity[3]	ASTM D4716	1/500,000 ft^2	9 x 10^{-4}	m^2/sec
Peel Adhesion	ASTM D7055	1/500,000 ft^2	1.0	lbs/in

Notes:

1. These are minimum average roll values (MARV values) and are based on the cumulative results of specimens tested. AOS in mm units is a maximum average roll value.
2. Component properties prior to lamination.
3. Gradient of 0.1, normal load of 10,000 psf, water at 70° F, between stainless steel plates for 15 minutes.
4. Refer to geotextile product data sheet for additional specifications.

D. GEOCOMPOSITE DRAINAGE MATERIAL MANUFACTURER AND INSTALLER

The Contractor will submit the qualifications of the Vendor and Installer of the GDM to the CQA ENGINEER.

The CQA ENGINEER will review and verify the following submittals from the GDM Manufacturer:

1. Production Certification
2. Material Certification
3. Test Data for Material

The CQA ENGINEER will review and verify the following prior to installation:

1. Qualifications of Installer Superintendent, Foreman and Field Crew
2. Field installation drawings
3. Qualifications of third-party CQC ENGINEERING TECHNICIAN of the HDPE installation

E. CONFORMANCE TESTING

CQA Conformance Testing will be performed by the CQC ENGINEER.

1. Transmissivity testing will be performed using ASTM D 4716 - Modified (100-hour transmissivity of geocomposites), conduct CQA testing for transmissivity at a confining pressure of 250 psf at a hydraulic gradient equal to the slope of the cover. The boundary conditions are cover soils on top and the specified geomembrane on the bottom of the GDM. The minimum required transmissivity is $9x10^{-4}$ m^2/sec. The test should be performed at a frequency of 1 per every 50,000 square feet of installed geocomposite
2. Resin Density ASTM D1505, 0.94 g/cc minimum average roll value, and one (1) test per lot.
3. Peel Adhesion ASTM D7005, 1.0 lbs/in minimum average roll value, and one (1) test per 50,000 sf.

F. INSTALLATION

Each roll of material delivered to the site will be wrapped and labeled by the manufacturer. The label will contain the following information:

1. Manufacturer's name
2. Product identification
3. Length and width
4. Roll number

Unloading of the drainage material from the delivery trucks will be performed by the Contractor. Unloading of the materials will be performed as directed by the manufacturer. The rolls must be adequate for safe transportation to the point of delivery, offloading and storage. Storage measures will be taken as specifically stated by the manufacturer in an area specified by GPC. The storage will be free of materials capable of damaging the material.

The geocomposite roll will be installed in the direction of the slope and in the intended direction of flow unless otherwise specified by the CQA ENGINEER. In the presence of wind, all geocomposites will be weighted down with sandbags or equivalent. Such sandbags will be used during placement and remain until replaced with cover material.

In applying fill material, no equipment will drive directly across the geocomposite. The specified fill material will be placed and spread utilizing vehicles with a low ground pressure. The cover soil will be placed on the geocomposite in a manner that prevents damage to the geocomposite.

Each component of the geocomposite will be secured or seamed to the like component at overlaps. Adjacent edges of the geonet along the length of the roll will be placed with the edges of each geonet butted against each other. The overlaps will be joined by tying the geonet structure with plastic cable ties spaced every five (5) feet along the roll length, located at least 3 intact ribs away from the leading edge and be a contrasting color to the geonet material.

Adjoining geocomposite rolls (end to end) across the roll width should be shingled down in the direction of the slope, with the geonet portion of the top overlapping the geonet portion of the bottom geocomposite a minimum of twelve (12) inches across the roll width, located at least 3 intact ribs away from the leading edge and be a contrasting color to the geonet material.

The geonet portion will be tied every six (6) inches in the anchor trench.

Prior to covering the deployed geocomposite, each roll will be inspected for damage resulting from construction. Any rips, tears or damaged areas on the deployed geocomposite will be removed and patched. The patch will be secured to the original geonet by tying every six (6) inches with the approved tying devices. If the area to be repaired is more than 50 percent of the width of the panel, the damaged area will be cut out and the two portions of the geonet will be joined as discussed above.

5. PROTECTIVE SOIL COVER & TOPSOIL

A. GENERAL

The CQC/CQA ENGINEER will verify that the protective cover is placed and vegetated in accordance with the approved plans and this CQA Plan.

B. CONFORMANCE TESTING

It will be necessary for the CQC ENGINEER to observe protective soils to ensure they are uniform and conform to the requirements of this section. For fill materials obtained from borrow areas, visual inspections and conformance tests will be performed by the CQC ENGINEER in accordance with the CQA Plan prior to the materials being used.

Protective soil cover should generally consist of sandy clays (CL), clayey silts (ML), clayey sands (SC), and clayey to silty sands (SC/SM). Unsuitable soils for the general fill are classified as organics, peat, highly plastic clays, and soils that contain roots, logs, wood, or any decomposable materials.

It will be necessary for the CQC ENGINEER to observe topsoil to ensure they are uniform and conform to the requirements in the CQA Plan and the Closure Drawings. For fill materials obtained from borrow areas, visual inspections and conformance tests will be performed by the CQC ENGINEER in accordance with the CQA Plan prior to the materials being used.

CQC personnel will observe soils for deleterious materials (e.g., roots, stumps, rocks, and large objects). The protective soil cover material will be free of angular stones, particles in excess of one inch in maximum diameter, or other foreign matter that could damage the geocomposite and the HDPE geomembrane liner.

Prior to hauling off-site borrow material to the project site, priority pollutant testing will be performed on the material. The Contractor will notify the CQC Engineer at least three weeks prior to hauling activities so soil samples may be collected for chemical analyses. No off-site borrow materials may be brought onto the site until the analytical results have been reviewed by the CQA ENGINEER and the borrow source approved.

C. COMPACTION

The CQC ENGINEER will confirm that the protective soil cover is placed and compacted with a minimum of four (4) complete passes with the tracks of low contact pressure, wide-tracked construction equipment.

D. VEGETATION

Vegetation will be established in accordance with the Closure Plan. If the use of fertilizers is warranted, the Contractor will follow the Fertilizer Requirements in the Closure Plan.

6. CERTIFICATION

The CQA ENGINEER will provide certification that the final closure cover system, access roads, ditches, and other associated ancillary facilities for AP-3 were constructed according to the Closure Drawings and this CQA Plan. Said certification will have the seal of a professional engineer registered in the State of Georgia.