



Hillsborough County
Public Utilities Department
Solid Waste Management Group

Southeast County Landfill
Sinkhole Remediation
Stage 5 - Isolation of Impacted Clay Liner
Construction Quality Assurance Plan

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TABLE OF CONTENTS

SECTION 1.0 INTRODUCTION	1
1.1 Purpose	1
1.2 Reference Documents.....	2
1.3 Definitions	2
SECTION 2.0 RESPONSIBILITY AND AUTHORITY	3
2.1 Permitting Agency.....	3
2.2 Facility Owner/Operator.....	4
2.3 Design Engineer	4
2.4 Construction Quality Assurance Organization.....	4
2.4.1 Construction Quality Assurance Engineer (CQA Engineer)	4
2.4.2 Construction Quality Assurance Inspector (CQA Inspector)	5
2.4.3 Construction Quality Assurance Laboratory (CQA Laboratory).....	6
2.5 Construction Contractors.....	7
2.5.1 Construction Contractor.....	7
2.5.2 Site Supervisor	8
2.5.3 Geomembrane Installation Contractor (Geomembrane Installer).....	8
2.5.4 Driven Vinyl Sheet Pile Installation Contractor (Sheet Pile Installer)	9
SECTION 3.0 SOIL COVER	10
3.1 Intermediate Soil Cover.....	10
3.1.1 Preconstruction	10
3.1.2 Construction.....	11
3.2 protective cover	12
3.2.1 Preconstruction	12
3.2.2 Construction.....	13
SECTION 4.0 GEOMEMBRANE LINER.....	15
4.1 Preconstruction.....	15
4.1.1 Certification of CQA Plan Conformance.....	15
4.1.2 Geomembrane Installer’s and Manufacturer’s QC Program	16
4.1.3 Geomembrane Installer’s Installation Plan.....	17
4.1.4 Contractor’s Geomembrane Preconstruction Material Submittals	17
4.1.5 CQA Conformance Testing	18
4.2 Construction	19
4.2.1 Delivery, Storage and Handling.....	19
4.2.2 Geomembrane Subsurface Preparation.....	20
4.2.3 Geomembrane Placement and Seaming.....	20
4.2.4 Field Quality Control	23
4.2.5 Geosynthetics Manufacturer’s Warranty	25
4.2.6 Installer’s Warranty	26

SECTION 5.0 GEOCOMPOSITE.....	27
5.1 Preconstruction.....	27
5.1.1 Manufacturer’s Quality Control.....	27
5.1.2 CQA Conformance Testing	28
5.2 Construction	29
5.2.1 Delivery, Storage and Handling.....	29
5.2.2 Geocomposite Subsurface Preparation	30
5.2.3 Geocomposite Placement and Seaming.....	30
5.2.4 Geocomposite Repairs	30
5.2.5 Placement of Soil Materials.....	31
 SECTION 6.0 SHEET PILE.....	 32
6.1 Preconstruction.....	32
6.1.1 Manufacturer’s Quality Control.....	32
6.2 Construction	33
6.2.1 Delivery, Storage and Handling.....	33
6.2.2 Subsurface Investigation (Borings).....	33
6.2.3 Sheet Pile Placement and Installation.....	33
6.2.4 Placement of Soil Materials.....	34
 SECTION 7.0 SURVEYING.....	 35
7.1 Survey Control	35
7.2 Surveying Personnel.....	35
7.3 Precision and Accuracy	35
7.4 Lines and Grades	35
7.5 Frequency and Spacing	36
7.6 Thickness Measurements	36
7.7 Tolerances	37
7.8 Documentation	37
 SECTION 8.0 REPORTING REQUIREMENTS AND DOCUMENTATION.....	 38
8.1 Project Meetings.....	38
8.1.1 Preconstruction CQA Meeting.....	38
8.1.2 Weekly Progress Meetings	39
8.1.3 Problem or Work Deficiency Meetings	39
8.2 Documentation	39
8.2.1 Daily Summary Report	39
8.2.2 Inspection Data Sheets and Photographs	40
8.2.3 Problem Identification and Corrective Measures Reports	41
8.2.4 Acceptance of Completed Components.....	41
8.2.5 Final Documentation.....	42

LIST OF FIGURES & TABLES

Figure 1 CQA/CQC Organization Chart.....	3
Table 3-1 Intermediate and Protective Cover Test Procedure Standards.....	10
Table 3-2 Intermediate Cover Conformance and Construction Testing	12
Table 3-3 Final Cover Conformance and Construction Testing	13
Table 4-1 MQC Conformance Testing for LLDPE and HDPE Geomembranes	16
Table 4-2 CQA Conformance Testing for LLDPE Geomembranes	18
Table 5-1 Manufacturer’s Quality Control Testing for Geonet / Geocomposite	27
Table 5-2 CQA Conformance Testing for Geocomposite	28
Table 6-1 Manufacturer’s Quality Control Testing for Vinyl Sheet Piles	32

SECTION 1.0 INTRODUCTION

1.1 PURPOSE

This Construction Quality Assurance (CQA) Plan is a document that contains requirements for testing materials and monitoring construction of the Hillsborough County Southeast County Landfill, Sinkhole Remediation Stage 5 - Isolation of Impacted Clay Liner project (Project), including the responsibilities of CQA personnel, documentation control, and reporting procedures.

The plan was prepared to provide the Owner, Design Engineer, CQA Engineer, and the Contractor the means to govern the construction quality; to satisfy environmental protection requirements for current solid waste management regulations; and utilize state-of-the-art construction practices and testing procedures to adequately document proposed construction activities. The proposed construction, testing, and documentation procedures are also intended to provide the necessary safeguards and provisions accepted by the Owner upon completion. The roles of each party have been sufficiently defined and the level of responsibility explained. The Stage 5 Work will be constructed in accordance with the design, the construction documented, and respective components approved and certified for acceptance.

More specifically, this CQA Plan addresses the soil cover, geosynthetic components, and installation of the vinyl sheet piles. Specific work elements include the following:

- Intermediate Cover
- Final Cover System which consists, from bottom to top, of
 - 12-inch compacted soil layer
 - 40-mil LLDPE liner (textured),
 - geocomposite drainage layer
 - 24-inch compacted soil layer (includes 6 inches of topsoil)
- 60-mil HDPE liner (textured)
- Protective cover over 60-mil HDPE liner

The CQA Engineer has the primary responsibility of implementing and managing the CQA program described in this plan. When construction is complete, the CQA organization will prepare a construction certification report that will include information generated through the CQA program and will document the extent to which construction was performed in accordance with the contract documents.

The CQA Plan is intended to be a supporting document to improve the overall implementation of the work. The Contractor is instructed to bring discrepancies in the contract documents to the attention of the Design Engineer or CQA Engineer for resolution. The Design Engineer has the sole authority to determine resolution of discrepancies existing within the Contract Documents. Unless otherwise determined by the Design Engineer, the more stringent requirement shall be the controlling resolution.

1.2 REFERENCE DOCUMENTS

In addition to the methods, procedures and requirements outlined in this CQA Plan refer to the following documents:

- Florida Department of Environmental Protection (FDEP) Chapter 62-701.400; 62-701.600
- Project Plans and Specifications
- Manufacturer's Quality Assurance Manuals (where applicable)
- Contractor's Construction Quality Control Plan
- EPA/600/R-93/182
- ASTM International - Current Edition

1.3 DEFINITIONS

This section provides definitions for terms used in this CQA Plan.

Contract Documents – All contractor submittals, construction plans, as-built plans, construction specifications, QA plan, safety plan and project schedule.

CQA Organization – The company and persons including CQA Engineer, CQA Inspector, and CQA Laboratories whose primary responsibility is to implement the CQA Plan.

CQA Plan – The document contained herein, entitled Hillsborough County Southeast County Landfill, Sinkhole Remediation Stage 5 – Isolation of Impacted Clay Liner Construction Quality Assurance Plan prepared for Hillsborough County Public Utilities Department, Solid Waste Management Group by HDR Engineering, Inc.

Project Plans and Specifications - All project related plans and specifications including design modifications and as-built plans.

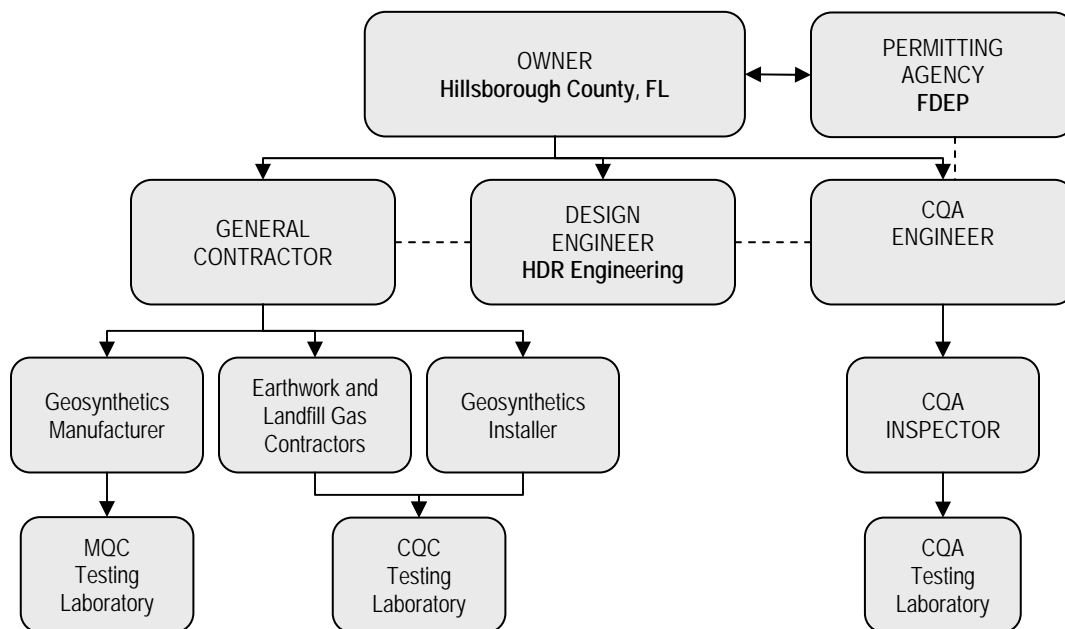
Quality Control - Actions taken by the geomembrane manufacturer and installer to ensure that the geosynthetic materials and workmanship meet the requirements of the Project Plans and Specifications.

Work - All tools, equipment, supervision, labor and material or supplies necessary to complete the project as specified herein and as shown on the Project Plans and Specifications.

SECTION 2.0 RESPONSIBILITY AND AUTHORITY

The principal organizations involved in permitting, designing and construction of the solid waste disposal facility include the permitting agency, facility owner/operator, Design Engineer, CQA organization, and Contractor. The principal organizations, their areas of responsibility and lines of authority as delineated for the CQA Plan are shown in Figure 1 below and described fully in this section. This establishes the necessary lines of communication that will facilitate an effective decision making process during implementation of the CQA Plan.

**Figure 1
CQA/CQC Organization Chart**



2.1 PERMITTING AGENCY

The Florida Department of Environmental Protection (FDEP), as the permitting agency, is authorized by law to accept or reject the Stage 5 construction documents. It is the responsibility of the FDEP to review the facility owner/operator's plans, including the site-specific CQA Plan, for compliance with FDEP's regulations and to make a decision whether to accept the Stage 5 construction documents based on this review. The FDEP has the responsibility and authority to review and accept or reject any design revisions or requests for variance that are submitted by the facility owner/operator after the acceptance is issued. The FDEP also has the responsibility and authority to review all CQA documentation during or after construction to confirm that the approved CQA Plan was followed and that the construction was completed as specified in the design.

2.2 FACILITY OWNER/OPERATOR

Hillsborough County, Florida ("Owner") is the facility owner/operator and is responsible for the design, construction, and operation of the solid waste disposal facility. This responsibility includes complying with the requirements of the FDEP in order to obtain acceptance and assuring the FDEP, by the submission of CQA documentation, that the facility was constructed as specified in the design. The Owner has the authority to select and dismiss organizations charged with design, CQA, and construction activities. The Owner also has the authority to accept or reject design plans and specifications, CQA Plans, reports and recommendations of the CQA Engineer, and the materials and workmanship of the contractor.

2.3 DESIGN ENGINEER

HDR Engineering, Inc. is the Design Engineer and is primarily responsible for designing the Sinkhole Remediation Stage 5 construction documents for the project that fulfills the requirements from the Owner and the FDEP. Design activities shall not end until construction of the Stage 5 construction is completed. The Design Engineer may be requested to change some component designs if unexpected site conditions are encountered or changes in construction methodology occur that could adversely affect landfill construction. Implementation of the CQA Plan provides assurance that these unexpected changes or conditions will be detected, documented, and addressed during construction.

The Owner has the authority to delegate additional responsibility and authority to the Design Engineer by expressed consent (i.e., a contractual agreement). Additional responsibilities and authority may include formulating and implementing a site-specific CQA Plan, periodic review of CQA documentation, modifying construction site activity, and identifying corrective measures in cases where deviation from the specified design or failure to meet design criteria, plans, and specifications is detected by the CQA Engineer.

2.4 CONSTRUCTION QUALITY ASSURANCE ORGANIZATION

2.4.1 Construction Quality Assurance Engineer (CQA Engineer)

The CQA Engineer is a party, independent of the manufacturer and the contractor, with responsibility for implementing this CQA plan. The CQA Engineer is responsible to the Owner but will function independently of the Owner and Contractor. At a minimum, the CQA Engineer is a Florida Registered Professional Engineer who possesses adequate formal academic training in engineering and managerial experience to successfully oversee and implement construction quality assurance activities for solid waste disposal facilities. The CQA Engineer is responsible for the following:

- Reviewing design criteria, permit conditions, the Contractor's Construction Quality Control (CQC) plan, and project plans and specifications for clarity and completeness so that the CQA plan can be implemented.

- Educating CQA Inspectors on CQA requirements and procedures.
- Scheduling and coordinating CQA activities including sampling for conformance testing.
- Confirming that regular calibration of testing equipment is properly conducted and recorded.
- Reviewing and interpreting test data and reports.
- Rejecting defective work and verifying that corrective measures have been implemented.
- Certifying construction completion.
- Providing signed, sealed final report and record drawings to the FDEP after owner review and approval stating that the project components have been installed in substantial conformance with the Project Plans and Specifications.

2.4.2 Construction Quality Assurance Inspector (CQA Inspector)

In order to assist the CQA Engineer in providing full-time on-site oversight and monitoring services, a CQA Inspector will be assigned. The CQA Inspector is a person(s) or firm(s) independent of the Contractor and Geomembrane Installer and authorized by the CQA Engineer and Owner to manage and oversee the execution of the work. The CQA Inspector shall possess formal academic training in soils engineering, engineering geology or other closely associated discipline. All completed work is subject to approval of the CQA Engineer.

The following minimum qualifications must be met by the CQA Inspector:

- The CQA Inspector must have been in business for at least ten (10) continuous years of operation immediately prior to the date of this project.
- The CQA Inspector must have inspected and tested a minimum of five (5) liner projects consisting of at least 10,000,000 square feet of LLDPE and/or HDPE liner.
- The CQA Inspector shall provide one full-time Qualified Engineering Technician and other trained technicians to perform the required tests and inspections of the liner system.
- The Qualified Engineering Technician is an engineering technician with a minimum of four years of directly related experience or a graduate engineer/geologist with one year of directly related experience.
- The CQA Inspector shall provide certified technicians to perform full time observation and documentation of activities related to the CQA of the liner system construction.
- The CQA Inspector must have registered full-time Professional Engineers on staff to sign, seal, and certify that the project was constructed in accordance with the contract documents.

The CQA Inspector's responsibilities include:

- Performing independent on-site inspection of the work in progress to assess compliance with the facility design, Project Plans and Specifications.

- Verifying that the equipment used in testing meets the test requirements and that the tests are conducted according to the standardized procedures defined by the CQA Plan.
- Reviewing design criteria, and Project Plans and Specifications for CQA requirements and procedures.
- Scheduling and coordinating inspection activities.
- Directing and supporting the inspection personnel in performing observations and tests by:
 - submitting test samples for analysis by the CQA laboratory,
 - confirming that regular calibration of testing equipment is properly conducted and recorded,
 - confirming that the testing equipment, personnel, and procedures do not change over time or making sure that any changes do not adversely impact the inspection process,
 - recording and maintaining comprehensive documentation of the liner system construction, and
 - verifying that the raw data are properly recorded, validated, reduced, summarized, and interpreted in accordance with the CQA Plan and the Project Plans and Specifications.
- Providing to the CQA Engineer reports on the inspection results including:
 - review and interpretation of all data sheets and reports,
 - identification of work that the CQA Inspector believes should be accepted, rejected, or uncovered for observation, or that may require special testing, inspection, or approval,
 - rejection of defective work and verification that corrective measures are implemented, and
 - verification that the Contractor's construction quality control plan is in accordance with the site-specific CQA Plan.

2.4.3 Construction Quality Assurance Laboratory (CQA Laboratory)

The CQA Laboratory will be independent of the geosynthetic manufacturer and installer. The CQA Laboratory will be qualified and responsible for material conformance testing for soil, geomembrane, geocomposite, geotextile, and for destructive seam tests on the installed geomembrane. The CQA Engineer and CQA Inspector will be responsible for coordinating with the laboratory, sampling the geosynthetics or arranging for sampling at the manufacturing facility, and reviewing conformance testing.

- The CQA Laboratory shall possess testing equipment which is capable of testing the interface friction between the liner system components in accordance with ASTM standards.

- The CQA Laboratory shall possess testing equipment which is capable of testing LLDPE and HDPE liner seams for peel and shear according to ASTM standards.
- The CQA Laboratory shall be familiar with ASTM, NSF and other applicable test standards. It shall have performed a minimum of 100 sets of peel and shear tests on seams of material the same type as specified.

2.5 CONSTRUCTION CONTRACTORS

2.5.1 Construction Contractor

It is the responsibility of the Contractor to construct the Stage 5 work in strict accordance with design criteria, Project Plans and Specifications, using the required construction procedures and techniques. The chosen Contractor will be registered in accordance with applicable local, state, and federal requirements and will have prior landfill-related experience.

The Construction Contractor's responsibilities include but are not limited to:

- Excavation, installing the vinyl sheet piles, landfill gas appurtenances, HDPE liner and protective cover soil, backfilling, and installation of the final cover system in strict accordance with the contract documents including Project Plans and Specifications using the necessary construction procedures and techniques.
- Formulating and implementing a Construction Quality Control (CQC) Plan in accordance with requirements of the technical specification.
- Contracting with subcontractors, such as manufacturers and specialty installers, and coordinating their activities.
- Supplying required materials and supporting QC documentation either directly or through subcontractors.
- Discussing procedures for locating and protecting construction materials and for implementing methods for preventing damage of the materials from inclement weather or other adverse effects.
- Coordinating activities with the CQA Engineer and CQA Inspector and providing the CQA organization with all necessary documentation as detailed in this plan.
- Updating original construction drawings and specifications to reflect any deviation from the original plans and furnishing as-built record drawings and all required quality control documentation.
- Planning and monitoring construction site health and safety procedures.
- Approving shop drawings prior to submission to the CQA Engineer.
- Determining and verifying:
 - field measurement,
 - field construction criteria,
 - catalog numbers and similar data, and

- conformance to Project Plans and Specifications.
- Coordinating each submittal with other submittals and with the requirements of work and of the Project Plans and Specifications
- Notifying the CQA Engineer in writing, at time of submission, of any variance in the submittals from the requirements of the Project Plans and Specifications. Any such deviations permitted by the Design Engineer will require modifications to the Project Plans and Specifications.

2.5.2 Site Supervisor

The Construction Contractor will be represented in the field by a Site Supervisor. The Site Supervisor is responsible for the following:

- Scheduling and coordinating work including subcontractors.
- Informing the CQA Inspector and CQA Engineer of any discrepancies between the Project Plans and Specifications and field conditions.
- Coordinating with the CQA Inspector and CQA Engineer.
- Attending project meetings.
- Maintaining a daily log of construction and quality control activities.
- Implementing and verifying CQC procedures.
- Submitting proposed alternative materials or construction methods for approval before acquisition and use.
- Construction.

2.5.3 Geomembrane Installation Contractor (Geomembrane Installer)

The Geomembrane Installer may be a general contractor or a subcontractor to the general construction contractor. The Geomembrane Installer has not been chosen at this time. The selected contractor will have experience in installing at least 10 million square feet of geosynthetics.

The Geomembrane Installer or their CQC Consultant will be responsible for the following:

- Coordinating with the general contractor and CQA Inspector.
- Handling, storing, placing, and installing manufactured materials.
- Implementing and verifying a manufacturer and installer QC plan.
- Geomembrane Installer Personnel Qualifications:
- Installation Superintendent shall have worked in a similar capacity on at least five geomembrane liner jobs similar in size and complexity to the project described in the Contract Documents.

- The Master Welder shall have completed a minimum of 5,000,000 square feet of geomembrane seaming work using the type of seaming apparatus proposed for use on this Project.
- Other welders shall have seamed a minimum of 1,000,000 square feet geomembrane.

2.5.4 Driven Vinyl Sheet Pile Installation Contractor (Sheet Pile Installer)

The sheet pile installer may be a general contractor or a subcontractor to the general construction contractor. The Sheet pile Installer has not been chosen at this time. The selected contractor will have experience installing vinyl sheet piles on at a minimum of three other projects.

The Sheet Pile Installer or their CQC Consultant will be responsible for the following:

- Coordinating with the general contractor and CQA Inspector.
- Handling, storing, placing, and installing manufactured materials.
- Implementing and verifying a manufacturer and installer QC plan.

Sheet Piling Installer Personnel Qualifications:

- Installation Superintendent shall have worked in a similar capacity on at least three vinyl sheet piling jobs similar in size and complexity to the project described in the Contract Documents.

**SECTION 3.0
SOIL COVER**

This section contains procedures and tests, which must be implemented in order to ensure the soil components of the intermediate and final cover systems, as well as the barrier layer, meet the design standards. This is a critical component of the Construction Quality Assurance Plan. All required tests and sampling procedures within this section shall be performed in accordance with generally accepted engineering procedures. Table 3-1 contains a listing of applicable test procedure standards for the intermediate and protective cover soils.

3.1 INTERMEDIATE SOIL COVER

Intermediate soil cover, as referred to in this CQA Plan, includes the 18-inch compacted cover soil layer for the intermediate cover system and the 12-inch cover soil layer required beneath the LLDPE geomembrane liner of the final cover system and beneath the HDPE geomembrane liner of the barrier layer.

3.1.1 Preconstruction

Soil materials to be used as intermediate cover shall consist of select borrow material meeting all requirements specified in Specification Section 02200 - Earthwork: Landfills. The borrow material for intermediate cover must be of approved regular on-site borrow or borrow excavation unless otherwise specified or noted on drawings. For all other soils from an off-site location, Contractor must submit the source test data to the CQA Inspector for approval a minimum of 48 hours prior to intended use.

**Table 3-1
Intermediate and Protective Cover Test Procedure Standards**

Standard	Test Description
ASTM D422	Method for Particle-Size Analysis of Soils
ASTM D698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft ²)
ASTM D2922	Test Methods for Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)
ASTM D2487	Test Method for Classification of Soils for Engineering Purposes (United Soil Classification System)
ASTM D2488	Practice for Description and Identification of Soils (Visual-Manual Procedure)
ASTM D3017	Test Method for Water Content of Soil and Rock In-Place by Nuclear Methods (Shallow Depth)
ASTM D2216	Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
ASTM D2937	Test Method for Density of In-Place Soils by Drive-Cylinder Method

Soil for the intermediate cover should be free of deleterious material (organics, sticks, roots, waste, etc.) and rock fragments, boulders or cobbles greater than ½ inch in size. Fines content of installed soil shall be a maximum of 50% (passing #200 sieve) and monitored as specified in the Project Plans and Specifications. Soil shall classify as SP, SW, SC, SM, SP-SM, or SP-SC in accordance with ASTM D2487 or ASTM D2488.

The intermediate cover layer shall be placed and compacted in accordance with specification section 02200 - Earthwork: Landfills. The CQA Inspector shall test materials and monitor compliance with requirements of the Project Plans and Specifications at the frequencies listed in Table 3-2. All observations and tests shall be conducted at locations selected by the CQA Inspector who has been assigned responsibility for verification and documentation of the element in question.

3.1.2 Construction

The following is an outline of the minimum construction requirements for the intermediate cover. For more detailed information, see the specification Sections 02200-Earthwork: Landfills, 02775-LLDPE Geomembrane Liner System, and 02776-HDPE Geomembrane Liner System.

- Strip vegetation from existing cover soils where present and dispose at a location designated by Owner.
- Verify that a minimum of 18 inches (intermediate cover system) or 12 inches (final cover system and barrier layer) of cover soils exist after stripping operations. Add additional soil as needed to fill surface depressions and achieve the minimum thickness required. Surface shall be smooth without irregularities unless shown on the drawings.
- Obtain approval from CQA Inspector with regard to suitability of soils and acceptable subgrade.
- Atmospheric conditions observed and recorded by the CQA Inspector and appropriate actions taken when unsuitable weather conditions exist.
- Dust control continuous throughout the intermediate cover operations.
- Verify grade control is established to control thickness of material placed.
- Verify final grading completed in accordance with specification Section 02200 – Earthwork: Landfills.
- Intermediate cover compacted to specified requirements provided in Section 02200.
- Surface of intermediate cover soils proof-rolled in accordance with technical specification Section 02200.
- Verify minimum thickness of the soils and geomembrane materials is achieved in accordance with the specifications.

- Provide as built survey of intermediate cover sealed by a professional land surveyor illustrating construction of all design features.
- Approval from CQA Inspector with regard to final surface smoothness and uniformity. Any objects protruding from the final surface or coarse fragments within the surface material that may damage the geomembrane will be removed.
- The required thickness of intermediate cover will be verified, as described in Specification 02200 – Earthwork: Landfills, on an established 50 feet x 50 feet grid system.
- Place topsoil over intermediate cover system only in accordance with Specification 02260 – Topsoiling and Finished Grading.

**Table 3-2
Intermediate Cover Conformance and Construction Testing**

Test Description	Standard	Test Frequency
Intermediate Cover		
Density, Nuclear Method	ASTM D2922	One per 1,000 yd ³
Moisture Content, Nuclear Method	ASTM D3017	One per 1,000 yd ³
Sand Cone or Drive Cylinder Method	ASTM D2937	One per 2 nuclear tests
Oven Moisture Content Verification	ASTM D2216	One per 2 nuclear tests
Moisture Density Relations	ASTM D698	One per 2,000 yd ³ *
Sieve Analysis	ASTM D422	One per 2,000 yd ³ *

* Increase frequency as needed to ensure each soil type is tested.

3.2 PROTECTIVE COVER

3.2.1 Preconstruction

Soil materials to be used as the 24-inch thick protective cover over the LLDPE geomembrane final cover system (including 6-inch thick topsoil cover) and the 12-inch thick protective cover over the HDPE geomembrane barrier layer shall consist of select borrow material meeting all requirements specified in Specification Section 02200 - Earthwork: Landfills. The borrow material for protective cover must be of approved regular on-site borrow or borrow excavation unless otherwise specified or noted on the drawings. If cover soil comes from off-site location, the Contractor must submit the source test data to the CQA Inspector for approval a minimum of 48 hours prior to intended use.

Soil for the bottom 18 inches of protective cover for the final cover system and the full 12 inches over the barrier layer should be free from deleterious material (organics, sticks, roots, etc.) and rock fragments, boulders or cobbles greater than ½ inch in size. The upper 6 inches of protective cover for the final cover system shall meet the same criteria except that the soil shall contain sufficient organics to promote vegetative growth.

The protective cover layer shall be placed and compacted in accordance with the specification Section 02200 – Earthwork: Landfills. The CQA Inspector will observe that placement of the soil material is done in a manner to protect the underlying geosynthetics. The CQA Inspector shall test materials and monitor compliance with requirements of the Project Plans and Specifications at the frequencies listed in Table 3-3. All observations and tests shall be conducted at locations selected by the CQA Inspector who has been assigned responsibility for verification and documentation of the element in question.

**Table 3-3
Protective Cover Conformance and Construction Testing**

Test Description	Standard	Test Frequency
Protective Cover		
Density, Nuclear Method	ASTM D2922	One per 1,000 yd ³
Moisture Content, Nuclear Method	ASTM D3017	One per 1,000 yd ³
Sand Cone or Drive Cylinder Method	ASTM D2937	One per 2 nuclear tests
Oven Moisture Content Verification	ASTM D2216	One per 2 nuclear tests
Moisture Density Relations	ASTM D698	One per 2,000 yd ³ *
Sieve Analysis	ASTM D422	One per 2,000 yd ³ *

* Increase frequency as needed to ensure each soil type is tested

Note: Testing is not required for topsoil layer

3.2.2 Construction

Protective cover should be stable for construction and maintenance traffic. Care will be exercised in placement so as not to shift, wrinkle or damage the underlying geosynthetic layers, and the placement methods will be documented by the Contractor and CQA Inspector.

The protective cover shall be placed under the direct supervision of the CQA Inspector. The Contractor shall utilize care to avoid damage to the geocomposite. No vehicular traffic will be permitted on the unprotected liner system except low ground pressure equipment necessary for the deployment and installation of liner system. The loose thickness of the initial lift of protective cover shall not be less than 12 inches and shall be spread with low ground pressure equipment (maximum pressure 10psi). Fill shall be placed by equipment starting at the toe of

slope and spreading toward the top of slope. Material shall not be placed over standing water or ice.

The following is an outline of the minimum construction requirements for the protective cover. For more detailed information, see specification section 02200 – Earthwork: Landfills:

- Approval from CQA Inspector with regard to suitability of soils.
- Atmospheric conditions observed and recorded by the CQA Inspector and appropriate actions taken when unsuitable weather conditions exist.
- Dust control continuous throughout protective cover operations.
- Verify the underlying geosynthetics construction is complete before material installation.
- Verify grade control is established to control thickness of material placed.
- For placement of material over geosynthetics, monitor 12-inch minimum thickness of material below spreading equipment and the spreading equipment has a ground pressure rating equal to or less than 10 psi. During placement of material, identify geosynthetics damaged during material installation and establish that the damage is repaired.
- Monitor haul road thickness over geosynthetics and verify that equipment hauling and placing material over geosynthetics meets equipment specifications.
- Monitor placement of material over piping and verify that pipe is not damaged by occasionally uncovering piping.
- Monitor equipment speed over material.
- Verify protective cover compacted to specified requirements. Do not compact topsoil layer of final cover system beyond tracking it in.
- Verify final grading completed in accordance with specification section 02200 – Earthwork: Landfills.
- Verify minimum thickness is achieved in accordance with specifications (final cover system only).
- Install sod in accordance with specifications (final cover system only).
- Approval from CQA Inspector with regard to final surface smoothness and uniformity.
- Provide as-built survey of protective cover sealed by a professional land surveyor illustrating construction of all design features.

The required thickness of protective cover will be verified, as described in Specification 02200 – Earthwork: Landfills, on an established 50 feet x 50 feet grid system.

SECTION 4.0

GEOMEMBRANE LINER

This section covers the work necessary to construct and test the geomembrane lining system, which will consist of a 40 mil Linear Low Density Polyethylene (LLDPE) liner material in accordance with specification Section 02775 - LLDPE Geomembrane Liner System and a 60 mil High Density Polyethylene (HDPE) liner material in accordance with specification Section 02776 – HDPE Geomembrane Liner System. The geomembrane material and installation will be in accordance with specification Sections 02775 and 02776. The LLDPE and HDPE liner material shall be new, first quality products designed and manufactured specifically for the purposes of the Work and shall have satisfactorily demonstrated, by prior use, to be suitable and durable for such purposes. All LLDPE and HDPE geomembranes will be textured on both sides and shall be an unmodified LLDPE and HDPE containing no plasticizers, fillers, chemical additives, or extenders. The only other compound ingredients to be added to the LLDPE and HDPE geomembrane resin shall be anti-oxidants and heat stabilizers required for manufacturing. The LLDPE and HDPE geomembranes shall be supplied as a single ply continuous sheet with no factory seams and in rolls with a minimum width of 22 feet. The roll length shall be maximized to provide the largest manageable sheet for the fewest field seams.

Extrusion resin used for fusion welding with extrudate to make field seams between geomembrane sheets and for repairs shall be produced from, and the same as, the geomembrane sheet resin. Physical properties shall be the same as the geomembrane sheets.

The LLDPE geomembrane liner shall conform to the testing requirements of GRI Standard GM17 - “Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes” (Geosynthetic Research Institute; Philadelphia, PA).

The HDPE geomembrane liner shall conform to the testing requirements of GRI Standard GM13 - “Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes” (Geosynthetic Research Institute; Philadelphia, PA).

4.1 PRECONSTRUCTION

4.1.1 Certification of CQA Plan Conformance

Prior to start of work, the Geosynthetics Manufacturer and the Geomembrane Installer, each, shall submit for approval by the CQA Inspector documented evidence of its ability and capacity to perform this Work. Each shall have successfully manufactured and/or installed a minimum of ten (10) million square feet of similar lining material in solid waste containment structures.

The Contractor shall submit written certification by the Geosynthetics Manufacturer that the lining materials conform to the requirements of the CQA Plan. The Contractor shall submit the

name and qualifications of its project superintendent that will be on the project whenever lining materials are being handled and/or installed plus the names and qualifications of senior installation personnel on the project. All manufacturer and Geomembrane Installer qualifications shall be submitted in accordance with technical specification Sections 02775 and 02776.

4.1.2 Geomembrane Installer’s and Manufacturer’s QC Program

The Geosynthetics Manufacturer and the Geomembrane Installer, each, shall submit a complete description of its quality control (QC) program, as applicable, for manufacturing, handling, installing, testing, repairing and providing a completed lining in accordance with requirements of the CQA Plan and contract documents. The description shall include, but not be limited to, polymer resin supplier, product identification, acceptance testing, fabrication and production testing, installation testing, documentation of changes, alterations and repairs, retests and acceptance.

Table 4-1 lists the quality control tests to be performed on the geomembrane by the manufacturer and the results submitted to the CQA Engineer for review.

**Table 4-1
MQC Conformance Testing for LLDPE and HDPE Geomembranes**

Standard	Test Description	Frequency of Testing
ASTM D6693, Type IV, 2 ipm	Standard Test Method for Determining Tensile Properties of Non-reinforced Polypropylene and Non-reinforced Flexible Polypropylene Geomembranes	Every 20,000 lbs
ASTM D1004	Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting	Every 45,000 lbs
ASTM D1505/D792	Standard Test Method for Density of Plastics by the Density-Gradient Technique	Every 200,000 lbs
ASTM D1238	Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer	One per rail car compartment
ASTM D1603	Standard Test Method for Carbon Black Content in Olefin Plastics	Every 20,000 lbs
ASTM D3895	Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry	Every 200,000 lbs
ASTM D4833	Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products	Every 45,000 lbs
ASTM D5596	Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics	Every 45,000 lbs
ASTM D5994 ¹	Standard Test Method for Measuring Core Thickness of Textured Geomembrane	Every roll
GRI GM12	Asperity Height	Every other roll

1. Textured Geomembrane Only.

4.1.3 Geomembrane Installer's Installation Plan

The Installer shall submit installation drawings, the Manufacturer's written Field Installation Procedure Manual, and a schedule for performing/completing the Work. Installation drawings shall show a lining sheet layout with proposed size, number, position, and sequence of placing of all sheets and indicating the location of all field seams. Installation drawings shall also show complete details and/or methods for anchoring the lining at its perimeter, making field seams, and making anchors/seals to pipes and structures.

The Installer shall submit a complete description of welding procedures for making field seams and repairs. The welding procedures shall conform to the latest procedures recommended by the lining Manufacturer.

The Contractor and Geomembrane Installer shall submit for approval, by the CQA Inspector, certification that the surface(s) on which the lining will be placed is acceptable. Installation of the lining shall not commence until this certification is furnished to the CQA Inspector and approved by the Engineer and Owner.

The Geomembrane Installer shall provide on-site technical supervision and assistance at all times during installation of the lining system. The Geomembrane Installer and Contractor, as applicable to each, shall submit for approval by the CQA Inspector written certification that the lining system was installed in accordance with the Manufacturer's recommendation, the CQA Plan, Project Plans, Specification Section 02775 or 02776, and approved submittals.

The CQA Engineer will initiate a pre-installation meeting with the Geomembrane Installer, Contractor, and CQA Inspector prior to installation of the lining system. Topics for review/discussion shall include, as a minimum, Project Plans and Specifications, approved submittals, and training and qualification procedures for Contractor personnel.

Prior to installation of the lining system, the Geomembrane Installer shall instruct the workmen of the hazards of installation, such as handling sheets of lining material in high winds; use of equipment; application of solvents, adhesives and caulks; and walking on lining surfaces. Work gloves, safety glasses, hard hats, high-visibility vests, and smooth-soled shoes are minimum safety wear requirements when working on the geomembrane. Safety shoes must be worn when handling heavy objects. High-visibility vests shall be worn at all times when on the project site.

The Owner shall have authority to order an immediate stoppage of work because of improper installation procedures, safety infractions, or for any reason which may result in a defective liner.

4.1.4 Contractor's Geomembrane Preconstruction Material Submittals

The Contractor will provide the CQA organization with the following items for review and testing:

- Results of interface friction testing for the LLDPE geomembrane proposed for the project as outlined in this CQA Plan.
- Manufacturer’s description (cut sheet) of the proposed geomembrane documenting it will meet or exceed specified requirements.
- Available historical data documenting that the proposed geomembrane will meet specified interface friction angle.
- Written instructions for storage, handling, installation, seaming, and repair of the proposed geomembrane consistent with the technical specifications, project plans, and the manufacturer’s recommendations.

Before shipment of the geomembrane, the CQA organization shall review all approved pre-construction submittals. Pre-construction submittals should be submitted a minimum of four weeks in advance to allow time for review and approval by the CQA organization.

The Contractor shall submit certifications that the LLDPE and HDPE geomembrane material delivered to the site meets the requirements of the Specification and that the LLDPE and HDPE geomembrane was received and accepted in undamaged condition from shipper.

4.1.5 CQA Conformance Testing

The geomembrane material will be sampled at the site by the CQA Inspector or at the manufacturing plant by a third party under the direction of the CQA organization. The sample will be taken across the entire roll width and will be 3 feet long. Samplers will mark the machine direction and the manufacturer’s roll identification number on the sample. Samplers will also assign a conformance test number to the sample and mark the sample with that number. The samples will be forwarded to a CQA testing laboratory for the conformance testing. The CQA Inspector will review all conformance test results and report any nonconformance to the Owner and CQA Engineer.

The following conformance tests will be performed on the LLDPE and HDPE geomembrane at the frequencies indicated in Table 4-2 (conformance testing frequency to be performed for both the LLDPE and the HDPE geomembrane).

**Table 4-2
CQA Conformance Testing for LLDPE Geomembranes**

Standard	Test Description	Frequency of Testing
ASTM D6693	Standard Test Method for Determining Tensile Properties of Non-reinforced Polypropylene and Non-reinforced Flexible Polypropylene Geomembranes	Every 20,000 lbs
ASTM D6392	Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.	Every 500 LF of seam

Standard	Test Description	Frequency of Testing
ASTM D5321	Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method (LLDPE Only)	One per project

Laboratory interface friction tests shall be conducted in general accordance with ASTM D5321, on the following interfaces:

- Textured LLDPE liner and geocomposite
- Textured LLDPE liner and intermediate cover soil

The CQA Laboratory will perform three (3) direct shear tests at the project specific effective normal stresses. These tests will be performed using the Contractor's proposed geosynthetic materials for above interfaces following award of the construction contract to the selected Contractor. Samples of intermediate cover soil and protective cover soil (if different than the intermediate cover soil material) proposed for the project will also be obtained for testing. A minimum interface friction angle based on the design will be required to maintain stability. The project specific testing parameters for direct shear testing, including the effective normal stresses and minimum required interface friction angles, for the LLDPE materials are provided in technical specification Section 02775-2.3.

The Owner will pay for “Passing” tests. Costs of corrective action, costs of “Failing” tests and all associated costs of testing due to failing tests will be paid by the Owner and the cost reimbursed to the Owner by the Contractor. Materials not meeting the required shear strength will not be approved for use on this project.

4.2 CONSTRUCTION

4.2.1 Delivery, Storage and Handling

Materials will be delivered to the site after the required submittals have been furnished and approved. The delivered roll goods will be marked by the manufacturer to show at a minimum the following information:

- Name of manufacturer.
- Product type.
- Product thickness.
- Manufacturing batch code.
- Date of manufacture.
- Physical dimensions.
- Roll number.

Lining materials delivered to the site shall be inspected for damage, unloaded, and stored with a minimum of handling. Each roll shall be wrapped in an opaque and waterproof layer of plastic during shipment and storage. The plastic wrap shall not be removed until deployment. Materials shall not be stored directly on the ground. The storage area shall be such that all materials are protected from mud, soil, dirt and debris. The stacking of lining shall not be higher than two rolls.

Under no circumstances shall the lining be subjected to materials, sandbags, equipment or other items being dragged across its surface. Nor shall workmen and others slide down slopes atop the lining. All scuffed surfaces resulting from abuse of any kind caused by the Contractor in performance of the Work shall be repaired at the CQA Inspector's direction.

Geomembrane or plastic wrapping damaged as a result of storage or handling shall be repaired or replaced, as directed. Geomembrane shall not be exposed to temperatures in excess of 60°C (140°F) or less if recommended by the Manufacturer.

No hooks, tongs or other sharp instruments shall be used for handling the geomembrane. Rolls shall not be lifted by use of cables or chains in contact with the geomembrane. The geomembrane shall not be dragged along the ground.

The Contractor shall be completely responsible for shipping, storage, handling, and installation of all lining materials in compliance with the CQA Plan.

4.2.2 Geomembrane Subsurface Preparation

Before geomembrane installation, the CQA Inspector will document that the intermediate cover installation is complete and CQC and CQA documentation verifies that subsurface has been prepared in accordance with specification Section 02775 or 02776.

4.2.3 Geomembrane Placement and Seaming

Prior to installation of the geomembrane, a site inspection will be conducted by the CQA Inspector and the Contractor to verify measurements, structures and surface conditions to support the geomembrane.

The Contractor and Geomembrane Installer will provide written documentation to the CQA Inspector that surfaces to receive the geomembrane have been inspected and are acceptable for installation of the lining.

Before the work begins, the Contractor will inspect all lining materials for damage from transit. Materials that cannot be repaired will be rejected and removed from the work area and site.

During unwrapping of lining materials for use and placement, the Contractor will visually inspect all materials, particularly surfaces of lining sheets, for imperfections and faulty areas. All such defective places will be marked and repaired in accordance with approved methods.

The geomembrane will be installed as shown on the project plans and approved installation drawings. Placement of the geomembrane will be done such that good fit, without bridging, is provided on all covers and grade changes. Excessive slack will be avoided to minimize rippling during the soil cover operation. Geomembrane liner shall be handled and placed in a manner which minimizes wrinkles, scratches and crimps.

Sheets of geomembrane materials will be of lengths and widths and will be placed in a manner as to reduce field seaming to a minimum. The lining will be anchored in accordance with details shown on approved plans and drawings. The lining will be anchored and sealed to structures, pipes and other types of penetrations, (if any), in accordance with details shown on approved plans and drawings. All changes in approved installation drawings and procedures must be approved by the Design Engineer.

Extreme care will be taken during installation of the lining to be certain no damage is done to any part of the lining. Dragging of the geomembrane material on the prepared subgrade will be prohibited. Smoking will be prohibited for all personnel. All handling and installation procedures will be performed by workers wearing shoes with smooth soles. Shoes with soles that have patterns in relief shall be prohibited. No foot traffic will be allowed on the geomembrane except with approved shoes. No vehicular traffic will be allowed on the geomembrane except low ground pressure equipment necessary for the deployment and installation of the lining system. All motor driven equipment using fuel will have spark arrestors. No gasoline driven generators or cans of gas or solvent will be placed directly on the lining material. Under no circumstances will the lining be used as a work area to prepare patches or to store tools and supplies. If needed, a tarpaulin of approved material will be spread out as a work area.

During installation, the Contractor will be responsible for protecting the lining against adverse effects of high winds such as uplift. Sand bags will be used as required to hold the lining material in position during installation. Sand bags will be sufficiently close-knit to preclude fines from working through the bottom, sides or seams. Paper bags, whether or not lined with plastic, will not be permitted. Burlap bags, if used, must be lined with plastic. Bags that are split, torn, or otherwise losing their contents will be immediately removed from the work area and any spills immediately cleaned up. Metal or wire ties will not be used.

The geomembrane material will not be installed under adverse climatic conditions, unless the Contractor can demonstrate that his installation techniques adequately compensate for such adverse conditions and quality of workmanship is not compromised. Adverse climatic conditions occur when the air temperature measured 6 inches above the geomembrane surface is less than 41°F and decreasing, or more than 104°F; when it is raining; or when there is frost on the ground; or during conditions of excessive winds.

Geomembrane field seams will be lap seams as indicated in the specifications. The lap seams will be formed by lapping the edges of geomembrane sheets a minimum of 3 inches unless otherwise specified in the approved plans and drawings. The contact surfaces of the sheets will be wiped clean to remove dirt, dust, moisture, and other foreign materials. Geomembrane shall not be welded when ambient temperatures are below 41°F or above 104°F without written consent of manufacturer and CQA Engineer or CQA Inspector. For fillet weld seams, bevel edge of geomembrane and clean oxidation from surfaces to receive extrudate by disk grinding or equivalent not more than one hour before seaming.

Lap seam intersections involving more than three thicknesses of lining material will be avoided, and all seam intersections will be offset at least 2 feet. No horizontal field seams will be allowed on the slope and sheets of lining material on the slopes will extend down slope to the perimeter anchor trench as shown on the drawings. Welds connecting downslope sheets shall be double wedge welds, and shall have a minimum of 10 feet vertical offset between adjacent panel welds. Wedge welds shall have a minimum of 3 inch overlap.

Geomembrane liners shall be welded using extrusion or double wedge welding equipment. Extrusion welding equipment shall be provided with thermocouples and temperature readout devices which continuously monitor the temperature of the extrudate. Wedge welding equipment shall be provided with thermocouples and temperature readout devices which continuously monitor the temperature of the wedge. Geomembrane liners shall be welded continuously without fishmouths or breaks in the weld. Where fishmouths are unavoidable, the geomembrane sheet shall be slit to a point such that the sheet lies flat and with no remaining wrinkle. The two edges of the slit shall be welded together provided that the overlap for this weld shall be a minimum of 6 inches. Areas of the slit that do not achieve an overlap of 6 inches, including the terminus of the slit, shall be provided with a patch.

Any necessary repairs to the geomembrane will be made with the lining material itself, using approved welding systems, equipment and techniques. The patch size will be 6 inches larger in all directions than the area to be patched. All corners of the patch will be rounded. Torn or permanently twisted geomembrane shall be replaced at no expense to the County.

All seams and seals of the geomembrane will be tightly bonded on completion of the work. Any lining surface showing injury due to scuffing or penetration by foreign objects or showing distress will be replaced or repaired as directed by the CQA Inspector.

Cleanup within the work area will be an ongoing responsibility of the Contractor. Particular care will be taken to insure that no trash, tools, and other unwanted materials are trapped beneath the lining. Care will be taken to insure that all scraps of lining material are removed from the work area prior to completion of the installation.

4.2.4 Field Quality Control

Inspection and testing will involve the full time observation of the installation of the geomembrane, including the making and testing of lining seams and patches and periodic measurement of the liner material thickness to insure compliance.

Test welds will be made to verify that adequate conditions exist for field seaming to proceed. Each seamer and seaming equipment will produce a test seam at the beginning of each shift to determine the peel and tensile strength of the seam. The CQA Inspector may require a sample field seam be made at any time during seaming production to verify equipment/operator performance and seam integrity. In addition, if a seaming operation has been suspended for more than 1/2 hour or if a breakdown of the seaming equipment occurs, a test seam will be produced prior to resumption of seaming operations.

The trial weld sample must be a minimum of three feet long and one and a half feet wide, with the seam centered lengthwise. The CQA Inspector must observe all trial welding operations, quantitatively test each trial weld for peel and shear, and record the results. A minimum of two peel and two shear tests will be performed per trial seam. The trial weld shall be completed under the same conditions for which the panels will be welded. The trial weld must meet the requirements for peel and shear as stated in the following paragraph and the break must be a film tear bond (FTB) for a wedge weld.

During the field seaming operation, destructive samples will be removed from field seams by the Installer at locations selected by the CQA Inspector. Repairs to the field seams will be made in accordance with repair procedures specified in this CQA Plan. The samples will have a width of 12 inches plus the seam width and length of 48 inches. A minimum of one stratified sample per 500 feet of field seam will be made. All field test specimens will have a film tear bond in peel and shear and will meet the minimum pound per inch width seam strength specified in the specification Section 02775 - LLDPE Geomembrane Liner System and Section 02776 - HDPE Geomembrane Liner System. The bonded shear strength for fusion and extrusion welds must be greater than or equal to the appropriate values shown in the specifications. A sufficient amount of the seam must be removed in order to conduct field testing, independent laboratory testing, and archiving of enough material in order to retest the seam when necessary. The archived material will be kept at the CQA laboratory. Field testing shall include at least two peel tests and two shear tests per sample. CQA laboratory testing shall consist of five shear tests and five peel tests per sample. Destructive seam-testing locations shall be cap-stripped and the cap completely seamed by extrusion welding to the geomembrane. Capped sections shall be non-destructively tested. Additional destructive test samples may be taken if deemed necessary by the CQA Inspector.

All field-tested specimens from a destructive-test location must be passing in both shear and peel for the seam to be considered as passing. Passing results, as specified in technical specification Sections 02775 and 02776, for both peel and shear for the seam must be received from the CQA laboratory to confirm the field testing and to accept the seam. The CQA testing laboratory will save all test samples including specimens tested until notified by the CQA Engineer relative to their disposal. All specimens which have failed under test will be shipped immediately by express delivery to the CQA Inspector for determination of corrective measures to be taken, which includes retest or repair of failed section.

For destructive samples which have failed the passing criterion, the Installer will reconstruct all the field seams between any two previous passed seam locations which include the failed seam or will go on both sides of the failed seam location (10 feet minimum), take another sample each side and test both. If both pass, the Installer may patch or cap strip the seam between the passed samples. If either fails, the Installer will remove and replace the entire seam. In all cases, acceptable field seams must be bounded by two passed test locations. The decision of the CQA Engineer will be final.

The Installer shall test all patch welds using one of the following nondestructive tests: vacuum tests or spark tests.

In the event capping of a field seam is required, the Installer will use a cover strip of the same thickness as the lining (and from the same roll, if available) and a minimum of 6 inch overlap away from the seam in all direction. It will be positioned over the center of the field seam and welded to the lining using a fillet weld each side.

All geomembrane sheets, seams, anchors, seals, and repairs will be visually inspected by the Installer for defects. Depending on seam welding equipment used, all seams and repairs will be tested continuously by a vacuum testing device, air pressure, or spark tests.

A visual inspection of the lining sheets, seams, anchors and seals will be made by the Installer and CQA Inspector as the installation progresses and again on completion of the installation. Defective and questionable areas will be clearly marked and repaired. Final approval of repairs will be given by the CQA Inspector.

If the extrusion lap weld is used to weld seams, the Installer will further test all seams and repairs in the geomembrane by vacuum box. All vacuum box testing will be done in the presence of the CQA Inspector. The area to be tested will be cleaned of all dust, debris, dirt and other foreign matter. A soap solution will be applied to the test area with a paint roller and the vacuum of 5 psi air pressure will be induced and held at least ten seconds to mark for repair any suspicious areas as evidenced by bubbles in the soap solution.

If the double hot-wedge is used, the Installer will further test all seams in the geomembrane by using the air pressure test which consists of inserting a needle with gauge in the air space between welds. Air will be pumped into space at a pressure and held for a time as indicated in the specifications. If pressure does not drop more than the amount allowed in the specifications, then the seam is acceptable.

All costs of retesting of the geomembrane including reruns of field weld tests and all repairs will be at the Installer's expense.

The Installer shall assemble the quality control data required above into a final report of geomembrane installation. The report will contain all test data and a final layout of geomembrane liner which shows the location of all seams, patches and sample locations. In addition, the Installer shall submit resin tests, tests of sheet material, factory seam tests, daily seam test results, and daily results of production seam testing.

The Contractor will retain responsibility for the integrity of the geomembrane system until acceptance by the CQA Engineer. The geomembrane will be accepted by the CQA Engineer when:

- Written certification letters including as built record drawings, have been received by the CQA Engineer.
- Installation is completed.
- Documentation of completed installation, including all reports, is received and approved.
- Verification of adequacy of field seams and repairs, including associated testing, is complete.

Acceptance of the completed work will include receipt of all submittals and all work completed to the satisfaction of the CQA Engineer.

4.2.5 Geosynthetics Manufacturer's Warranty

The Geosynthetics Manufacturer's warranty shall be against manufacturing defects or workmanship and against deterioration due to ozone, ultraviolet or other normal weather aging. The warranty shall be limited to replacement of material only, and shall not cover installation of said material. It shall not cover damage due to vandalism, acts of animals or unusual acts of God. The warranty shall state that the furnished material meets all requirements of specification Section 02775 or specification Section 02776, and the Contract Documents, is free from manufacturing defects and is able to withstand normal weathering for a period of five years, prorated. Written warranties addressing the LLDPE and HDPE geomembrane material shall be furnished by the contractor and shall be made to Hillsborough County.

4.2.6 Installer's Warranty

The Installer shall furnish a written guarantee that the entire lining work constructed by him to be free of defects in material and workmanship and installed pursuant to the CQA Plan for a period of two (2) years following the date of acceptance of the work by the CQA Engineer. The Installer shall agree to make any repairs or replacements made necessary by defects in materials or workmanship in the Work which become evident within said guarantee period. The Installer shall make repairs and/or replacements promptly, the Owner may do so, and the Installer shall be liable to the Owner for the cost of such repairs and/or replacements. The Installer's warranty shall state that the materials were properly installed, properly welded, seamed and jointed and will not fail within 2 years of installation under similar conditions. The warranty shall provide for complete repair/replacement for the warranty period. Written warranties addressing the LLDPE and HDPE geomembrane material shall be furnished by the contractor and shall be made to Hillsborough County.

**SECTION 5.0
GEOCOMPOSITE**

The following section outlines the CQA required for the installation of the double-sided geocomposite. The double-sided geocomposite will be used as the drainage layer of the final cover system.

5.1 PRECONSTRUCTION

All HDPE drainage composite shall be manufactured in accordance with specification Section 02777 - Drainage Composite Final Cover. The drainage composite manufacturer will provide the Contractor and the CQA Inspector with a written certification, signed by a responsible party, that the drainage composites actually delivered have properties which meet or exceed the guaranteed properties. The CQA Inspector will examine all manufacturers' certifications to ensure that the property values listed on the certifications meet or exceed the project specifications. Any deviations will be reported to the CQA Engineer.

5.1.1 Manufacturer's Quality Control

Before scheduled manufacturing of the product, the Geosynthetics Manufacturer will provide the CQA organization with the following items for review and testing:

- Manufacturer's description (cut sheet) of the proposed geocomposites documenting that it will meet or exceed specified requirements.
- Available historical data documenting that the proposed geocomposites will meet specified interface residual strength.
- Written instructions for storage, handling, installation, seaming, and repair of the proposed geocomposites.

Before shipment of the geocomposite, the CQA organization will review pre-construction submittals.

Table 5-1 lists the quality control tests to be performed on the Geonet, Geotextile and Geocomposite by the manufacturer and the results submitted to the CQA Engineer for review.

**Table 5-1
Manufacturer's Quality Control Testing for Geonet/Geotextile/Geocomposite**

Material	Type of Test	Standard Test Method	Frequency of Testing
Geonet	Specific Gravity/Density (g/cm ³) (min)	ASTM D 1505	One per 50,000 ft ² and every resin lot
	Thickness (mil)	ASTM D 5199	One per 50,000 ft ² and every resin lot
	Carbon Black Content (% Minimum)	ASTM D 1603	One per 50,000 ft ² and every resin lot
	Tensile Strength (MD), (lb/in)	ASTM D 5035	One per 50,000 ft ² and every resin lot
Geotextile	Mass per Unit Area, (oz/sy)	ASTM D5261	One per 50,000 ft ²
	Grab Tensile Strength (lbs)	ASTM D4632	One per 50,000 ft ²

Material	Type of Test	Standard Test Method	Frequency of Testing
	Puncture Strength (lbs)	ASTM D4833	One per 50,000 ft ²
	AOS, US sieve (mm)	ASTM D4751	One per 100,000 ft ²
	Permittivity, (sec ⁻¹)	ASTM D4491	One per 100,000 ft ²
	Flow Rate, gpm/ft ²	ASTM D4491	One per 100,000 ft ²
	UV Resistance ⁽²⁾	ASTM D7238	One per formulation
Geocomposite	Transmissivity ¹ (m ² /sec)	ASTM D4716	One per 50,000 ft ²
	Ply adhesion (lb/ft ²)	ASTM D7005	One per 50,000 ft ²

1. This is an index transmissivity value measured at stress = 1,000 psf; a gradient = 0.33; time = 100 hours, minimum 1 hour if data equivalent to 100 hours is provided; and boundary conditions = plate/geocomposite/plate.
2. Evaluation to be on 2.0 inch strip tensile specimens after 500 light hours exposure.

5.1.2 CQA Conformance Testing

The CQA Organization will obtain geocomposite conformance test samples of each type of material manufactured for the project. Samples will be obtained across the entire roll width and will be 3 feet long. Samplers will mark the manufacturer's roll identification number, as well as the machine direction, on the sample. Samplers will assign a conformance test number to the sample and mark the sample with that number. Each sample will be sent to the CQA Laboratory for conformance testing. The CQA Inspector will review all test results and report any non-conformance to the CQA Engineer.

Table 5-2 lists the conformance tests to be performed on the geocomposite:

**Table 5-2
CQA Conformance Testing for Geocomposite**

Material	Type of Test	Standard Method	Frequency of Testing
Geocomposite	Transmissivity (m ² /s)*	ASTM D4716	One per 50,000 ft ²
	Ply Adhesion	ASTM D 7005	One per 50,000 ft ²
	Thickness (Geonet Core Only)	ASTM D5199	One per 50,000 ft ²
	Interface Friction	ASTM D5321	One per Project

* See specifications for transmissivity testing criteria.

Laboratory interface friction tests shall be conducted in general accordance with ASTM D5321, on the following interfaces (double-sided geocomposite only):

- Textured LLDPE and geocomposite.
- Geocomposite and protective cover soil.

The CQA Laboratory will perform three (3) direct shear tests at the project specific effective normal stresses. These tests will be performed using the Contractor's proposed LLDPE and a sample of geocomposite obtained from the Geosynthetics Manufacturer following award of the construction contract to the selected Contractor. A sample of protective cover soil proposed for the project will also be obtained for testing. A minimum interface friction angle based on the landfill design will be required to maintain stability.

The Owner will pay for “Passing” tests. Costs of corrective action, costs of “Failing” tests and all associated costs of testing due to failing tests are the sole responsibility of the Contractor. Materials not meeting the required shear strength will not be approved for use on this project.

5.2 CONSTRUCTION

The following subsection describes the CQA inspection activities that are necessary during the geocomposite installation. Refer to the specification Section 02777 - Drainage Composite – Final Cover, for project specific construction and test requirements.

The CQA Inspector shall observe the geocomposite placement to confirm that specifications Section 02777 is followed, including coverage of all specified areas and adequate material overlap or seaming

5.2.1 Delivery, Storage and Handling

During delivery of geocomposite the CQA Inspector will observe rolls for the following, and any deviation will be reported to the CQA Engineer:

- Equipment used to unload the rolls does not damage the material.
- Rolls are wrapped in impermeable and opaque protective covers.
- Care is used to unload the rolls.
- Documentation required by specification Section 02777 - Drainage Composite – Final Cover has been received.
- The drainage composite manufacturer has identified all rolls of drainage composite in accordance with specification Section 02777 - Drainage Composite – Final Cover.

Drainage composite cleanliness is essential to its performance; therefore, the shipping and storage of drainage composite must be in strict accordance with specification Section 02777 - Drainage Composite – Final Cover. The CQA Inspector will verify the following and report any deviations to the CQA Engineer.

- Materials are stored in a location that will protect the rolls from ultraviolet light exposure, precipitation, mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions.

- Drainage composites are free of dirt and dust just before installation. If the drainage composites are judged dirty or dusty, they will be washed by the drainage composite installer prior to installation. Washing operations will be observed by the CQA Inspector and improper washing operations will be reported to the CQA Engineer.
- When several layers of drainage composite are stacked, care is taken to ensure that stacked drainage composites are placed in the same direction. A stacked drainage composite will never be laid in a perpendicular direction to the underlying drainage composite (unless otherwise specified by the CQA Engineer.)

Damaged rolls may be rejected. If rejected, it must be verified that rejected material is removed from the site or stored at a location separate from accepted rolls. Geocomposite rolls that do not have proper manufacturer's documentation must also be stored at a separate location until all documentation has been received and approved.

5.2.2 Geocomposite Subsurface Preparation

Before geocomposite installation, the CQA Inspector will observe for the following:

- Lines and grades for the composite liner subgrade have been verified by the Contractor.
- Geomembrane installation is complete.

5.2.3 Geocomposite Placement and Seaming

During deployment and seaming operations, the CQA Inspector will observe for the following:

- All defects and defect corrective actions (panel rejected, patch installed, etc.) are recorded, and corrective actions are performed in accordance with the specifications.
- Equipment used to install geocomposite does not damage it during deployment.
- Crews working on the geocomposite do not smoke, wear shoes that could damage the geocomposite, or engage in activities that could damage the geocomposite.
- The geocomposite is securely anchored to prevent movement by the wind.
- Adjacent panels are overlapped and connected in accordance with Specification Section 02777 - Drainage Composite – Final Cover.
- The geotextile component is not exposed to direct sunlight for more than the number of days recommended by the manufacturer.

The CQA Inspector will inform both the CQA Engineer and Contractor if they observe any conditions that do not conform to the requirements of the CQA Plan.

5.2.4 Geocomposite Repairs

Repair any holes or tears in the drainage composite by placing a patch of drainage composite extending a minimum of 2 feet beyond the edges of the holes or tear. Use approved fasteners, spaced every 6 inches around the patch to fasten the patch to the original roll.

5.2.5 Placement of Soil Materials

All soil material placed over the drainage composite will be placed in accordance with specification Section 02200 – Earthwork: Landfills, so as to ensure the following:

- The drainage composite and underlying geomembrane are not damaged.
- Minimal slippage of the drainage composite on the underlying geomembrane occurs.
- No excess tensile stresses occur in the drainage composite.

The CQA Inspector will inform both the CQA Engineer and Contractor if they observe any conditions that do not conform to the requirements of the CQA Plan.

SECTION 6.0
SHEET PILE

The following section outlines the CQA required for the installation of the driven vinyl sheet piles. The driven vinyl sheet piles will be used to isolate the impacted clay liner within the proximity of the sinkhole area in the Phase VI portion of Phases I-VI.

6.1 PRECONSTRUCTION

All vinyl sheet piles shall be manufactured in accordance with specification Section 02362 - Driven Vinyl Sheet Piling. The sheet pile manufacturer will provide the Contractor and the CQA Inspector with a written certification, signed by a responsible party, that the sheet pile material actually delivered has properties which meet or exceed the guaranteed properties. The CQA Inspector will examine all manufacturers' certifications to ensure that the property values listed on the certifications meet or exceed the project specifications. Any deviations will be reported to the CQA Engineer.

6.1.1 Manufacturer's Quality Control

Before scheduled manufacturing of the product, the Manufacturer will provide the CQA organization with the following items for review and testing:

- Manufacturer's description (cut sheet) of the proposed vinyl sheet piles documenting that it will meet or exceed specified requirements.
- Available historical data documenting that the proposed vinyl sheet piles will meet specified interface residual strength.
- Written instructions for storage, handling, installation, seaming, and repair of the proposed materials.

Before shipment of the sheet pile material, the CQA organization will review pre-construction submittals.

Table 6-1 lists the quality control testing to be performed on the vinyl sheet piles by the manufacturer and the results submitted to the CQA Engineer for review.

Table 6-1
Manufacturer's Quality Control Testing for Vinyl Sheet Piles

Material	Type of Test	Standard Test Method	Frequency of Testing
Vinyl Sheet Pile	Cell Classification	ASTM D4216	One per Truck Load
	Section Modulus (in ³)	Manufacturer's Certifications	One per Truck Load
	Moment of Inertia (in ⁴)	Manufacturer's Certifications	One per Truck Load
	Thickness (in)	Manufacturer's Certifications	One per Truck Load

6.2 CONSTRUCTION

The following subsection describes the CQA inspection activities that are necessary during the sheet pile installation. Refer to the specification Section 02362 - Driven Vinyl Sheet Piling, for project specific construction and test requirements.

The CQA Inspector shall observe the vinyl sheet pile installation to confirm that specification Section 02362 is followed, including the use of a pre-punch, observation of clay on the mandrel during extraction, and confirmation of sheet pile lengths.

6.2.1 Delivery, Storage and Handling

During delivery of sheet piling material, the CQA Inspector will observe the material for the following, and any deviation will be reported to the CQA Engineer:

- Equipment used to unload the material does not damage the material.
- Care is used to unload the sheet piling.
- Documentation required by specification Section 02362 - Driven Vinyl Sheet Piling has been received.

Damaged sheet piling may be rejected. If rejected, it must be verified that rejected material is removed from the site or stored at a location separate from accepted material. Sheet piles that do not have proper manufacturer's documentation must also be stored at a separate location until all documentation has been received and approved.

6.2.2 Subsurface Investigation (Borings)

Prior to beginning the installation of the sheet piles, the Contractor will schedule and perform at least six (6) geotechnical SPT borings along the proposed sheet piling layout to confirm the elevation of the top of clay liner. The locations of each SPT boring will be surveyed to obtain the x, y, and z coordinates. The SPT boring will include continuous sampling in order to assess the depth to the top of the clay liner. The depth from grade will be communicated immediately in the field to the CQA Engineer. Data from these borings, as well as previously collected boring data within the proximity of the vinyl sheet pile alignment, will be used to modify the elevation of the sheet piles, if required. Upon conclusion of the SPT borings, the Contractor will provide the CQA Engineer with final boring logs, signed and sealed by a Professional Geologist or Engineer.

6.2.3 Sheet Pile Placement and Installation

During deployment and driving operations, the CQA Inspector will observe for the following:

- Equipment used to install sheet piles does not result in damage to the sheet pile during installation. Use of additional blocking will be used to prevent slippage of previously installed adjacent sheet piles, if required.

- Adjacent sheets are overlapped and connected in accordance with Specification Section 02362 - Driven Vinyl Sheet Piling.
- Sheet piles are driven into the clay layer.
- During installation, previously installed and adjacent sheet piles do not slide below the proposed elevations.

The CQA Inspector will inform both the CQA Engineer and Contractor if they observe any conditions that do not conform to the requirements of the CQA Plan.

6.2.4 Placement of Soil Materials

All soil material placed over the sheet piling will be placed in accordance with specification Section 02200 - Earthwork: Landfills, so as to ensure the following:

- The sheet piling is not damaged.
- Minimal displacement of the sheet piles occurs.

The CQA Inspector will inform both the CQA Engineer and Contractor if they observe any conditions that do not conform to the requirements of the CQA Plan.

SECTION 7.0 SURVEYING

Surveying of lines and grades is conducted on an ongoing basis during construction of the Stage 5 – Isolation of Impacted Clay Liner work. Close construction quality control (CQC) of the surveying is absolutely essential to ensure that slopes are properly constructed. The surveying conducted at the site shall be performed by the Contractor.

7.1 SURVEY CONTROL

Permanent benchmarks and baseline control points are to be established for the site at locations convenient for daily tie-in. The vertical and horizontal controls for this benchmark will be established within normal land surveying standards.

7.2 SURVEYING PERSONNEL

The Contractor's survey crew will consist of a Senior Surveyor, and as many Surveying CQC Monitors as are required to satisfactorily undertake the requirements for the work. All Surveying CQC personnel will be experienced in the provision of these services, including detailed, accurate documentation.

All surveying will be performed under the direct supervision of a Registered Professional Engineer (PE) or Licensed Land Surveyor (PLS) licensed in the state in which the project is located. The Licensed Land Surveyor may be the Senior Surveyor.

7.3 PRECISION AND ACCURACY

A wide variety of survey equipment is available to meet the requirements of this project. The survey instruments used for this work should be sufficiently precise and accurate to meet the needs of the project. All survey instruments should be capable of reading to a precision of 0.01 foot and with a setting accuracy of 20 seconds. (5.6×10^{-3} degrees).

7.4 LINES AND GRADES

The following surfaces shall be surveyed to verify the lines and grades achieved during construction. The survey should at least include (as deemed appropriate by the CQA Engineer and CQA Inspector):

- One or more construction baselines.
- The edges of all surface breaks (i.e., toes, crests, ridges and valleys).
- Surface of the intermediate cover.
- Surface of the protective cover.
- Surface of the final cover.
- All LFG piping, wells, structures, and other LFG appurtenances.
- Inverts of drainage pipe inlets and outlets.

- Top/toe of all berms, roads, and channels.
- Location of edge of liners, anchor trenches tie-in seam to adjacent existing liner system (as applicable).
- Major patches of LLDPE and HDPE liner.
- Locations and depths of geotechnical SPT borings along the alignment of vinyl sheet piles.

Laser planes are highly recommended for achieving the correct lines and grades during construction of each surface.

7.5 FREQUENCY AND SPACING

All surveying will be carried out immediately upon completion of a given installation to facilitate progress and avoid delaying commencement of the next installation. In addition, spot checks during construction, as determined by the Senior Surveyor, CQA Inspector, or CQA Engineer, may be necessary to assist the Contractor in complying with the required grades.

The following spacings and locations will be provided by the CQC surveyor, as a minimum, for survey points:

- Surfaces with slopes less than 10 percent will be surveyed on a square grid not wider than 50 feet.
- On slopes greater than 10 percent, a square grid not wider than 50 feet will be used, but, in any case, a line of survey points at the crest, midpoint, and toe of the slope will be taken.
- A line of survey points no farther than 50 feet apart will be taken along any slope break (this will include the inside edge and outside edge of any bench on a slope).
- A line of survey points not farther than 50 feet apart will be taken for all piping used for downdrains, in particular, at the end points.
- At a minimum, every 25 feet along the perimeter of the final cover liner system.

7.6 THICKNESS MEASUREMENTS

The CQC surveyor as a representative of the Contractor shall obtain thickness measurements of the protective cover over HDPE, intermediate cover, and final cover at a maximum 50-foot grid points and at all grade break lines prior to placement of the geomembrane liner. The procedure for obtaining thickness measurements of the intermediate cover, protective cover, and final cover shall be agreed to by the CQA Inspector and CQA Engineer prior to construction. The CQC Surveyor shall review the survey information with the Contractor to ensure that the survey demonstrates compliance with the Project Plans and Specifications. The Contractor is responsible for identifying and reporting to the CQA Inspector any areas of non-compliance evidenced by the survey, and for repairing such areas. The CQA Inspector and Contractor shall

review the elevation measurements of the intermediate cover prior to placement of the geomembrane liner.

7.7 TOLERANCES

The following are maximum tolerances for survey points:

- On surfaces, the maximum tolerances shall be 0.1 foot. When comparing survey points for surfaces to determine conformance with design, the surveyed elevation and not the design elevation shall be used to determine if the surface meets design and the tolerances required in this section.
- On piping for down drain lines, the maximum tolerances shall be 0.1 foot. When comparing survey points for surfaces to determine conformance with design, the surveyed elevation and not the design elevation shall be used to determine if the surface meets design and the tolerances required in this section.
- For thickness verifications, no minor tolerances are acceptable.

7.8 DOCUMENTATION

All field survey notes will be retained by the Senior Surveyor. The results from the field surveys will be documented on a set of survey record (as-built) drawings by the Contractor for submittal to the CQA Inspector. The Contractor shall certify to the CQA Inspector and CQA Engineer that the results of the survey demonstrates compliance with the Contract Documents. Sealed surveys depicting the information gathered in Paragraph 7.5 shall be supplied to the CQA Engineer and CQA Inspector in sufficient quantities. The surveys shall depict the information in a topographic format and illustrate actual data points. For thickness verification a table shall be compiled by the CQC surveyor or contractor containing the following information for each point.

- Top of intermediate cover elevation.
- Intermediate cover thickness.
- Top of protective cover over LLDPE geomembrane elevation.
- Protective cover over LLDPE geomembrane thickness.
- Top of protective cover over HDPE geomembrane elevation.
- Protective cover over HDPE geomembrane thickness.

Any deviations in elevation or thickness outside the tolerances allowed by specification shall be corrected.

SECTION 8.0

REPORTING REQUIREMENTS AND DOCUMENTATION

8.1 PROJECT MEETINGS

Conducting periodic project meetings is the responsibility of the Design Engineer who will make physical arrangements for meetings, record minutes and distribute copies to participants and those affected by decisions made at meetings. At a minimum the following meetings will be held.

- Pre-construction CQA meeting
- Problems or Work deficiency meetings

8.1.1 Preconstruction CQA Meeting

This meeting shall be attended by the Owner, Design Engineer, CQA Engineer, CQA Inspector, and Contractor. The topics should include but are not limited to:

- Providing each organization with all relevant CQA documents and supporting information.
- Familiarizing each organization with the site-specific CQA Plan and its role relative to the design criteria.
- Determining any changes to the CQA Plan that are needed to ensure that the facility will be constructed to meet or exceed the specified design.
- Reviewing the responsibilities of each organization.
- Reviewing lines of authority and communication for each organization.
- Discussing the established procedures or protocol for observations and tests including sampling strategies.
- Discussing the established procedures or protocol for handling construction deficiencies, repairs, and retesting.
- Reviewing methods for documenting and reporting inspection data.
- Reviewing methods for distributing and storing documents and reports.
- Reviewing work area security and safety protocol.
- Discussing procedures for the location and protection of construction materials and for the prevention of damage of the materials from inclement weather or other adverse events.
- Conducting a site walk-around to review construction material and inspection equipment storage locations.

The meeting shall be documented by a designated person, and minutes should be transmitted to all parties.

8.1.2 Weekly Progress Meetings

A progress meeting shall be held weekly at the work area at a time determined at the pre-construction meeting. The frequency of progress meetings may be reduced as the project proceeds if agreed to by the Owner, Contractor, and CQA Engineer. At a minimum, the meeting should be attended by the CQA Engineer, CQA Inspector, Contractor and the Owner.

The purpose of the meeting is to:

- Review the previous week's activities and accomplishments.
- Review status of progress schedule.
- Review the work location and activities for the week.
- Identify the contractor's personnel and equipment assignments for the week.
- Discuss any potential construction problems.

This meeting shall be documented by the CQA Engineer.

8.1.3 Problem or Work Deficiency Meetings

A special meeting shall be held when and if a problem or deficiency is present or likely to occur. At a minimum, the meeting shall be attended by the Design Engineer, Owner, Contractor, CQA Engineer, and CQA Inspector. The purpose of the meeting is to define and resolve a problem or recurring work deficiency in the following manner:

- Define and discuss the problem or deficiency.
- Review alternative solutions.
- Implement a plan to resolve the problem or deficiency.

The meeting shall be documented by the CQA Engineer and transmitted to the Owner, Contractor, CQA Inspector and Design Engineer, if applicable.

8.2 DOCUMENTATION

Documentation is an essential element of the CQA Plan. The following documentation and record keeping of inspection activities will be required.

8.2.1 Daily Summary Report

A summary report shall be prepared daily by the CQA Inspector. This report will provide the chronologic framework for identifying and recording all other reports. At a minimum, the summary reports shall include the following information:

- Unique identifying sheet number for cross-referencing and document control.
- Date, project name, location, and other identification.
- Data on weather conditions.
- Reports on any meetings held and their results.

- Unit processes, and locations, of construction under way during the timeframe of the daily summary report.
- Equipment and personnel being worked in each unit process, including subcontractors.
- Descriptions of areas or units of work being inspected and documented.
- Description of off-site materials received, including any quality verification (vendor certification) documentation.
- Calibrations, or recalibrations, of test equipment, including actions taken as a result of recalibration.
- Decisions made regarding approval of units of material or of work (blocks), and/or corrective actions to be taken in instances of substandard quality.
- Unique identifying sheet numbers of inspection data sheets and/or problem reporting and corrective measures reports used to substantiate the decisions described in the preceding item.
- Supporting inspection data sheets.
- Signature of the CQA Inspector.

8.2.2 Inspection Data Sheets and Photographs

All observations, and field and/or laboratory tests, shall be recorded on an inspection data sheet. Required data to be addressed for most of the standardized test methods are included in the pertinent ASTM Standards.

At a minimum, the inspection data sheets shall include the following information:

- Unique identifying sheet number for cross-referencing and document control.
- Description or title of the inspection activity.
- Location of the inspection activity or location from which the same increment was obtained.
- Type of inspection activity; procedure used (reference to standard method when appropriate).
- Recorded observation or test data, with all necessary calculations.
- Results of the inspection activity; comparison with specification requirements.
- Personnel involved in the inspection activity.
- Signature of the appropriate inspection personnel and concurrence by the CQA Engineer.

Items above may be formulated into site-specific checklists and data sheets so that details are not overlooked.

Photographic supporting data sheets also may prove useful. Such data sheets could be cross-referenced or appended to inspection data sheets and/or problem identification and corrective measures reports. At a minimum, photographic reporting data sheets should include the following information:

- A unique identifying number on data sheets and photographs for cross-referencing and document control.
- The date, time, and location where the photograph was taken and weather conditions.
- The size, scale, and orientation of the subject matter photographed.
- Location and description of the work.
- The purpose of the photograph.
- Signature of the photographer and concurrence of the CQA Engineer.
- Photographic supporting data sheets may be in MS Word or PDF format.

These photographs will serve as a pictorial record of work progress, problems, and corrective measures. They should be kept in a permanent protective file in the order in which they were taken.

8.2.3 Problem Identification and Corrective Measures Reports

A problem is defined herein as material or workmanship that does not meet the specified design. Problem identification and corrective measures reports shall be cross-referenced to specific inspection data sheets where the problem was identified. At a minimum, they shall include the following information:

- Unique identifying sheet number for cross-referencing and document control.
- Detailed description of the problem.
- Location of the problem.
- Probable cause.
- How and when the problem was located (reference to inspection data sheets).
- Estimation of how long problem has existed.
- Suggested corrective measure.
- Documentation of correction (reference to inspection data sheets).
- Final results.
- Suggested methods to prevent similar problems.
- Signature of the appropriate CQA inspection personnel and concurrence by the CQA Engineer.

Copies of the report shall be sent to the Design Engineer and the Owner for their comments and acceptance. These reports should not be submitted to the FDEP at that time unless they have been specifically requested. However, a summary of all data sheets and reports will be submitted to the FDEP upon completion of construction.

8.2.4 Acceptance of Completed Components

All daily inspection summary reports, inspection data sheets, and problem identification and corrective measures reports, shall be reviewed by the CQA Engineer.

8.2.5 Final Documentation

At the completion of the project, the Owner will submit a final construction certification report to the FDEP. This report will include all of the daily inspection summary reports, inspection data sheets, problem identification and corrective measures reports, photographic supporting data, acceptance reports, deviations from design and material specifications (with justifying documentation), and record drawings. This document shall be certified correct by the CQA Engineer and included as part of the CQA Plan documentation.