CONSTRUCTION QUALITY ASSURANCE PLAN

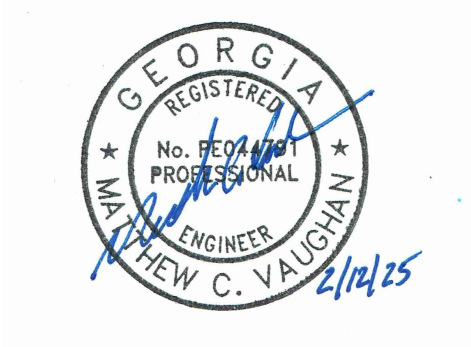
HUFFAKER ROAD LANDFILL

PLANT HAMMOND
FLOYD COUNTY, GEORGIA

FOR

Georgia Power

FEBRUARY 2025



Stantec

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1. GENERAL

A. This Construction Quality Assurance (CQA) Plan provides the quality assurance standards, procedures, and minimum acceptance criteria for construction and closure of the Huffaker Road Landfill disposal parcels and associated basins including the composite liner and leachate collection and removal system. This CQA Plan includes the minimum level of activities that provide assurance that construction proceeds in accordance with the Permit.

Parcels A, B, and E have been constructed and have received CCR. As future Parcels C, D, and F are constructed, a Construction Quality Assurance Report (Construction Certification Report) will be submitted along with a registered engineer's certification that the parcel(s) was constructed within the limitations of and according to the approved permit plans. Coal Combustion Residuals (CCR) may not be placed into the newly constructed disposal area until the Environmental Protection Division (EPD) has reviewed and approved the Construction Certification Report.

The requirements for the closure construction documentation are provided in the Closure Plan provided in Part A of the Permit Application. The requirements for placement, conditioning, and compaction of CCR fill within the waste boundary is provided in the Operation Plan in Part A of the Permit Application.

B. Georgia Power Company (Georgia Power) will notify the EPD of new parcel construction or each major closure event prior to construction. CQA will be provided by a third-party consulting engineering firm specializing in the inspection and testing of soils and geosynthetics.

C. The services of a Construction Quality Control (CQC) firm and CQA firm will be required during construction activities described in this document.

D. The project team will consist of the following:

1. DESIGN ENGINEER: Responsible for providing interpretations and clarifications of 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 licensed in Georgia.

2. CQA ENGINEER: Responsible for implementing the quality assurance requirements as stated in the Permit 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 report to Georgia Power. 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/her representative.

3. CQC ENGINEER: Responsible for quality control monitoring, testing, and documentation for all field work performed during the construction of the facility. The CQC ENGINEER will report to the Contractor. 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/her 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 and CQC personnel during construction will be largely visual; therefore, all CQA and CQC personnel must be experienced with the 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 on the components of the composite liner and closure system by a registered professional land surveyor licensed in Georgia as described in this CQA Plan. Additional information may be requested by the CQA ENGINEER throughout the life of the parcel development.

6. GCL INSPECTOR: Responsible for observing all aspects of Geosynthetic Clay Liner (GCL) installation, seaming, testing, and damage repair. This GCL INSPECTOR will be an individual or company who is independent from the GCL Manufacturer and Installer or part of the Installer's CQC program, who will be responsible for monitoring and documenting activities related to the CQC of the GCL throughout installation. This role will only be required if GCL is installed on this project.

7. GEOMEMBRANE INSPECTOR: Responsible for observing all aspects of geomembrane installation, seaming, testing, and damage repair. This GEOMEMBRANE INSPECTOR will be an individual or company who is independent from the geomembrane Manufacturer and Installer or part of the Installer's CQC program, who will be responsible for monitoring and documenting activities related to the CQC of the geomembrane throughout installation.

8. GDM INSPECTOR: Responsible for observing all aspects of geocomposite drainage material (GDM) installation and damage repair. This GDM INSPECTOR will be an individual or company who is independent from the GDM geomembrane Manufacturer and Installer or part of the Installer's CQC program, who will be responsible for monitoring and documenting activities related to the CQC of the GDM throughout installation.

2. STRUCTURAL EARTH FILL

A. GENERAL

The CQC ENGINEER or his/her 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 Permit Drawings and this CQA Plan.

B. SUBGRADE

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 cut to achieve grade. Material placed to achieve grades indicated on the plans will be tested by the CQC ENGINEER in accordance with the test methods and frequencies listed herein to verify that the compacted fill materials used by the Contractor comply with this CQA Plan. Areas of proof rolling or compacted fill that do not conform to this 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.

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

Prior to receiving structural earth fill, the foundation area will be scarified by harrowing or other suitable means. Structural earth fill materials will be placed in uniform layers of eight (8) 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 any 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.

D. TEST METHODS AND FREQUENCY

All testing will be conducted in accordance with the CQA Plan. The field test methods used to evaluate the suitability of soils during their installation will be performed by the CQC ENGINEER in accordance with current American Society for Testing and Materials (ASTM) test procedures indicated in the table below. 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.

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.

Testing will be conducted during the course of the Work. The minimum construction testing frequencies are presented in the table below. The frequency may be increased at the discretion of the CQC 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 – Structural Fill Properties

Testing	Minimum Frequency
Proof-roll	Prior to placement of earth fill on foundation area
Laboratory Moisture-Density/ASTM D698	Observed change in soil consistency for earth fill
Liquid Limit, Plastic Limit, Plasticity Index/ASTM D4318	Observed change in soil consistency for earth fill
Sieve Analysis/ASTM D422	Observed change in soil consistency for earth fill
Field Density and Moisture Content/ Sand Cone, ASTM D1556 Nuclear, ASTM D6938	1 test/ 40,000 sf/ lift (approx. 1,000 CY)
Moisture Content, ASTM D2216	1 test/ 40,000 sf/ lift (approx. 1,000 CY)

E. COMPACTION

The CQC ENGINEER will confirm that structural earth fill material is compacted to a minimum 96% of the relative maximum dry density as determined by the Standard Proctor compaction test (ASTM D 698). The moisture content of the earth fill at the time of placement will be between -1% and +3% of the optimum obtained by Standard Proctor compaction test.

If the moisture content is too low, the moisture content will be adjusted to within the above limits prior to compaction. Moisture adjustments 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.

Earth fill which cannot be compacted with roller equipment because of inadequate clearances will be spread in four (4) inch layers and compacted with hand-guided power tampers to the extent required by these specifications. Rock three (3) inches and greater (in any dimension), roots, and debris will be removed from the fill and disposed of in an approved manner.

The location, lift designation, and elevation or depth of the field density and moisture tests (passing, failing, and retests) will be recorded and noted on the respective test records.

If the construction of the embankment is interrupted, the surface of the last lift will be shaped and smoothed to provide a surface that will shed as much water as possible during the interruption. When the work is resumed, the surface lift will be leveled, scarified, and compacted before placing additional layers.

F. ANCHOR TRENCH

The geomembrane anchor trench will be excavated to the lines, grades, and widths shown on the project 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 geomembrane systems.

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 one hundred (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 twelve (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. COMPACTED CLAY LINER

A. GENERAL

The CQC ENGINEER or his/her representative will observe and document all grading activities and test the placement and compaction of the compacted clay liner. The CQA ENGINEER is responsible for certifying that the materials and construction were in accordance with the plans and this CQA Plan.

B. SUBGRADE

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-rolls of areas that are cut to achieve grade. Material placed to achieve grades indicated on the plans will be tested by the CQC ENGINEER in accordance with the test methods and frequencies listed herein to verify that the compacted fill materials used by the Contractor comply with this CQA Plan. Areas of proof-rolls or compacted fill that do not conform to this 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.

C. CONFORMANCE TESTING

The CQC ENGINEER will observe and test the compacted clay liner fill to ensure they are uniform and conform 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.

For compacted clay liner underlying a geomembrane, the maximum particle size will be 1/2 inch. The material will be free of any debris which could puncture or damage any overlying geomembrane.

The compacted clay liner will be placed in uniform layers of 6 to 8 inches, nominal thickness, loose measurement. The compacted surface of each lift will provide a proper bonding surface for the succeeding layer.

Prior to hauling any 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.

D. TEST METHODS AND FREQUENCY

All testing will be conducted in accordance with the CQA Plan. The following minimum testing frequencies are provided in the table below.

Table 2 - Compacted Clay Liner Properties

Testing	Minimum Frequency
Field Density and Moisture Content – Nuclear, ASTM D6938 Sand Cone, ASTM D1556	1 test/ 10,000 sf/ lift (approx. 250 CY) & 1 test/ lift / 200 LF side slope
Moisture Content, ASTM D2216	1 test/ 10,000 sf/ lift (approx. 250 CY) & 1 test/ lift / 200 LF side slope
Hydraulic Conductivity Undisturbed, ASTM D5084	1 test/ 40,000 sf/ lift (approx. 1,000 CY) & 1 test/ lift / 800 LF side slope

Laboratory confirmation testing for the compacted clay liner material will be performed to verify that the permeability of the compacted fill is equal to or less than that required. The confirmation testing will consist of obtaining undisturbed samples of the compacted fill for laboratory confirmation of hydraulic conductivity of field-compacted material.

The drive tubes used to collect the undisturbed samples will be cleaned and sealed to preserve the moisture content and delivered to the independent soil testing laboratory. A duplicate tube will be obtained at each location as a spare for confirmation testing.

The undisturbed samples will be stored and handled in such a manner as to prevent damage to the sample from freezing, transporting or other means.

After the undisturbed samples are taken, the holes will be filled with bentonite (powder, chips, or pellets), or repaired in such a manner as to maintain the integrity of the compacted clay liner.

E. COMPACTION AND PERMEABILITY

The CQC ENGINEER will confirm that compacted clay liner meets compaction and permeability requirements as follows:

Table 3 - Compacted Clay Liner Acceptance Criteria

Testing	Criteria
Compacted Clay Liner	$\geq$ 98% Standard Proctor (ASTM D 698)
Moisture Content	Min. +2.5% of optimum
Hydraulic Conductivity	$\leq 1 \times 10^{-7}$ cm/sec*

* Maximum Hydraulic Conductivity of the Compacted Clay Liner is reduced to $\leq 1 \times 10^{-5}$ cm/sec if a GCL is installed

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

The location, lift designation, and elevation or depth of the field density and moisture tests (passing, failing, and retests) and the undisturbed samples will be recorded and noted on the respective test records.

4. GEOSYNTHETIC CLAY LINER

A. GENERAL

The CQC ENGINEER and CQA ENGINEER will certify the materials and installation are in accordance with the plans and this CQA Plan. This section applies to the bottom liner system.

B. MATERIAL

The GCL will be polymer enhanced to resist chemical attack from anticipated leachate generation. Requirements for demonstrating chemical compatibility are provided in this Section. Manufacturer will provide recommendations for a GCL that meets the requirements of this Section following the compatibility testing.

The GCL and its components will exhibit properties and testing that meet or exceed the minimum average values outlined herein. No GCL will be installed until the requirements of this Section and other Sections have been met, and the DESIGN ENGINEER has approved all submittals.

The minimum six (6) inch overlap guideline will be imprinted on one edge of the component of the GCL to be placed upward in the field as a means for providing quality assurance of the overlap dimension. Lines will be printed in easily visible, non-toxic ink.

Needle punched and stitched GCL will be essentially free of broken needles and fragments that would negatively affect the performance of the final product. There will be continuous needle detection and removal devices (e.g., metal detectors and magnets) used during manufacture of GCL products.

The manufactured GCL will have good appearance qualities and will be free from such defects that would affect the specified properties and integrity of the product. General manufacturing procedures will be performed in accordance with the Manufacturer's internal quality control guide and/or documents. ASTM D5888 and D5889 will be followed. The required GCL properties are shown in the table below.

Table 4 - Geosynthetic Clay Liner Properties

Tested Property	Test Method	Frequency	Minimum Average Value
Bentonite Coating [(1)], lb/ft^2	ASTM D5993	1 / 5,000 yd^2	≥ 0.75
Effective Hydraulic Conductivity [(2)], cm/sec	ASTM D5887/E96	1 / 30,000 yd^2	≤ 5 x 10^{-9}
GCL Tensile Strength [(3, 4)], lb/in	ASTM D6768	1 / 25,000 yd^2	23
Non-woven geotextile oz/yd^2 (both sides)	ASTM D5261	1 / 25,000 yd^2	5.9
GCL Hydrated Internal Shear Strength	ASTM D6243	1 per project or change in product	30 100
Hydraulic Flux, m^3/m^2/sec	ASTM D5887	1 / 30,000 yd^2	≤ 1 x 10^{-8}
Swell Index, ml/2 g	ASTM D5890	1 / 50 tonnes	≥ 24
Fluid Loss, ml	ASTM D5891	1 / 50 tonnes	≤ 18
GCL Peel Strength [(4)], lb/in	ASTM D6496	1 / 5,000 yd^2	2.1
Interface Shear Strength (degrees)	ASTM D5321	1 per interface/source	32

Notes:
(1) 0% moisture content.
(2) Based on leachate compatibility testing performed in accordance with ASTM D6766 and these Specifications.
(3) 4-inch-wide sample, 12 in/min. Values are representative of the geomembrane tensile yield strength.
(4) All tensile strength testing is performed in the machine direction using ASTM D6768. All peel strength testing is performed using ASTM D6496.
(5) Upon request, tensile and peel results can be reported per modified ASTM D4632 using 4-inch grips.

C. LEACHATE COMPATIBILITY TESTING

The Geosynthetic Manufacturer(s) or Installer will provide the required testing and results to demonstrate that the proposed GCL product meets the minimum hydraulic conductivity defined in Table 4 in accordance with ASTM D6766 using Falling Head (Method B and Scenario 2 (leachate solution)). Leachate generation for compatibility testing will be performed in accordance with JLT Test Designation S-108-04 – Standard Test Method for Generation of Leachate for Compatibility Testing.

D. PROCUREMENT, DELIVERY, AND STORAGE

GCL procurement and delivery will be the responsibility of the Contractor. The Contractor will be liable for damages to the materials incurred prior to and during transportation to the site and during installation and covering. The Contractor should contact the manufacturer prior to shipment to ascertain the appropriateness of the proposed unloading methods and equipment.

Prior to shipment, the GCL manufacturer will label each roll, identifying the product identification (manufacturer's name and address, brand product code), lot number, roll number, roll length, width, and weight.

A visual inspection of each roll should be made during unloading to identify if any packaging has been damaged. Rolls with damaged packaging should be marked and set aside for further inspection. The packaging should be repaired prior to being placed in storage.

The GCL will be labeled, stored, and handled in accordance with ASTM D4873. The GCL will be kept dry and wrapped in a waterproof wrapping such that it is protected from UV light and the elements during shipping and storage. GCL rolls will be stored in a manner which protects them from the elements. If stored outdoors, they will be elevated and protected with a waterproof, opaque cover.

Rolls should be stored in a manner that prevents sliding or rolling from the stacks.

E. GCL MANUFACTURER AND INSTALLER

The Contractor will submit the qualifications of the Geosynthetic Manufacturer and Installer of the GCL to the CQA ENGINEER. The GCL Installer will submit the following as obtained from the GCL Manufacturer to the CQA ENGINEER:

1. Production Certification, including project references (at least five (5) years continuous experience) in manufacturing GCL and/or experience totaling ten (10) million square feet of manufactured GCL, with at least eight (8) million square feet installed.

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 GCL Installer will submit the following to the CQA ENGINEER prior to the installation:

1. Qualifications of GCL Installer Superintendent and Foreman

2. Proposed GCL panel layout drawing and written installation procedure

3. Qualifications of third-party GCL INSPECTOR

The Geosynthetic Installer will be the manufacturer, or a dealer trained to install the manufacturer's GCL. Installation will be performed under the constant direction of a field installation supervisor who will remain on site and be responsible throughout the GCL installation for layout, seaming, testing, repairs, and all other activities by the Installer. The field installation supervisor will have installed or supervised the installation of a minimum of one (1) million square feet of GCL or must provide satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the respective geosynthetic will be installed in a competent, professional manner. The field installation supervisor and/or master seamer will be present whenever seaming is performed.

The GCL INSPECTOR will be an individual or company who is independent from the GCL Manufacturer and Installer or part of the Installer's CQC program, who will be responsible for monitoring and documenting activities related to the CQC of the GCL throughout installation. The CQC INSPECTOR who is on site monitoring the installation activities everyday as they are taking place will have provided CQC services for the installation of the proposed or similar products for at least five (5) completed projects totaling not less than one (1) million square feet or must provide satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the respective geosynthetic will be installed in a competent, professional manner. The GCL INSPECTOR should be an engineer registered to practice in the state of Georgia or an ICP – certified geosynthetic installation technician. The GCL INSPECTOR will directly observe all aspects of GCL installation, seaming, testing, and damage repair.

F. SURFACE PREPARATION

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 Georgia Power 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.

Prior to placement, the Installer and GCL INSPECTOR will confirm that the surface is properly compacted, smooth, and uniform. The suitability of the subgrade will be evaluated, and it will be verified that the foundation soil layer surface is rolled to a smooth, level surface, free of stones typically greater than one-half (1/2) inches in diameter, or protrusions/ruts one-half (1/2) inches or greater.

G. GCL PLACEMENT

Once the subgrade approved, GCL rolls will be delivered to the working area in their original packaging. The GCL will be placed in accordance with guidelines and specifications provided by the manufacturer of the material unless otherwise noted.

Immediately prior to deployment, the packaging will be carefully removed without damaging the GCL. Equipment used to deploy the GCL must be rubber tired with six (6) psi maximum ground pressure and is subject to approval by the CQA ENGINEER. Personnel working on the GCL will not smoke or wear damaging shoes. Equipment should not cause rutting of the subgrade surface, should not make sharp turns, and should not be driven over the GCL, unless proper demonstration of GCL survivability and approval of the CQA ENGINEER can be obtained. Any damage to the subgrade or the GCL will be the responsibility of the Contractor to replace or put back to the pre-installation conditions.

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 GCL INSPECTOR and the CQA ENGINEER. The method used to unroll the panels will not cause damage to the GCL. Care will be taken to minimize the extent to which the GCL is dragged across the subgrade in order

to avoid damage to the GCL's bentonite surface. A temporary geosynthetic subgrade covering slip sheet or rub sheet may be used, as necessary, to reduce friction damage during placement. Care will be taken to not entrap objects or moisture (e.g. greater than the typical morning dew) beneath the GCL. GCL will not be installed during periods of rain or in areas of ponded water or unusually moist soils.

The individual deployed rolls (panels) will be placed so that overlapping edges are parallel to the direction of the slope. The panels will be placed to ensure a minimum overlap of six (6) inches between panels or per the manufacturer's recommendations. All GCL will be placed and maintained flat on the underlying surface, with no wrinkles or folds, especially at the exposed edges of the panels. All exposed GCL panels will be covered the same day with geomembrane liner. If the bentonite becomes hydrated before the cover is placed, it will be tested and replaced, as necessary, to meet the specified maximum allowable moisture contents listed.

On the side slopes, the GCL will first be anchored securely at the top of the slope, and then deployed down the slope in a controlled continuous manner. The GCL will extend continuously from the top to the toe of the slope unless otherwise directed by the CQA ENGINEER. Seams at the ends of the panels will be constructed such that they are shingled in the direction of the grade to prevent the potential for runoff flow to enter the overlap zone. Shingling is performed in such a manner as the upgradient GCL sheet overlies the downgradient sheet.

Each panel will be marked with an "identification code" (number or letter). The identification code will be simple and logical. The number of panels deployed in one (1) day will be limited by the number of panels which can be seamed and covered on the same day.

Adequate loading (e.g., sandbags 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).

H. REPAIR PROCEDURES

If the GCL is defective or damaged (torn, punctured, perforated, etc.) during installation, then patching will be performed in accordance with the Manufacturer's recommendations. Patching material will be obtained from a new GCL roll and will be cut to size such that a minimum overlap of twelve (12) inches is achieved around all of the damaged area. Granular bentonite or bentonite mastic should be applied around the damaged area prior to placement of the patch. Adhesion tape such as masking tape or other approved tape may be used to hold the patch in place, while cover soil is being placed. Damage repair will be performed under the direct supervision of the GCL INSPECTOR.

I. DIRECT SHEAR INTERFACE LABORATORY TESTING

See Section 5.H of this CQA Plan for direct shear interface laboratory testing requirements.

5. 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. This section applies to both the bottom liner and final cover systems.

B. MATERIAL

The linear low-density polyethylene (LLDPE) structured geomembrane, used for the engineered turf final cover system, shall conform to the requirements in this CQA Plan. The Contractor will provide certification that these requirements are met to the CQC ENGINEER. 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 for the LLDPE structured geomembrane shall confirm the material meets the minimum physical properties of a 50-mil thick LLDPE geomembrane as listed in the latest of GRI-GM17, "Standard Specification, Test Methods, Test Properties and Testing Frequency for Linear Low-Density Polyethylene (LLDPE) Smooth and Textured Geomembranes" and as listed in the following table.

Table 5 – 50-mil LLDPE Structured Geomembrane Properties

Property	Test Method	Frequency	Value	Units
Thickness	ASTM D5994	Per roll	50	mil
1. Minimum average 2. Lowest individual of 8 to 10 readings 3. Lowest individual of 10 readings			47.5 45 42.5	
Drainage Stud Height (min. avg.) Friction Spike Height (min. avg.)	ASTM D7466	Every 2nd roll	130 175	mil
Sheet Density (max.)	ASTM D792, Method B	1 / 200,000 lbs	0.939	g/cc
Tensile Properties[1] 1. Break Strength 2. Break Elongation	ASTM D6693, Type IV	1 / 20,000 lbs	 105 300	lb/in %
Tear Resistance	ASTM D1004	1 / 45,000 lbs	30	lbs
Puncture Resistance	ASTM D4833	1 / 45,000 lbs	55	lbs
Carbon Black Content	ASTM D4218	1 / 20,000 lbs	2-3	%
Carbon Black Dispersion	ASTM D5596	1 / 45,000 lbs	-Note 2-	
Oxidative Induction Time (OIT) Standard OIT	ASTM D3895	1 / 200,000 lbs	>140	minutes

Notes:
1. Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction. Break elongation is calculated using a gauge length of 2.0 inches.
2. Only near spherical agglomerates for 10 views in Cat. 1 or 2.

The high-density polyethylene (HDPE) liner and cap materials will conform to the requirements in this CQA Plan. The Contractor will provide certification that these requirements are met to the CQC ENGINEER. Black textured geomembrane will be used as the upper portion of a composite liner system to line the parcels, the bottom liner of the double HDPE liner system in the leachate ponds, and the geomembrane component of the final cover system. A black textured geomembrane with a UV resistant, light-reflective, white surface on one side will be used as the upper liner of the double HDPE liner system in the Parcels A/B leachate pond. 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. Carbon black will be added to the resin if the resin is not compounded for ultra-violet resistance.

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.

The geomembrane will be manufactured of polythene resins and will be compounded and manufactured specifically for the intended purpose and meets the following physical properties:

Table 6 – 60-mil HDPE Geomembrane Properties

Property	Test Method	Frequency	HDPE Requirements
Density, g/cc	ASTM D1505	1 / 200,000 lbs	0.94
Melt Index, g/10 min.	ASTM D1238	1 / 200,000 lbs	≤1.0
OIT, min	ASTM D8117	1 / 200,000 lbs	100

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 the following table.

Table 7 – 60 mil HDPE Geomembrane Properties

Property	Test Method	Frequency	Value	Units
Raw Materials:				
Density	ASTM D792 ASTM D1505	1 / 200,000 lbs of resin	≥0.94	g/cc
Melt Index	ASTM D1238	1 / 200,000 lbs of resin	≤ 1.0	g/10 min.
Oxidative Induction Time (OIT)				
Standard OIT	ASTM D8117		100	min (min avg)
Or		1 / 200,000 lbs of resin		
High Pressure OIT	ASTM D5885		400	min (min avg)
Thickness				
Minimum Average			57	mil nom
Lowest individual of 8 of 10 Readings	ASTM D5994	Per roll	54	mil
Lowest individual of 10 Readings			51	mil
Asperity Height[1]	ASTM D7466	Every 2nd Roll[2]	16	mil
Density	ASTM D1505 ASTM D792	1 / 200,000 lbs of resin	≥0.940	g/cc
Tensile Properties[3]	ASTM D6693			
Yield Strength	Type IV		≥126	lb/in
Break Strength	Dumbell 2 ipm	1 / 20,000 lbs	≥90	lb/in
Yield Elongation	G.L.=1.3in		12	%
Break Elongation	G.L.=2.0in		100	%
Tear Resistance	ASTM D1004	1 / 45,000 lbs	≥42	lb (min avg)
Puncture Resistance	ASTM D4833	1 / 45,000 lbs	≥90	lb (min avg)
Stress Crack Resistance	ASTM D5397	Per GRI GM-10	≥500	hr
Carbon Black Content	ASTM D4218[4]	1 / 20,000 lbs	2.0 – 3.0	%
Carbon Black Dispersion[5]				
Categories 1 or 2	ASTM D5596	1 / 45,000 lbs	9	-
Category 3			1	-
Oven Aging @ 85°C				
Standard OIT (min avg)	ASTM D5721		55	%
Retained after 90 days	ASTM D8117	Per Each Formulation		
High Pressure OIT (min avg)			80	%
Retained after 90 days	ASTM D5885			
UV Resistance				
Standard OIT	ASTM D8117		N.R.(7)	
Or		Per Each Formulation		
High Pressure OIT (min avg)	ASTM D5885		50	%
Retained after 1600 hrs				

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.
6. For NCTLSC, oven aging, and UV resistance, Manufacturer's certification may be accepted in lieu of actual test results.
7. Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

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.

The geomembrane will be supplied in rolls. Labels on each roll will identify the thickness of the material, the length and width of the roll, batch and roll numbers, and the name of the manufacturer. The geomembrane rolls will meet or exceed the specifications stated herein. Certification will be provided for each roll stating that these items have been met or exceeded. The certification will reference the manufacturer's batch and roll number and will indicate the name of the manufacturer.

C. GEOMEMBRANE MANUFACTURER AND INSTALLER

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

1. Production Certification, including project references (at least five (5) years continuous experience) in manufacturing polyethylene geomembrane and/or experience totaling ten (10) 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 the GEOMEMBRANE INSPECTOR of the geomembrane installation

The installation Contractor will be the manufacturer, or a dealer trained to install the manufacturer's geomembrane. Installation will be performed under the constant direction of a field installation supervisor who will remain on site and be responsible throughout the liner installation for liner layout, seaming, testing, repairs, and all other activities by the Installer. The field installation supervisor will have installed or supervised the installation of a minimum of two (2) million square feet of polyethylene geomembrane. Seaming will be performed under the direction of a master seamer (who may also be the field installation supervisor) who has seamed a minimum of one (1) million square feet of polyethylene geomembrane, using the same type of

seaming apparatus specified for this project. The field installation supervisor and/or master seamer will be present whenever seaming is performed.

The GEOMEMBRANE INSPECTOR will be an individual or company who is independent from the geocomposite manufacturer and installer, who will be responsible for monitoring and documenting activities related to the CQC of the geomembrane throughout installation. The GEOMEMBRANE INSPECTOR who is on site monitoring the installation activities everyday as they are taking place will have provided CQC services for the installation of the proposed or similar products for at least five (5) completed projects totaling not less than one (1) million square feet or must provide satisfactory evidence, through similar experience in the installation of other types of geomembranes, that the respective geomembrane will be installed in a competent, professional manner. The GEOMEMBRANE INSPECTOR should be an engineer registered to practice in the state of Georgia or an ICP – certified geomembrane installation technician. The ENGINEERING TECHNICIAN will directly observe all aspects of geomembrane installation, seaming, testing, and damage repair.

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 geomembrane installation 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 Georgia Power's review fourteen (14) days prior to installation.

The only approved seaming processes are fusion and extrusion welding. On side slopes, seams will 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 will 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 (1) 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 (1) 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-half (1/2) 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 one-half (1/2) 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 Georgia Power 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 GEOMEMBRANE INSPECTOR 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., sandbags 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 GEOMEMBRANE INSPECTOR 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.

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 (4) inches for fusion welding and six (6) 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 (4) hours for each seaming apparatus and personnel used that day.

All trial seams will be made in contact with the subgrade. Welding rods 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 (1) sample per maximum five hundred (500) cumulative feet of seam length from a location specified by the GEOMEMBRANE INSPECTOR. If the amount of extrusion seaming is less than five hundred (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 manufacturer's recommendations.

The GEOMEMBRANE INSPECTOR will test ten (10) one (1)-inch wide specimens from one of the aforementioned pieces cut from the 12-in. x 36-in. sample: five (5) specimens for shear strength and five (5) for peel strength. Seam test results will be evaluated using the current GRI test method GM19 which allows for four (4) of five (5) specimens meeting the required seam strength and the fifth specimen meeting 80% of the required strength. Additionally, peel excursion will not exceed 25%.

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.

The following procedures will apply whenever a sample fails the field destructive test.

1. The Installer will cap strip the seam between the failed location and any passed test locations.

2. The installer will retrace the welding path to a location (initially a minimum of ten (10) feet on each side of the failed seam location) to identify and isolate the failed seam in both previous and next direction of failed destructive test, by taking two (2) new samples, one from each direction. If these tests pass, then the seam will be capped between the passing tests. If the test fails, then the process is repeated.

3. Over the length of the seam failure, the Installer will either cut out the old seam, reposition and reseam, or add a cap strip.

4. Each suspect location in seam and non-seam areas will be non-destructively tested as appropriate in the presence of the GEOMEMBRANE INSPECTOR. Each location that fails the non-destructive testing will be marked by the GEOMEMBRANE INSPECTOR and repaired accordingly.

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 (2) 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 (6) 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 thirty (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 (6) inches beyond the edge of the defect, i.e., be a minimum of twelve (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. DIRECT SHEAR INTERFACE LABORATORY TESTING

Large scale direct shear interface testing will be performed for the composite bottom liner system and final cover system (soil final cover system or engineered turf final cover system). The materials for each option are provided below:

1. Composite Bottom Liner System – compacted clay layer, GCL (optional), geomembrane liner, GDM, drainage sand, and ash fill (coal combustion residuals).

2. Final Cover System

    a. Soil Final Cover System – ash fill, geomembrane liner, GDM, protective soil cover, and topsoil.

    b. Engineered Turf Final Cover System – ash fill, structured geomembrane, engineered turf, and sand infill.

Samples of the geomembrane liner, ash fill, GDM, and soil (along with LLDPE structured geomembrane, engineered turf, and sand infill if an engineered turf final cover system is selected) will be provided by the Contractor/Installer and sent by the CQA ENGINEER to a certified laboratory for large scale direct shear interface testing to determine the composite strength envelope (combination of internal friction angle and cohesion/adhesion) for the respective components. A sample of the GCL material will also be provided if installed. 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 cover substrates for use in the bottom liner system geosynthetic interface testing will be compacted to 98% of maximum dry density at 2.5% above optimum moisture content as determined by Standard Proctor ASTM D698.

2. Soil and ash substrates for use in the cap system 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.

3. 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.)

4. Normal Loads for Bottom Liner System: 2,000 psf, 6,000 psf, and 10,000 psf

5. Normal Loads for Soil Cover System: 100 psf, 200 psf, and 400 psf

6. Normal Loads for LLDPE structured geomembrane Engineered Turf Final Cover System: 10 psf, 20 psf, 50 psf.
7. Shear in a submerged condition following a 24-hour submerged seating period at each respective normal load.

8. Shear Rate: 0.04 in/min

6. 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. This section applies to both the bottom liner and final cover systems.

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 drainage layer will be as follows:

Table 8 – GDM Properties

Tested Property	Test Method	Frequency	Value [1]	Units
Geonet Core [2]				
Raw Materials: Density Melt Index	ASTM D1505 ASTM D1238	 Per lot Per lot	 0.95 ≤ 1.0	 g/cc g/10 min.
Thickness	ASTM D5199	1 / 50,000 lbs	300	mil
Density	ASTM D1505	1 / 50,000 lbs	0.95	g/cc
Carbon Black Content	ASTM D4218	1 / 100,000 lbs	1.5 – 3.0	%
Tensile Strength	ASTM D7179	1 / 50,000 lbs	75	lbs/in
Compressive Strength	ASTM D6364	1 / 100,000 lbs	120	lbs/in^2
Flow Rate/Width	ASTM D4716	1 / 200,000 lbs	13	gpm/ft
Geotextile (prior to lamination) [3]				
Mass per Unit Area	ASTM D5261	1 / 90,000 ft^2	8.0	oz/yd^2
Grab Strength and Elongation	ASTM D4632	1 / 90,000 ft^2	200 50	Lbs %
Trapezoidal Tear Strength	ASTM D4533	1 / 90,000 ft^2	80	lbs
Puncture Strength	ASTM D6241	1 / 540,000 ft^2	430	lbs
Permittivity	ASTM D4491	1 / 540,000 ft^2	0.2	sec^{-1}
AOS	ASTM D4751	1 / 540,000 ft^2	0.25	mm
UV Resistance	ASTM D4355	Once per formula	50	% ret.
Geocomposite				
Flow Rate/Width	ASTM D4716	1 / 200,000 lbs	3.0	gpm/ft
Ply Adhesion	ASTM D7005	1 / 100,000 lbs	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. Refer to geotextile product data sheet for additional specifications.

C. 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 GDM Contractor will have the following qualifications:

1. The drainage material manufacturer will have successfully manufactured five (5) million square feet of polyethylene drainage material.

2. Installation of the drainage material will be performed by the manufacturer or be a manufacturer-approved dealer/installer. The drainage material installer must either have installed at least one (1) million square feet of product, or must provide satisfactory evidence, through similar experience in the installation of other types of geosynthetics, that the respective geosynthetic will be installed in a competent, professional manner.

3. The installation supervisor will have worked in a similar capacity on projects similar in size and complexity to the project described in the contract documents.

4. The geocomposite/geonet GDM INSPECTOR will be an individual or company who is independent from the manufacturer and installer and will be responsible for monitoring and documenting activities related to the CQC of the geocomposite throughout installation. The GDM INSPECTOR who is on site monitoring the installation activities every day as they are taking place, will have provided CQC services for the installation of the proposed or similar products for at least five (5) completed projects totaling not less than one (1) million square feet. The GDM INSPECTOR should be an engineer registered to practice in the State of Georgia or an ICP-certified geosynthetics installation technician.

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 GDM INSPECTOR of the GDM installation

D. CONFORMANCE TESTING

CQA Conformance Testing will be performed by the CQC ENGINEER.

1. Transmissivity testing will be performed using ASTM D4716 - Modified (100-hour transmissivity of geocomposites). CQA testing will be performed for transmissivity at a confining pressure of 250 psf and 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 geocomposite. The minimum required transmissivity is $9x10^{-4}$ m^2/sec. The test should be performed at a frequency of one (1) per every 100,000 square feet of installed geocomposite.

2. Resin Density testing will be performed using ASTM D1505. The minimum average roll value is 0.95 g/cc minimum average roll value. The test should be performed at a frequency of one (1) test per lot.

3. Ply Adhesion testing will be performed using ASTM D7005. The minimum average roll value is 1.0 lbs/in. The test should be performed at a frequency of one (1) test per 100,000 sf.

E. 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.

With the exception of the interior of the cells where the geocomposite will be placed on the bottom of the parcel only, the geocomposite will be properly anchored in the anchor trenches, common to the HDPE liner, to resist sliding as shown on the construction drawings. Anchor trench compacting equipment will not come into direct contact with the geocomposite. In the parcels, the geocomposite may be anchored in the trench containing the leachate piping around the perimeter of the cell.

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 (maximum 6 psi) 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 three (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 three (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 fifty (50) percent of the width of the panel, the damaged area will be cut out and the two (2) portions of the geonet will be joined as discussed above.

F. DIRECT SHEAR INTERFACE LABORATORY TESTING

See Section 5.H of this CQA Plan for direct shear interface laboratory testing requirements.

7. LEACHATE COLLECTION & REMOVAL SYSTEM (LCRS)

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 drainage blanket and leachate collection and removal system (LCRS) material (sand and rock) will be non-carbonate and meet the following criteria:

Table 9 – LCRS Material Criteria

Testing	Minimum Criteria
Grain size	< 1/4 inch
Permeability	> $1x10^{-2}$ cm/sec
Filter gradation limits	0.1mm < $D15_f$ < 0.7mm $D50_f$ < 1.8 mm

The cover material on the interior side slopes of the parcel will be a gravel material meeting the Georgia Department of Transportation (GDOT) Specifications No. 3 stone or drainage sand.

The backfill material for the LCRS trench will be a gravel material meeting the GDOT Specifications No. 57 stone unless otherwise specified on the drawings.

The LCRS piping will meet or exceed the physical properties values listed below for HDPE smooth wall pipe, Polypipe PE3408. Note that leachate force mains for Parcels C, D and F will be dual containment HDPE smooth wall pipe meeting these requirements. The dimensions for the HDPE smooth wall pipe will meet the following specifications:

Table 10 – LCRS Piping Criteria

Nominal Size (in)	Nominal Inside Diameter (in)	Nominal Outside Diameter (in)	Minimum Wall Thickness (in)	Weight/100 ft. (lbs)
SDR 13.5 - ASTM D3035				
6	5.580	6.625	0.491	413.00
10	9.158	10.750	0.796	1067.75
SDR 17 - ASTM D3035				
4	3.938	4.468	0.265	154.00
6	5.798	6.578	0.390	334.00
8	7.550	8.625	0.507	569.00
10	9.410	10.750	0.632	883.00
12	11.160	12.750	0.750	1,243.00

C. CONFORMANCE TESTING

The CQC ENGINEER will observe and test the drainage blanket material to ensure they are uniform and conform to the requirements of this CQA Plan. On the parcel bottoms, there will be 24 inches of sand overlain by landfill tarps.

On the cell interior side slopes, there will be twelve (12) inches of sand overlain by twelve (12) inches of GDOT No. 3 stone (non-carbonate) or twenty- four (24) inches of sand. The interior slopes will also have landfill tarps placed as needed (following placement of the aggregate materials). Tarps (or stormwater flaps) shall consist of material, and follow installation procedures, as provided in the drawings. This material shall periodically be inspected for rips or tears during construction operations.

The HDPE pipe supplier will provide certification that the pipe satisfies the criteria provided in this CQA Plan.

D. TEST METHODS AND FREQUENCY

All testing will be conducted in accordance with the CQA Plan. At a minimum, the following data must be collected and submitted in support of the Construction Certification Report.

Table 11 – LCRS Material Testing Properties

Testing	Minimum Frequency
Grain size, ASTM D422	1,500 CY (provided by supplier) 15,000 CY (verified by contractor)
Permeability, ASTM D2434	3,000 CY

E. INSTALLATION

During placement of drainage material, no equipment will drive directly across or on the geocomposite drainage material. The specified fill material will be placed and spread utilizing vehicles with a low ground pressure.

The granular drainage material will be placed at the edge of the geocomposite drainage material and spread ahead of the equipment in lifts no less than twelve (12) inches in thickness.

During spreading, the equipment will be operated in such a manner that the underlying geocomposite and liner system will not be damaged or moved. The equipment will not make abrupt stops, sharp turns, or other maneuvers that would lessen the required twelve (12) inch minimum cover.

The drainage material should be placed in a manner that prevents the material from entering the geocomposite overlap zones. Placement will be such that the tensile forces on the geocomposite and underlying liner system are minimized. On slopes, the material will be placed from bottom of slope up.

F. PROTECTIVE COVER – LEACHATE PONDS

The HDPE in the leachate ponds will be overlain by heavy-weight (14 to 16 oz) non-woven geotextile fabric in turn overlain by cover material consisting of a six (6)-inches of GDOT No. 89 stone and one (1)-foot of GDOT No. 57 stone. The material will be free of vegetation, debris, sticks, sharp rocks, and any other foreign matter that could damage the underlying HDPE liner.

The protective cover will be placed using low contact pressure, wide tracked construction equipment that minimizes stresses on the HDPE geomembrane. During placement of the drainage material, no equipment will drive directly across or on the geomembrane.

The granular drainage material will be placed on the edge of the geomembrane and spread ahead of the equipment in one (1) lift and tracked with a minimum of four (4) passes.

8. ENGINEERED TURF

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. This section applies to the high-density turf and sand infill materials used for the engineered turf final cover system.

B. MATERIAL

The high-density turf will conform to the requirements in this CQA Plan. The Contractor will provide certification that these requirements are met to the CQC ENGINEER. Manufacturer Quality Control will confirm the material meets requirements as listed in the table below.

Table 12 – Engineered Turf Properties

Property	Test Method	Frequency	Values
CBR Puncture	ASTM D6241	1 / 300,000 ft^2	1,500 lb (MARV)[1]
Tensile Product (MD/XD)[2]	ASTM D4595	1 / 300,000 ft^2	2,100 MD / 1,600 XD lb/ft (MARV)
Yarn Weight (Total Product Weight)	ASTM D5261	1 / 300,000 ft^2	≥20 oz. / sq. yd. (≥32 oz. / sq. yd.)
Tensile Strength of Yarn	ASTM D2256	1 / 300,000 ft^2	15 lbs. min.

1. MARV = Minimum Average Roll Value
2. Machine direction (MD) and cross machine direction (XD)

Sand infill Component of the engineered turf final cover system shall meet the fine aggregate angularity, specific gravity, and grain size distribution as specified below.

1. Fine aggregate angularity shall be tested in accordance with ASTM C 1252 Standard Test Methods for Uncompacted Void Content of Fine Aggregate (as Influences by Particle Shape, Surface Texture, and Grading), Method A. Method A uncompacted void content shall be greater than or equal to 40%.

2. Sand infill specific gravity shall be tested in accordance with ASTM C 128 Standard Test Method for Relative Density (Specific Gravity) and Absorption of Fine Aggregate. Bulk oven-dry specific gravity shall be greater than or equal to 2.40.

3. Sand infill grain size distribution shall be tested in accordance with ASTM C 136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates. The grain size distribution shall be prescribed in the table below.

Table 13 – Sand Infill Material Criteria

Sieve	Percent Passing
9.5 mm (3/8 in.)	100
4.75 mm (No. 4)	90 to 100
2.36 mm (No. 8)	50 to 85
1.18 mm (No. 16)	25 to 65
600 µm (No. 30)	10 to 45
300 µm (No. 50)	0 to 30
150 µm (No. 100)	0 to 10
75 µm (No. 200)	0 to 5

C. ENGINEERED TURF INSTALLATION

Prior to installation of Engineered Turf, the CQA ENGINEER shall observe the following:

1. The engineered turf final cover system structured geomembrane component has been seamed, tested, approved, and is released for further component deployment by the CQA ENGINEER.

2. The supporting surface (e.g., the structured geomembrane) is substantially free of debris.

3. The installed structured geomembrane shall be inspected and approved in writing by the GPC, CQA ENGINEER, Contractor, and Installer.

During deployment of Engineered Turf, the CQA ENGINEER shall observe the following:

1. Observe the engineered turf as it is deployed and record defects and disposition of the defects (i.e., panel rejected, patch installed, etc.).

2. The repairs are made in accordance with the Specifications.

3. Equipment used does not damage the engineered turf or underlying structured geomembrane.

4. That all panels are deployed from the top of the slope in a way that the Engineered Turf filaments are pointing upslope after deployment is complete.

5. That the turf is anchored to prevent movement by the wind (the Installer is responsible for any damage resulting to or from windblown Engineered Turf).

6. That the engineered turf remains substantially free of contaminants.

7. That the engineered turf is laid substantially smooth.

8. That on slopes, the turf is secured with sandbag anchoring at the top of the slope after deployment.

D. ENGINEERED TURF COMPONENT FUSION SEAMING METHOD

Techniques for Fusion Seaming Engineered Turf will be as follows:

1. Engineered Turf fusion seaming device will be a DemTech VM20/4/A fusion welder only.
2. Fusion seams require a minimum of five (5) inches of overlap.
3. Frayed or loose geotextile strands will be cut off or removed.
4. Prior to starting the production fusion seaming, trial seams must be performed as outlined below.
5. Demonstrate the preparation methods and equipment utilized for removal of the selvage from the outside edge of the rolls of engineered turf (i.e. trimming & cutting devices).
6. Mechanical or hot knife trimming and cutting devices will be utilized for selvage trimming.
7. Demonstrate and control the fraying of geotextile strands when performing the removal of selvage.
8. Verify that engineered turf tufts are not pulled out by the installation process.
9. Any damage that occurs due to production seaming will be repaired as outlined in Section 8F.

Trial Welds for the engineering turf shall meet the following conditions:

1. Prior to engineered turf component welding by any operator and each welding device, perform trial welds on engineering turf samples to verify welding equipment is operating properly.
2. Make trial welds under the same surface and environmental conditions as the production welds, i.e., in contact with subgrade and similar ambient temperature.
3. A minimum of two (2) trial welds shall be performed per full workday, per welding apparatus and operator combination (one (1) made prior to the start of work and one (1) completed at mid shift). If work (for the workday) is completed prior to mid-shift, only one (1) trial weld per welding apparatus and operator combination is required.
4. The trial weld sample must be a minimum of three (3) feet long and twelve (12) inches wide, with the seam centered lengthwise.
5. The trial weld must be allowed to cool to ambient temperature before seam snapping or panel adjustments are applied.
6. Trial Sample Test Results: Trial weld samples must comply with visual passing criteria. Visual passing criteria is verified when a manual peel/pull test is performed and the top

engineered turf panel tufts transfer to the bottom engineered turf panel. The transfer of approximately 75% or more of the tufts constitutes a passing trial weld.

7. Repeat the trial weld, in its entirety, when any of the trial weld samples fail the visual passing criteria.

8. No welding equipment or welder shall be allowed to perform production welds until equipment and welders have successfully completed the trial weld.

CQA documentation of trial seam procedures will include the following:

1. The names of seaming personnel;

2. The name of the fusion seaming technician;

3. The welding apparatus number, time, date;

4. Ambient air temperature; and

5. Welding apparatus temperature.

E. REPAIR OF ENGINEERED TURF COMPONENT

When repairs and tie-ins of Engineered Turf occur, the CQA ENGINEER shall observe the following:

1. Repairs to Engineered Turf are completed by using a heat-bonded seam.

2. All tie-in seams along flatter slopes (i.e. 15% or less) with length greater than twenty-five (25) feet will use an approved leistering machine so as consistent pressure is achieved throughout the seam.

3. A handheld gun with a pressure wheel will be used in a smaller/concentrated areas.

F. SAND INFILL INSTALLATION

Sand infill that is placed between the tufts of the Engineered Turf:

1. Will be placed to a three-quarter (¾) inch minimum thickness.

2. Will consist of sand meeting the requirements of Section 8B.

3. CQA ENGINEER shall check final thickness of sand infill at approximately one hundred (100) foot grid intervals.

Sand Infill Grain Size Parameters shall conform to the gradation shown in this Section.

1. Sand infill Installer shall meet the following requirements:

    a. Installation of sand infill will only be performed by the Manufacturer's approved Installer.

    b. Areas that are to receive sand infill must be accepted by Georgia Power and CQA ENGINEER before placement of sand infill takes place.

2. The CQA ENGINEER shall observe the following:

    a. The sand infill shall be worked into the Engineered Turf between the synthetic yarn blades.

    b. Conveyor systems and/or express blowers will be used to spread and place the sand infill.

    c. Sand Infill Installer has provided, in an approved submittal, the method of sand infill deployment to be used.

    d. That previously installed engineered turf final cover system components are not displaced or damaged as a result of the sand infill component installation.

    e. That sand infill placement does not occur with snow or ice on the Engineered Turf component.

    f. The method for measuring the sand infill thickness will be performed utilizing a digital caliper, or a CQA ENGINEER approved alternative measuring device.

    g. A standard washer will be utilized as a plate for the point of entry into the sand infill for consistent depth control.

9. PROTECTIVE SOIL COVER & TOPSOIL

A. GENERAL

The CQC ENGINEER and the CQA ENGINEER will verify that the protective cover is placed and vegetated in accordance with the Permit Drawings 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 materials to ensure they are uniform and conform to the requirements in the CQA Plan and the Permit 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 (1) 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 (3) 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.

10. CERTIFICATION

New parcel construction will be documented with a Construction Certification Report along with a registered engineer's certification that the parcel under consideration was constructed within the limitations of and according to the approved permit plans and this CQA Plan. The report will include, but not be limited to, the following:

1. Details and survey data of the bottom liner construction including drainage layers.

2. A summary of major construction activities which will include a description of the activity and schedule dates. This summary will be based on daily logs provided by the on-site CQA ENGINEERING TECHNICIAN. This will also serve to document the presence of a qualified member of the inspection team during any construction activity involving structural fill or any component of the liner or leachate collection and transport system.

3. Project Quality Control summary reports including all field testing and inspection results. This summary will be inclusive of all passing tests as well as failing tests and retests.

4. An as-built final panel layout with panel numbers of the installed HDPE liner (where installed) is to be submitted upon completion of installation. This plan will reference the 1) location by roll number of synthetic materials, 2) location of referenced destructive tests, 3) location of required repairs to the liner due to defects, accidental punctures, or failed tests.

5. A record topographic survey of the constructed cell and associated structures.

For closure of the landfill, the CQA ENGINEER will provide certification that the final closure cover system, access roads, ditches, sediment basin, and other associated ancillary facilities for this unit were constructed according to the Permit Drawings and this CQA Plan. Said certification will have the seal of a professional engineer registered in Georgia.