Attachment C

Phase I-VI Construction Quality Assurance Plan

Construction Quality Assurance Plan
Phase I-VI Closure
Southeast County Landfill
Hillsborough County, Florida

Hillsborough County
Solid Waste Management Department (SWMD)
322 N. Falkenburg Road
Tampa, FL 33619

Florida Board of Professional Engineers
Certifícate No. 000082852

SCS ENGINEERS

Table of Contents

Section Page

1.0 Introduction....1
1.1 Purpose....1
1.2 Discrepancies Between Documents....1
2.0 Definitions....1
2.1 Construction Quality Assurance....1
2.2 Construction Quality Control....2
2.3 Manufacturing Quality Control....2
2.4 Manufacturing Quality Assurance....2
2.5 Geosynthetic Materials....2
2.6 Geomembrane Materials....2
2.7 Non-conformance....2
2.8 Record Drawings....3
3.0 Personnel and Organization Responsibilities....3
3.1 Permitting Agency....3
3.2 Owner....3
3.3 Design Engineer....3
3.4 CQA Consultant....3
3.5 Construction Quality Assurance Representative (CQAR)....4
3.6 Contractor....5
3.7 Contractor's Representative....6
3.8 Geosynthetics Manufacturer....6
3.9 Geosynthetics Installer....6
3.10 CQA Geosynthetics Laboratory....7
3.11 CQC Soils Laboratory....7
3.12 Surveyor....7
4.0 Communications and Project Meetings....9
4.1 Pre-Construction Meeting....9
4.2 Progress Meetings....10
4.3 Construction Resolution Meetings....10
4.4 Geomembrane Pre-Installation Meeting....10
5.0 Earth Material Quality Assurance....11
5.1 General....11
5.2 Material Evaluation and Testing....12
5.2.1 Excavated Intermediate Cover Soil Testing....12
5.2.2 General Fill Soil Testing....12
5.2.3 Structural Fill Soil Testing....13
5.2.4 Protective Cover Soil Testing....13
5.2.5 Topsoil Testing....14
5.3 Construction Quality Evaluation....14
5.3.1 Deficiencies....15

5.3.2 Notification, Repair, and Retesting 15
5.4 Intermediate Cover 15
5.4.1 Preparation and Acceptance 15
5.4.2 Intermediate Cover Repair 16
5.5 Protective Cover Soil Layer 16
5.6 Topsoil Layer 16
5.7 Anchor Trenches 17
6.0 Geomembrane Material 17
6.1 Geomembrane Manufacturing and Delivery 17
6.1.1 Manufacturing 17
6.1.1.1 Manufacturer Quality Control Documentation 17
6.1.1.2 Manufacturer Quality Control Certificates 18
6.1.1.3 Manufacturer Quality Control Testing 18
1. Carbon black dispersion for 10 different views: All 10 views in categories 1, 2. 19
6.1.2 Delivery, Handling, and Storage 19
6.1.2.1 Delivery and Handling 19
6.1.2.2 Storage 19
6.2 Geomembrane Conformance Testing 20
6.2.1 Conformance Sample Collection 20
6.2.2 Conformance Testing 20
6.3 Geomembrane Field Quality Control 21
6.3.1 Panel Identification 21
6.3.2 Panel Placement and Deployment 21
6.3.2.1 Personnel Requirement 22
6.3.2.2 Seam Layout 23
6.3.2.3 Seaming Methods 23
6.3.2.4 Seam Preparation 23
6.3.2.5 Seaming Procedures 24
6.3.2.6 Extrusion Welding 24
6.3.2.7 Hot Wedge Welding 25
6.3.2.8 Trial Welds 25
6.3.3 Field Seam Testing 25
6.3.3.1 Non-destructive Testing 25
6.3.3.2 Destructive Testing 26
6.3.3.3 CQA Geosynthetics Laboratory 27
6.3.3.4 Procedures for Destructive Test Failures 27
6.3.4 Defects, Repairs, and Wrinkles 28
7.0 Geocomposite Material 29
7.1 Geocomposite Manufacturing and Delivery 29
7.1.1 Manufacturing 29
7.1.1.1 Manufacturer Quality Control Documentation 29
7.1.1.2 Manufacturer Quality Control Certificates 30
7.1.1.3 Manufacturer Quality Control Testing 30
7.1.2 Delivery, Handling, and Storage 32

7.1.2.1 Delivery and Handling ... 32
7.1.2.2 Storage ... 33
7.2 Geocomposite Conformance Testing ... 33
7.2.1 Conformance Sample Collection ... 33
7.2.2 Conformance Testing ... 33
7.3 Geocomposite Field Quality Control ... 35
7.3.1 Deployment ... 35
7.3.2 Roll Joining Methods ... 35
7.3.3 Roll Joining Requirements ... 35
7.3.4 Defects and Repairs ... 36
7.3.5 Placement of Soil Materials ... 36
8.0 Geotextile Material ... 36
8.1 Geotextile Manufacturing and Delivery ... 36
8.1.1 Manufacturing ... 36
8.1.1.1 Manufacturer Quality Control Documentation ... 36
8.1.1.2 Manufacturer Quality Control Certificates ... 37
8.1.1.3 Manufacturer Quality Control Testing ... 37
8.1.2 Delivery, Handling, and Storage ... 38
8.1.2.1 Delivery and Handling ... 38
8.1.2.2 Storage ... 39
8.2 Geotextile Conformance Testing ... 39
8.2.1 Conformance Sample Collection ... 39
8.2.2 Conformance Testing ... 39
8.3 Geotextile Field Quality Control ... 40
8.3.1 Deployment ... 40
8.3.2 Seaming Procedures ... 40
8.3.3 Defects and Repairs ... 40
8.3.4 Placement of Soil Materials ... 41
9.0 Landfill Gas System Improvements ... 41
9.1 landfill Gas Improvement Construction Sequencing ... 41
9.2 Landfill Gas Well Installation ... 41
9.2.1 Verification Survey ... 41
9.2.2 Drilling ... 42
9.2.3 Obstructions and Saturated Conditions ... 42
9.2.4 Boring Abandonment and Redrilling ... 42
9.2.5 Well Construction Logs ... 43
9.3 Gas Well Abandonment ... 43
9.4 Landfill Gas System Record Data ... 44
10.0 Documentation ... 44
10.1 Reports ... 44
10.1.1 Daily Logs and Summary Reports ... 44
10.2 Observation and Testing Reports ... 45
10.3 Photodocumentation And Reporting Data Sheets ... 46
10.4 Design and/or Technical Specifications Changes ... 46

10.5 Progress Reports 47
10.6 Record Drawings 47
10.7 Certification Report 48

TECHNICAL SPECIFICATIONS

ATTACHMENTS

APPENDIX A DAILY FIELD REPORT
APPENDIX B GEOSYTHETIC INSTALLATION FORMS
CERTIFICATE OF INTERMEDIATE COVER ACCEPTANCE
PANEL PLACEMENT LOG
GEOMEMBRANE PLACEMENT LOG
TRIAL WELD LOG
GEOMEMBRANE SEAMING LOG
NON-DESTRUCTIVE TEST LOG
DESTRUCTIVE TEST LOG
GEOMEMBRANE REPAIR LOG

1.0 INTRODUCTION

1.1 PURPOSE

This Construction Quality Assurance Plan (CQA Plan) addresses the Construction Quality Assurance (CQA) and Construction Quality Control (CQC) testing, procedures, and requirements for construction activities of the Southeast County Landfill Phase I-VI Closure. Construction activities include earthwork, piping, installation of geosynthetic materials, landfill gas collection and control system (LFGCCS) improvements, stormwater improvements, surveying, and sodding. This CQA Plan supplements the CONSTRUCTION DRAWINGS and TECHNICAL SPECIFICATIONS and has been prepared to meet the requirements set forth in the Florida Administrative Code (FAC), Chapter 62-701.400.

Detailed Manufacturer Quality Control (MQC), Manufacturer Quality Assurance (MQA), and CQC requirements, which are the responsibility of organizations that manufacture materials, and CONTRACTORS that install these materials, are provided in the TECHNICAL SPECIFICATIONS.

Upon completion of the PROJECT, a certification of construction completion report will be prepared by the CQA CONSULTANT, documenting construction was performed in accordance with the design intent, CONSTRUCTION DRAWINGS, and TECHNICAL SPECIFICATIONS.

1.2 DISCREPANCIES BETWEEN DOCUMENTS

This CQA Plan is intended to be a supporting document to improve the overall implementation of the WORK. The CQA Plan may be more or less specific than the TECHNICAL SPECIFICATIONS, and conflicts potentially may exist between the documents. The CONTRACTOR is instructed to bring discrepancies immediately to the attention of the DESIGN ENGINEER and/or CQA CONSULTANT for resolution. The DESIGN ENGINEER has the sole authority to determine the resolution of discrepancies existing within the CONSTRUCTION DRAWINGS and TECHNICAL SPECIFICATIONS. Unless otherwise determined by the DESIGN ENGINEER, the more stringent requirement shall be the controlling resolution.

2.0 DEFINITIONS

Whenever the terms listed below are used, the intent and meaning will be interpreted as indicated.

2.1 CONSTRUCTION QUALITY ASSURANCE

CQA is a planned system of activities and actions, employed by the OWNER, that provides the OWNER and PERMITTING AGENCY assurance the PROJECT was constructed as specified in the CONSTRUCTION DRAWINGS, TECHNICAL SPECIFICATIONS, and Construction Permit. CQA refers to measures taken by the DESIGN ENGINEER, CQA CONSULTANT, and OWNER to determine compliance with the requirements for materials and workmanship as stated in the CONSTRUCTION DRAWINGS and TECHNICAL SPECIFICATIONS for the PROJECT. CQA includes construction observation and monitoring, materials testing, verifications, audits, and evaluations of materials and workmanship necessary to determine and document the quality of the WORK. CQA refers to measures taken by the CQA organization to assess if the INSTALLERS and CONTRACTORS are in compliance with the CONSTRUCTION DRAWINGS and TECHNICAL SPECIFICATIONS for the PROJECT.

2.2 CONSTRUCTION QUALITY CONTROL

CQC refers to those actions taken by the MANUFACTURERS, FABRICATORS, INSTALLERS, and CONTRACTOR to ensure materials and workmanship meet the requirements of the CONSTRUCTION DRAWINGS, TECHNICAL SPECIFICATIONS, and CQA Plan. CQC is a planned system of observations used to directly monitor and control the quality of a construction PROJECT. CQC is performed by the CONTRACTOR or specialty SUBCONTRACTORS and is necessary to achieve quality in the constructed or installed system. CQC refers to measures taken by the CONTRACTOR or specialty SUBCONTRACTORS to determine compliance with the requirements for materials and workmanship as stated in the CONSTRUCTION DRAWINGS and TECHNICAL SPECIFICATIONS for the PROJECT. In the case of soils, CQC is provided by the CONTRACTOR. In the case of geosynthetics, CQC is provided by the MANUFACTURERS and INSTALLERS of the various geosynthetics.

2.3 MANUFACTURING QUALITY CONTROL

MQC is a planned system of inspections used to directly monitor and control the manufacture of a material which is factory-originated. MQC is normally performed by the MANUFACTURER of materials and is necessary to ensure minimum (or maximum) specified values in the manufactured product. MQC refers to measures taken by the MANUFACTURER to determine compliance with the requirements for materials and workmanship as stated in the CONSTRUCTION DRAWINGS and TECHNICAL SPECIFICATIONS for the PROJECT.

2.4 MANUFACTURING QUALITY ASSURANCE

MQA is a planned system of activities that provides assurance materials were manufactured as specified in the CONSTRUCTION DRAWINGS and TECHNICAL SPECIFICATIONS for the PROJECT. MQA includes manufacturing facility inspections, verifications, audits, and evaluation of raw materials and products to assess the quality of the manufactured materials. MQA refers to measures taken by the MQA organization to determine if the MANUFACTURER of the product is in compliance with the CONSTRUCTION DRAWINGS and TECHNICAL SPECIFICATIONS for the PROJECT.

2.5 GEOSYNTHETIC MATERIALS

For the purposes of this CQA Plan, the term “geosynthetic” is applied to materials manufactured from synthetic polymers (such as geomembranes, geotextiles, and geocomposites).

2.6 GEOMEMBRANE MATERIALS

For the purposes of this CQA Plan, the term “geomembrane” is applied to flexible membrane liners. More specifically, “geomembrane” refers to synthetic liners with a textured surface for increased friction. A linear low-density polyethylene (LLDPE) geomembrane shall be used on this PROJECT.

2.7 NON-CONFORMANCE

A deficiency in characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate. Examples of non-conformance include but are not limited to, physical defects, test failures, and inadequate documentation.

2.8 RECORD DRAWINGS

Drawings recording the constructed dimensions, details, and coordinates of the project. Also referred to as “as-builts.”

3.0 PERSONNEL AND ORGANIZATION RESPONSIBILITIES

The principal parties involved in the CQA and CQC for the PROJECT include the PERMITTING AGENCY, OWNER, DESIGN ENGINEER, CQA CONSULTANT, CONTRACTOR, GEOSYNTHETICS MANUFACTURER, GEOSYNTHETICS INSTALLER, CQA GEOSYNTHETICS LABORATORY, and CQA SOILS LABORATORY. The general responsibilities of each of these parties are described in the following subsections. The responsibility and/or authority of a given party may be modified or expanded by the OWNER, DESIGN ENGINEER, and/or CQA CONSULTANT as dictated by specific needs as construction progresses. Refer to Figure 3-1 Organizational Chart below that shows the relationships of all the parties involved in the Southeast County Landfill Phase I-VI Closure.

3.1 PERMITTING AGENCY

The PERMITTING AGENCY is authorized to issue the Construction Permit based on review and acceptance of the permit application by the DESIGN ENGINEER. The PERMITTING AGENCY must have issued a Construction Permit for the PROJECT prior to commencement of WORK. As construction progresses, the PERMITTING AGENCY has the responsibility and authority to review and accept design revisions or requests for variance submitted by the OWNER.

3.2 OWNER

The OWNER is responsible for the facility, including coordinating the design and construction of the Southeast County Landfill Phase I-VI Closure. This responsibility includes compliance with the Construction Permit and the submission of CQA documentation demonstrating the PROJECT was constructed in accordance with the CONSTRUCTION DRAWINGS, TECHNICAL SPECIFICATIONS, and Construction Permit for the PROJECT. The OWNER has the authority to contract and manage parties charged with design, CQA, and construction. The OWNER also has the authority to accept or reject the CONSTRUCTION DRAWINGS, TECHNICAL SPECIFICATIONS, CQA Plan, reports, recommendations of the CQA CONSULTANT, and the materials and workmanship of the CONTRACTORS.

3.3 DESIGN ENGINEER

The DESIGN ENGINEER is the individual or firm responsible for the design and preparation of the CONSTRUCTION DRAWINGS, TECHNICAL SPECIFICATIONS, and CQA Plan. The DESIGN ENGINEER must approve all design and TECHNICAL SPECIFICATIONS changes, CQA procedural changes, and design clarifications necessitated during construction. The DESIGN ENGINEER shall be a professional skilled in the appropriate discipline, certified or licensed as required by regulation, and shall be familiar with applicable regulatory requirements.

3.4 CQA CONSULTANT

CQA shall be the responsibility of the OWNER and CQA CONSULTANT who will act as the OWNER’S representative. The CQA CONSULTANT is a party independent of the CONTRACTORS,

MANUFACTURERS, and INSTALLERS, and if applicable, the DESIGN ENGINEER. The CQA CONSULTANT is responsible for field testing, observing and documenting activities related to construction, the Construction Permit, and the CQA Plan. The CQA CONSULTANT will be represented on-site by CONSTRUCTION QUALITY ASSURANCE REPRESENTATIVE (CQAR) personnel, as appropriate, to observe construction. In general, the responsibilities and authorities of the CQA CONSULTANT include the following:

- Understanding the CONSTRUCTION DRAWINGS, TECHNICAL SPECIFICATIONS, and Construction Permit concerning all aspects of the CQA Plan.
- Securing documents from the DESIGN ENGINEER and OWNER which approve deviations from the CONSTRUCTION DRAWINGS, TECHNICAL SPECIFICATIONS, Construction Permit, and/or CQA Plan.
- Implementation of this CQA Plan and coordination with the CQA GEOSYNTHETICS LABORATORY and CQA SOILS LABORATORY for material sample collection, testing, and confirming of the results of the test data.
- Maintaining open lines of communication with other parties involved in construction.
- Verifying material quality through submittals provided by the CONTRACTOR.
- Reviewing CQC and MQC test reports and material certifications provided by the CONTRACTOR.
- Compiling record construction data.

3.5 CONSTRUCTION QUALITY ASSURANCE REPRESENTATIVE (CQAR)

The CQAR is a qualified individual assigned by the CQA CONSULTANT to be responsible for observing and documenting activities related to the CQA of the production and installation of the WORK on behalf of the CQA CONSULTANT and OWNER. In general, the responsibilities and authorities of the CQAR include the following:

- Completing a daily report documenting the WORK. A typical daily report with the required information is provided in Attachment A.
- Completing a video inspection of all on-site roadway documenting the conditions prior to the WORK being started.
- Performing independent on-site observation of the WORK in progress to assess compliance with the CONSTRUCTION DRAWINGS, TECHNICAL SPECIFICATIONS, Construction Permit, and CQA Plan.
- Documenting and reporting deviations from the CONSTRUCTION DRAWINGS, TECHNICAL SPECIFICATIONS, Construction Permit and CQA Plan to the OWNER, DESIGN ENGINEER, and CONTRACTOR.
- Documenting, rejecting, and determining the extent of the defective or non-conforming WORK.

- Immediately notifying the OWNER, DESIGN ENGINEER and/or CQA CONSULTANT, and CONTRACTOR.

- Verifying and documenting that corrective measures were implemented as required by the OWNER, DESIGN ENGINEER, and/or CQA CONSULTANT.

- Verifying the INSTALLER'S test equipment meets testing and calibration requirements and those tests conducted are according to procedures defined in the TECHNICAL SPECIFICATIONS and CQA Plan.

- Documenting and recording CQA activities and collecting data required for the CQA CONSULTANT to prepare the Certification of Construction Completion report that will be submitted to the appropriate PERMITTING AGENCY.

- Compiling photographic documentation of the WORK.

3.6 CONTRACTOR

The CONTRACTOR is anyone with whom the OWNER enters into a contractual AGREEMENT to perform construction activities for the PROJECT as described in TECHNICAL SPECIFICATIONS Section 01010 Summary of Work. The CONTRACTOR shall meet the qualifications as indicated in the CONTRACT DOCUMENTS. The CONTRACTOR shall provide a representative at all times during any construction activity on-site. In general, the responsibilities of the CONTRACTOR include the following:

- The CONTRACTOR is responsible for the WORK in conformance with the CONTRACT DOCUMENTS and for completion of the PROJECT and site-specific responsibilities as required by the CONSTRUCTION DRAWINGS, TECHNICAL SPECIFICATIONS, Construction Permit, and CQA Plan.

- Submittal coordination by the MANUFACTURERS and INSTALLERS as required by the TECHNICAL SPECIFICATIONS and the overall CQC for the PROJECT.

- Scheduling and coordination of the required WORK with the MANUFACTURERS and the INSTALLERS to complete the PROJECT.

- Furnishing as-built drawings and a copy of complete documentation for the WORK.

- Daily updating of the CONSTRUCTION DRAWINGS on-site and for any and all deviations from those drawings. All deviations must be initialed as approved by the CQAR on-site.

- Completing a video inspection of all on-site roadway documenting the conditions prior to the WORK being started. Verify record data is obtained and provided to the OWNER and CQA CONSULTANT. Refer to additional requirements outlined in the appropriate section of the TECHNICAL SPECIFICATIONS.

    - Record survey information and associated point data shall be obtained on the same datum and coordinate basis as the CONSTRUCTION DRAWINGS and shall be provided by the CONTRACTOR.

3.7 CONTRACTOR'S REPRESENTATIVE

The Contractor's Representative is a qualified individual assigned by the CONTRACTOR to represent them on-site at all times during the performance of the WORK. The Contractor's Representative shall meet the qualifications as indicated in the CONTRACT DOCUMENTS. The Contractor's Representative shall have the authority to direct and instruct his/her crew and subcontractors. In general, the responsibilities of the Contractor's Representative include the following:

- Coordinating and supervising his/her crew and SUBCONTRACTORS work on-site.
- Ensuring construction activities are conducted in accordance with the CONSTRUCTION DRAWINGS, TECHNICAL SPECIFICATIONS, Construction Permit, and CQA Plan.
- Communicating with the CQAR any discrepancies between the CONSTRUCTION DRAWINGS, TECHNICAL SPECIFICATIONS, and field conditions.
- Attending all meetings held on the PROJECT as a representative of the CONTRACTOR.
- Keeping a daily log of all construction activities on-site.
- Proposing alternative construction methods, where necessary, to the CQAR for approval and signature, as required in the TECHNICAL SPECIFICATIONS and CQA Plan.

3.8 GEOSYNTHETICS MANUFACTURER

The GEOSYNTHETICS MANUFACTURER is responsible for the production of geosynthetics including geomembranes, geocomposites, and geotextiles which meet the requirements as specified in the CONSTRUCTION DRAWINGS, TECHNICAL SPECIFICATIONS, and CQA Plan for the PROJECT. The GEOSYNTHETICS MANUFACTURER shall meet the qualifications as indicated in the CONTRACT DOCUMENTS. In general, the responsibilities of the GEOSYNTHETICS MANUFACTURER include the following:

- Providing documentation regarding the characteristics of the raw material andfinal product, testing performed to verify the characteristics, and the MQC measures performed during manufacturing.
- Loading and transporting of the geosynthetics from the manufacturing plant to the PROJECT site and responsibility of any damage to the geosynthetics which may occur during these operations.

3.9 GEOSYNTHETICS INSTALLER

The GEOSYNTHETICS INSTALLER is responsible for unloading, field handling, seaming, storing, and temporarily loading against wind and other aspects of the geosynthetics installation in accordance with the CONSTRUCTION DRAWINGS, TECHNICAL SPECIFICATIONS, Construction Permit, and CQA Plan. The GEOSYNTHETICS INSTALLER shall meet the qualifications as indicated in the CONTRACT DOCUMENTS. In general, the responsibilities of the GEOSYNTHETICS INSTALLER include the following:

- The preparation of the panel layout drawings, including dimensions and details, and the provision of the installation schedule and a list of proposed field personnel and their qualifications.

- During installation, the GEOSYNTHETICS INSTALLER is responsible for providing CQC documentation and a "Certificate of Subbase (Intermediate Cover) Acceptance" before placement of the geomembrane.

- Upon completion of the geosynthetics installation, the GEOSYNTHETICS INSTALLER shall provide the installation documentation, installation warranties, and MANUFACTURER warranties to the CQA CONSULTANT.

3.10 CQA GEOSYNTHETICS LABORATORY

The CQA GEOSYNTHETICS LABORATORY is a third party, independent from the OWNER, MANUFACTURERS, and GEOSYNTHETICS INSTALLER. The CQA GEOSYNTHETICS LABORATORY service cannot be provided by any party involved with the manufacture or installation of any of the geosynthetic components. The CQA CONSULTANT is required to coordinate the CQA GEOSYNTHETICS LABORATORY work schedule and type and quantity of tests. In general, the responsibilities of the CQA GEOSYNTHETICS LABORATORY include the following:

- Performing laboratory tests on geosynthetic materials as required by the CONSTRUCTION DRAWINGS, TECHNICAL SPECIFICATIONS, Construction Permit, and CQA Plan.

- Providing documentation of testing equipment used, analytical test results, and test methods followed. All results will be reported to the CQA CONSULTANT.

3.11 CQC SOILS LABORATORY

The CQC SOIL LABORATORY is responsible for performing the laboratory testing on soils and aggregates as required by the CONSTRUCTION DRAWINGS, TECHNICAL SPECIFICATIONS, Construction Permit, and CQA Plan. The CONTRACTOR is required to coordinate the CQC SOIL LABORATORY work schedule and type and quantity of tests. In general, the responsibilities of the CQA SOILS LABORATORY include the following:

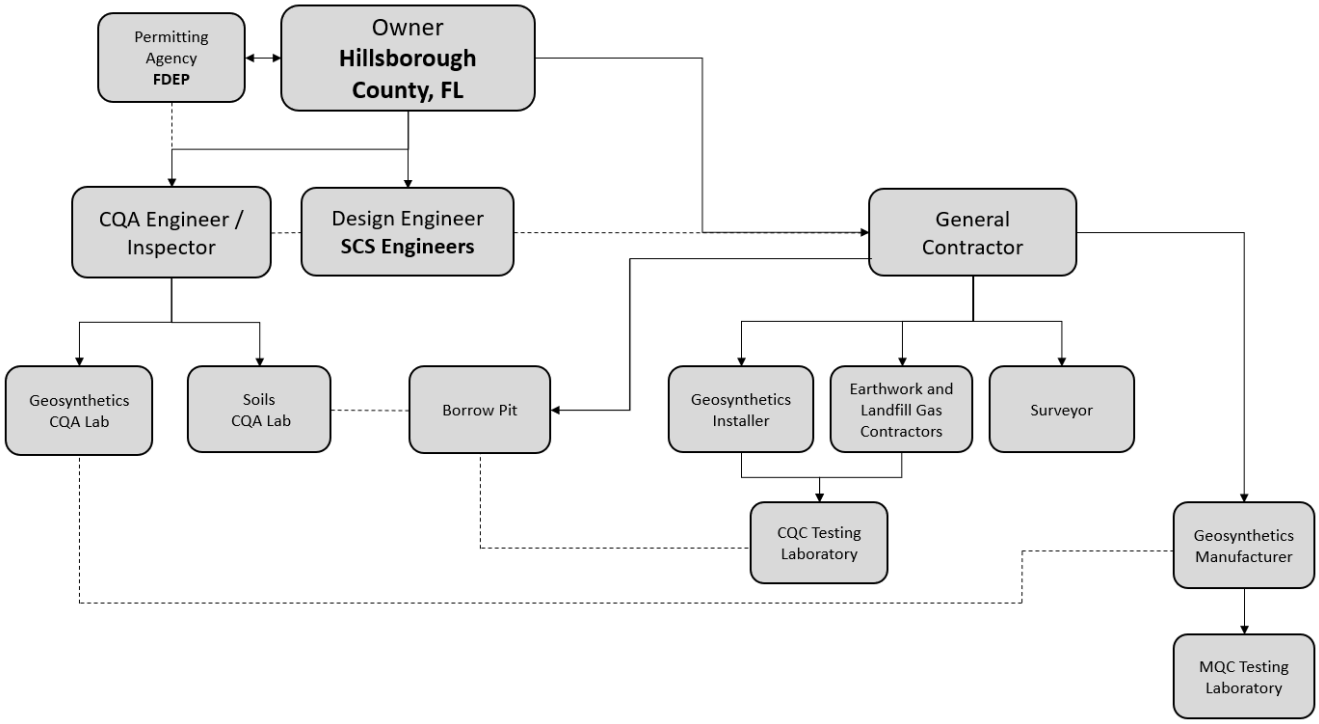
- Performing laboratory tests on soil materials as required by the CONSTRUCTION DRAWINGS, TECHNICAL SPECIFICATIONS, Construction Permit, and CQA Plan.

- Providing documentation of testing equipment used, analytical test results, and test methods followed. All results will be reported to the CQA CONSULTANT.

3.12 SURVEYOR

The SURVEYOR is the responsibility of the CONTRACTOR and is responsible for all stakeout and survey control as outlined in the CONSTRUCTION DRAWINGS and TECHNICAL SPECIFICATIONS. The SURVEYOR shall be licensed in the State of Florida. Refer to TECHNICAL SPECIFICATIONS Section 01050 Site Conditions Survey.

Figure 3-1 Organizational Chart



4.0 COMMUNICATIONS AND PROJECT MEETINGS

Continuous communications between parties involved in the construction and CQA of this PROJECT, including, but not limited to, the PERMITTING AGENCY, OWNER, DESIGN ENGINEER and/or CQA CONSULTANT, CQAR, CONTRACTOR, GEOSYNTHETICS MANUFACTURER, GEOSYNTHETICS INSTALLER, CQA GEOSYNTHETICS LABORATORY, and CQA SOILS LABORATORY, coupled with regularly scheduled meetings are necessary components of this CQA Plan. Such communication and meetings are intended to resolve construction quality and design issues as early as possible, to keep all parties informed of schedules, and to verify the WORK is proceeding in accordance with the schedule, CONTRACT DRAWINGS, TECHNICAL SPECIFICATIONS, and this CQA Plan. At a minimum there should be a Pre-Construction Meeting, regular Progress Meetings, a Geomembrane Pre-Installation Meeting, and Construction Resolution Meetings, as described below:

4.1 PRE-CONSTRUCTION MEETING

The Pre-Construction Meeting shall be held at least two weeks prior to the start of construction and should be attended by the OWNER, DESIGN ENGINEER, and/or CQA CONSULTANT, CQAR, and CONTRACTOR. Other specialty subcontractors can attend the meeting if required. Refer to TECHNICAL SPECIFICATIONS Section 01200 Project Meetings. Specific topics at the meeting should include but are not limited to, the following:

- Introduction of all personnel and a review of the responsibilities of each party.
- Establish PROJECT communications and delineate lines of authority and communication.
- Review the CONTRACTOR'S schedule for construction, including material shipment and working hours.
- Critical WORK sequencing.
- Discuss liquidated damages, (if any).
- Review methods for documenting and reporting, and for the transmittal, distribution, review, and approval of the CONTRACTOR'S submittals.
- Processing Applications for Payment.
- Field decisions and Change Orders.
- Maintaining Record Documents.
- Use of premises, stockpile areas, laydown areas, material storage areas, access roads, haul roads, security, housekeeping and related items, and OWNER'S needs.
- Major equipment deliveries and priorities.
- Establish locations for soil and geosynthetic materials stockpiles.
- CONTRACTOR'S assignments for health and safety.

Minutes from the Pre-Construction Meeting shall be prepared by the CQA CONSULTANT and distributed to all parties in attendance, in addition to an established distribution list, for PROJECT communications.

4.2 PROGRESS MEETINGS

Progress Meetings shall be held at a mutually agreed upon day and time and attended by representatives of the OWNER, DESIGN ENGINEER, and/or CQA CONSULTANT, CQAR, CONTRACTOR, GEOSYNTHETICS INSTALLER, and other parties that may be involved in specific activities occurring at that time. Refer to TECHNICAL SPECIFICATIONS Section 01200 Project Meetings. Topics for the Progress Meetings shall include but are not limited to, the following:

- The purpose of the Progress Meetings will be to review the progress of the WORK, maintain coordination of efforts, discuss changes in scheduling, and resolve problems that may develop. Corrections, additions, or deletions to the minutes shall be noted and addressed at the following meeting.

- WORK progress to date, scheduled activities for the next 2 weeks, issues requiring resolution, and any new business or revisions to the WORK.

- Review of construction issues including questions on CONSTRUCTION DRAWINGS, TECHNICAL SPECIFICATIONS, material test results, test failures, retests, procedures, weather conditions, working hours, holidays, communications, minutes from previous meetings, schedules, pay applications, problems and resolutions, documentation, and other PROJECT-related topics.

- Review health and safety issues for the site.

Minutes from the Progress Meetings shall be prepared by the CQA CONSULTANT and distributed to all parties in attendance, in addition to an established distribution list, for PROJECT communications.

4.3 CONSTRUCTION RESOLUTION MEETINGS

In some cases, construction issues or problems may arise that demand specific attention outside of the regular Progress Meetings and may include parties not available at the regular Progress Meetings. Such Construction Resolution Meetings shall be held as necessary to resolve construction problems or issues in a timely manner so the WORK can proceed. To the extent possible, these meetings shall be scheduled such that the key parties are available. Refer to TECHNICAL SPECIFICATIONS Section 01200 Project Meetings.

Minutes from the Construction Resolution Meetings shall be prepared by the CQA CONSULTANT and distributed to all parties in attendance, in addition to an established distribution list, for PROJECT communications.

4.4 GEOMEMBRANE PRE-INSTALLATION MEETING

A Geomembrane Pre-Installation Meeting shall be held at a mutually agreed upon day and time and attended by representatives of the OWNER, DESIGN ENGINEER, and/or CQA CONSULTANT, CQAR, CONTRACTOR, GEOSYNTHETICS INSTALLER, and other parties that may be involved in geomembrane

installation activities. Refer to TECHNICAL SPECIFICATIONS Section 01200 Project Meetings. Topics for the Progress Meetings shall include but are not limited to, the following:

- A "Certificate of Subbase (Intermediate Cover) Acceptance" shall be co-signed by the GEOSYNTHETICS INSTALLER and the CQAR prior to commencement of geomembrane installation in the area under consideration.
- As-built documents reviewed and approved by the CQA CONSULTANT prior to installation.
- All geosynthetic materials have been approved for use by the CQA CONSULTANT.
- Geomembrane seam properties.
- Destructive testing requirements.
- Non-destructive testing requirements, including:
    1. Vacuum testing.
    2. Air pressure testing.
- Equipment acceptable for use on geosynthetics.
- Trial seams.
- Adequate ballasts to prevent wind uplift.
- Geonet overlap, shingling, and tying requirements.
- Panel layout orientation.
- Requirements prior to placing overlying materials.

Minutes from the Geomembrane Pre-Installation Meeting shall be prepared by the CQA CONSULTANT and distributed to all parties in attendance, in addition to an established distribution list, for PROJECT communications.

5.0 EARTH MATERIAL QUALITY ASSURANCE

5.1 GENERAL

This section of the CQA Plan describes CQA procedures for earth material (e.g. soil and aggregate) components of the PROJECT. The two categories of testing covered in this CQA Plan include pre-construction testing (conducted by the CQA CONSULTANT) and testing during construction (conducted by the CQA CONSULTANT).

5.2 MATERIAL EVALUATION AND TESTING

Pre-construction materials evaluations shall be performed on samples from potential soil borrow sources by the CQA CONSULTANT'S independent CQA SOILS LABORATORY prior to incorporation into construction to ascertain their acceptability as construction materials by the CQA CONSULTANT. Criteria to be used for the determination of acceptability of earth materials for use during construction are defined in the TECHNICAL SPECIFICATIONS. Testing shall be performed by the CQA SOILS LABORATORY during the course of the WORK to verify continued material compliance with the TECHNICAL SPECIFICATIONS.

Special testing, if determined to be required by the CQA CONSULTANT and the criteria to be used to determine the acceptability of materials, shall be conducted at the direction of the OWNER, the CQA CONSULTANT, or their representative.

5.2.1 Excavated Intermediate Cover Soil Testing

Insitu material that does not contain waste, as determined by the CQAR, and meets the TECHNICAL SPECIFICATIONS, may be reused and incorporated into the PROJECT. No excavated material shall be wasted without permission, and where necessary to waste such material it shall be at the direction of the CQA CONSULTANT and OWNER. Prior to being reused or incorporated into the WORK, the CQA CONSULTANT shall review the Excavated Intermediate Cover Soil test results from the CQA CONSULTANT'S independent CQA SOILS LABORATORY to ascertain its acceptability as construction material in accordance with TECHNICAL SPECIFICATIONS Section 02220 Excavation, Backfill, Fill, and Grading.

TABLE 02220-1 EXCAVATED INTERMEDIATE COVER SOIL QUALIFICATION TESTING

TEST METHOD/PROPERTY	FREQUENCY (MINIMUM)
ASTM D2216 Natural Moisture Content	1 test per source or change in material
ASTM D698 Standard Proctor	1 test per source or change in material
ASTM D2487 Soil Classification	1 test per source or change in material
ASTM D422 Sieve Analysis	1 test per source or change in material
ASTM D4318 Atterberg Limits	1 test per source or change in material
ASTM D6141 Chemical Compatibility	1 test per source or change in material

5.2.2 General Fill Soil Testing

Prior to the incorporation of General Fill material into construction, the CQA CONSULTANT shall review test results from potential soil borrow sources as required by TECHNICAL SPECIFICATIONS Section 02220 Excavation, Backfill, Fill, and Grading to ascertain its acceptability as construction material. The CQA CONSULTANT will collect one random sample of the material and test it as required by TECHNICAL SPECIFICATIONS Section 02220 Excavation, Backfill, Fill, and Grading prior to providing approval.

After the materials have been approved for use in the PROJECT, the CQA CONSULTANT will coordinate for testing to be performed by the CQA SOILS LABORATORY during the course of the WORK to verify continued material compliance with the TECHNICAL SPECIFICATIONS. Any non-conformance test results obtained by the CQA SOILS LABORATORY will be reported to the OWNER,

CQA CONSULTANT, and CONTRACTOR. Material not meeting the PROJECT requirements will be removed at the CONTRACTORS expense.

TABLE 02220-4 GENERAL FILL SOIL QUALIFICATION TESTING

TEST METHOD/PROPERTY	FREQUENCY (MINIMUM)
ASTM D2216 Natural Moisture Content	1 test per source or change in material
ASTM D698 Standard Proctor	1 test per source or change in material
ASTM D2487 Soil Classification	1 test per source or change in material
ASTM D422 Sieve Analysis	1 test per source or change in material
ASTM D4318 Atterberg Limits	1 test per source or change in material
ASTM D6141 Chemical Compatibility	1 test per source or change in material

5.2.3 Structural Fill Soil Testing

Prior to the incorporation of Structural Fill material into construction, the CQA CONSULTANT shall review test results from potential soil borrow sources as required by TECHNICAL SPECIFICATIONS Section 02220 Excavation, Backfill, Fill, and Grading to ascertain its acceptability as construction material. The CQA CONSULTANT will collect one random sample of the material and test it as required by TECHNICAL SPECIFICATIONS Section 02220 Excavation, Backfill, Fill, and Grading prior to providing approval.

After the materials have been approved for use in the PROJECT, the CQA CONSULTANT will coordinate for testing to be performed by the CQA SOILS LABORATORY during the course of the WORK to verify continued material compliance with the TECHNICAL SPECIFICATIONS. Any non-conformance test results obtained by the CQA SOILS LABORATORY will be reported to the OWNER, CQA CONSULTANT, and CONTRACTOR. Material not meeting the PROJECT requirements will be removed at the CONTRACTORS expense.

TABLE 02220-7 STRUCTURAL FILL SOIL QUALIFICATION TESTING

TEST METHOD/PROPERTY	FREQUENCY (MINIMUM)
ASTM D2216 Natural Moisture Content	1 test per source or change in material
ASTM D698 Standard Proctor	1 test per source or change in material
ASTM D2487 Soil Classification	1 test per source or change in material
ASTM D422 Sieve Analysis	1 test per source or change in material
ASTM D4318 Atterberg Limits	1 test per source or change in material

5.2.4 Protective Cover Soil Testing

Prior to the incorporation of Protective Cover material into construction, the CQA CONSULTANT shall review test results from potential soil borrow sources as required by TECHNICAL SPECIFICATIONS Section 02220 Excavation, Backfill, Fill, and Grading to ascertain its acceptability as construction material. The CQA CONSULTANT will collect one random sample of the material and test it as required by TECHNICAL SPECIFICATIONS Section 02220 Excavation, Backfill, Fill, and Grading prior to providing approval.

After the materials have been approved for use in the PROJECT, the CQA CONSULTANT will coordinate for testing to be performed by the CQA SOILS LABORATORY during the course of the WORK to verify continued material compliance with the TECHNICAL SPECIFICATIONS. Any non-conformance test results obtained by the CQA SOILS LABORATORY will be reported to the OWNER, CQA CONSULTANT, and CONTRACTOR. Material not meeting the PROJECT requirements will be removed at the CONTRACTORS expense.

TABLE 02220-10 PROTECTIVE COVER LAYER GRADATION REQUIREMENTS

SIEVE SIZE	PERCENT PASSING (MAXIMUM)
No. 4	100
No. 30	95
No. 50	65
No. 70	20
No. 200	0 - 8

TABLE 02220-11 PROTECTIVE COVER MATERIAL QUALIFICATION TESTING

TEST METHOD/PROPERTY	FREQUENCY (MINIMUM)	VALUE (RANGE)
ASTM D422-88(2019) Standard Guide for Selection of Methods of Particle Size Analysis of Fluvial Sediments (Manual Methods)	1 test per source or change in material	See note 1
ASTM D2434-19 Standard Test Method for Permeability of Granular Soils (Constant Head) See note 2	1 test per source or change in material	1X10-4 to 5X10-4 cm/sec

Notes:

1. Refer to TECHNICAL SPECIFICATIONS TABLE 02220-10 PROTECTIVE COVER LAYER GRADATION REQUIREMENTS.
2. Sample compacted in the lab to 90% Standard Proctor.

5.2.5 Topsoil Testing

Prior to the incorporation of Topsoil material into construction, the CQA CONSULTANT shall review test results from potential soil borrow sources as required by TECHNICAL SPECIFICATIONS Section 02220 Excavation, Backfill, Fill, and Grading to ascertain its acceptability as construction material. The CQA CONSULTANT will collect one random sample of the material and test it as required by TECHNICAL SPECIFICATIONS Section 02220 Excavation, Backfill, Fill, and Grading prior to providing approval to the CONTRACTOR.

5.3 CONSTRUCTION QUALITY EVALUATION

Construction quality evaluation shall be performed on all soil components of the WORK. These evaluations will be performed at the frequencies indicated in the TECHNICAL SPECIFICATIONS.

Criteria used for determination of the acceptability of the WORK will be as identified in the TECHNICAL SPECIFICATIONS. Construction evaluation testing includes the visual observations of the WORK, in-place density/moisture content testing, surveys of as-built conditions and elevations, thickness monitoring, and special testing. Observation of the WORK shall include the following:

- Size of foreign materials and stones and other physical properties of the soil during processing, placement, and compaction.
- Thickness of lifts as loosely-placed and as compacted.
- Action of the compaction equipment on the construction surface.

5.3.1 Deficiencies

If defects are discovered in the earthwork, the extent and nature shall be evaluated by the CQA CONSULTANT. If a defect is indicated by a failing test, the CQA CONSULTANT shall determine the limits of the affected area by additional tests, observations, a review of records, and other means deemed appropriate. If the defect is related to adverse site conditions, the CQA CONSULTANT shall define the limits and nature of the defect.

5.3.2 Notification, Repair, and Retesting

The CQA CONSULTANT shall notify the OWNER, DESIGN ENGINEER, and CONTRACTOR after determining the nature and extent of the defect. Deficiencies shall be corrected by the CONTRACTOR to the satisfaction of the CQA CONSULTANT. The CQA CONSULTANT shall also verify all installation requirements as outlined in the TECHNICAL SPECIFICATIONS and this CQA Plan (i.e., material quality, thickness, and compaction) have been met and all submittals have been provided. Appropriate retests shall be scheduled by the CQA CONSULTANT when the WORK deficiency is corrected.

5.4 INTERMEDIATE COVER

5.4.1 Preparation and Acceptance

The CONTRACTOR shall be responsible for preparing the Intermediate Cover upon which the geomembrane will be placed according to the TECHNICAL SPECIFICATIONS Section 02220 Excavation, Backfill, Fill, and Grading. Prior to acceptance, the CQA CONSULTANT shall verify the following:

- A qualified land surveyor has verified all lines and grades.
- The supporting soil provides a firm, unyielding foundation.
- The surface to be lined is relatively smooth and free of stones (greater than 1/2-inch in any dimension), protrusions, irregularities, roots, loose soil, abrupt changes in grade, or other conditions that may puncture or abrade the geomembrane.
- There is no standing water or areas excessively softened by high moisture content.

- All tests have been completed and meet the TECHNICAL SPECIFICATIONS requirements and no other tests are necessary.

The INSTALLER shall certify, in writing, the surface on which the geomembrane will be installed is acceptable. A "Certificate of Subbase (Intermediate Cover) Acceptance" (provided in Attachment B) shall be co-signed by the geomembrane INSTALLER and the CQAR prior to commencement of geomembrane installation in the area under consideration, and a copy of this certificate shall be provided to the OWNER. After the supporting soil has been accepted by the INSTALLER, it shall be the INSTALLER'S responsibility to indicate to the CQA CONSULTANT any change in the supporting soil condition that may require correction. If the CQA CONSULTANT concurs with the INSTALLER, the CONTRACTOR shall ensure the supporting soil is repaired.

5.4.2 Intermediate Cover Repair

At any time during the geomembrane installation, the CQA CONSULTANT shall indicate to the INSTALLER and CONTRACTOR locations which may not provide adequate support to the geomembrane so the areas in question can be tested and, if necessary, repaired. To that end, the Intermediate Cover shall be observed by the INSTALLER and the CQA CONSULTANT, and the decision to repair areas, if any, shall be made by the OWNER and the CQA CONSULTANT.

5.5 PROTECTIVE COVER SOIL LAYER

Placement of the Protective Cover soil material layer will only occur after the underlying geosynthetic material installations are complete and approved in accordance with the TECHNICAL SPECIFICATIONS.

- Place Protective Cover soil material to the lines and grades shown on the CONSTRUCTION DRAWINGS. The CONTRACTOR shall place a minimum of 18 inches of Protective Cover soil material (measured perpendicular to the slope).

- Place Protective Cover soil material in a manner to not cause wrinkles and undue stresses to the underlying geosynthetic liner system.

- The CONTRACTOR shall provide and maintain a means of continuously observing the installed depth of the Protective Cover soil material on the required grid intervals. If temporary markers are used, the marker shall be free-standing and shall not be sharp or pointed so it cannot damage the geosynthetic liner materials if hit by equipment. Markers shall be removed after use and shall not be abandoned in place after Protective Cover installation.

- By survey methods, verify that all grades, slopes, and elevations conform to specified requirements. Record elevations in accordance with TECHNICAL SPECIFICATIONS Section 01050 Site Conditions Survey.

5.6 TOPSOIL LAYER

Placement of the Topsoil soil material layer will only occur after the underlying Protective Cover material installations are complete and approved in accordance with the TECHNICAL SPECIFICATIONS.

- Place Topsoil material to the lines and grades shown on the CONSTRUCTION DRAWINGS. The CONTRACTOR shall place a minimum of 6 inches of Topsoil (measured perpendicular to the slope).

- The CONTRACTOR shall provide and maintain a means of continuously observing the installed depth of the Topsoil material on the required grid intervals. If temporary markers are used, the marker shall be free-standing and shall not be sharp or pointed so it cannot damage the geosynthetic liner materials if hit by equipment. Markers shall be removed after use and shall not be abandoned in-place after Topsoil installation.

- By survey methods, verify that all grades, slopes, and elevations conform to specified requirements. Record elevations in accordance with TECHNICAL SPECIFICATIONS Section 01050 Site Conditions Survey.

5.7 ANCHOR TRENCHES

The CQA CONSULTANT shall verify the anchor trenches have been constructed according to the CONSTRUCTION DRAWINGS and TECHNICAL SPECIFICATIONS. Rounded or smoothed corners shall be provided where the geomembrane enters the trench so as to avoid sharp bends in the geomembrane. No loose or excessively wet soil shall be allowed to underlie the geomembrane in the anchor trenches. The anchor trench shall be adequately drained to prevent ponding or otherwise softening of the adjacent soils while the trench is open. The anchor trench shall be carefully backfilled and compacted by the CONTRACTOR or the INSTALLER as outlined in the TECHNICAL SPECIFICATIONS. Care shall be taken when backfilling the trenches to prevent bridging of the geomembrane or damage.

6.0 GEOMEMBRANE MATERIAL

6.1 GEOMEMBRANE MANUFACTURING AND DELIVERY

6.1.1 Manufacturing

This CQA Plan has been created to verify the specified geomembrane is manufactured and tested according to TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner.

6.1.1.1 Manufacturer Quality Control Documentation

The GEOMEMBRANE MANUFACTURER shall provide documentation and certification the material meets the requirements outlined in TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner and MQC measures have been implemented during the manufacturing process. The following information will be provided by the GEOMEMBRANE MANUFACTURER to the CQA CONSULTANT prior to shipment of the geomembrane to the PROJECT site:

- The origin (resin supplier's name, resin production plant), identification (brand name, number), and production date of the resin.

- MQC certificates issued by the resin supplier noting results of density and melt index.

- MQC certificates for all MQC testing of the geomembrane required by TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner.

- The CQA CONSULTANT shall verify the property values certified by the GEOMEMBRANE MANUFACTURER meet the test methods listed in TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner and the GEOMEMBRANE MANUFACTURER-guaranteed minimum values.

- An inventory list of quantities with descriptions of materials that comprise the geomembrane shipments.

6.1.1.2 Manufacturer Quality Control Certificates

The GEOMEMBRANE MANUFACTURER shall be required to perform, at a minimum, the tests listed in TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner. Prior to shipment to the PROJECT site, the GEOMEMBRANE MANUFACTURER shall provide the CQA CONSULTANT the MQC certificates for the geomembrane, written on the MANUFACTURER'S company letterhead, for each roll of geomembrane, signed by a responsible party employed by the GEOMEMBRANE MANUFACTURER. The MQC certificates shall include at a minimum the roll identification numbers and the MQC test results (listed individually). The CQA CONSULTANT shall review the MQC certificates and verify the required testing frequencies and results meet the requirements specified according to TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner and the MANUFACTURER'S guaranteed minimum values for all materials and rolls. The CQA CONSULTANT shall report any noncompliance to the OWNER, INSTALLER, and GEOMEMBRANE MANUFACTURER.

6.1.1.3 Manufacturer Quality Control Testing

Testing during manufacturing shall be accomplished by the GEOMEMBRANE MANUFACTURER laboratory. The MANUFACTURER shall test the resin batches per the frequency, at a minimum, that conforms to TABLE 02700-2 RESIN MQC REQUIREMENTS as required by TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner.

TABLE 02700-2 RESIN MQC REQUIREMENTS

TEST METHOD/PROPERTY	VALUE	FREQUENCY (MINIMUM)
ASTM D1505 Polymer Density	0.932 to 0.950 (g/cm3)	not less than 1 test per resin lot
ASTM D1238 Polymer Melt Index	≤ 1.0 g/10 min.	not less than 1 test per resin lot
ASTM D3895 Oxidation Induction Time	> 100 min.	not less than 1 test per resin lot

The MANUFACTURER shall test the geomembrane per the frequency of material per lot, at a minimum, that conforms to TABLE 02700-3 LLDPE GEOMEMBRANE MQC TESTING as required by TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner.

TABLE 02700-3 LLDPE LINER MQC TESTING

TEST METHOD/PROPERTY	FREQUENCY (MINIMUM)
ASTM D7466/D7466M-10(2015)e1 Asperity Height	1 per 100,000 SF
ASTM D1505-18 Polymer Density	1 per 100,000 SF
ASTM D5994/D5994M-10(2015)e1 Thickness	1 per 50,000 SF
ASTM D6693/D6693M-20 Tensile Property (each direction)	1 per 100,000 SF
ASTM D6693/D6693M-20 Yield Stress	1 per 100,000 SF
ASTM D6693/D6693M-20 Yield Elongation	1 per 100,000 SF
ASTM D6693/D6693M-20 Break Stress	1 per 100,000 SF
ASTM D6693/D6693M-20 Break Elongation	1 per 100,000 SF
ASTM D4218 Carbon Black Content	1 per 100,000 SF
ASTM D5596-03(2021) Carbon Black Dispersion[1]	1 per 100,000 SF

Notes:

1. Carbon black dispersion for 10 different views: All 10 views in categories 1, 2.

6.1.2 Delivery, Handling, and Storage

6.1.2.1 Delivery and Handling

Rolls of geomembrane will be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading according to the MANUFACTURER'S recommendations.

Upon delivery at the PROJECT site, visual observation by the INSTALLER and the CQAR shall be conducted on all rolls for evidence of defects or damage. This observation shall be done without unrolling the rolls unless damage or defects are detected. No off-loading shall be performed unless the OWNER or CQAR is present. The CONTRACTOR is responsible for off-loading and storage of the geomembrane. The CONTRACTOR is responsible for replacing damaged or unacceptable material. Damage during off-loading shall be documented by the CQAR. Rolls of geomembrane exhibiting damage shall be marked and set aside for closer examination during deployment. Damaged materials will be identified and repaired per TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner or rejected at the discretion of the CQA CONSULTANT.

6.1.2.2 Storage

Storage of the geomembrane rolls shall be the responsibility of the CONTRACTOR. The materials shall be unloaded by the CONTRACTOR in areas designated by the OWNER. The CONTRACTOR shall provide the proper equipment and labor necessary to unload the material. Rolls shall not be stacked upon one another to the extent that deformation of the core or flattening of the rolls occurs and no more than three rolls high. At a minimum, the storage location for geomembrane material shall

provide protection from theft, vandalism, traffic, light, punctures, abrasions, excessive dirt, and moisture that may damage the geomembrane material.

6.2 GEOMEMBRANE CONFORMANCE TESTING

6.2.1 Conformance Sample Collection

The geomembrane conformance samples will be selected and collected at the required frequency according to TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner by the CQA CONSULTANT or the OWNER'S REPRESENTATIVE prior to shipment of the material to the PROJECT site. Samples shall not include any portion of a roll which has been subjected to excess pressure or stretching. All lots of material and the particular sample that represents each lot will be defined before the samples are obtained. The conformance samples shall be sent to the CQA GEOSYNTHETICS LABORATORY for conformance testing.

6.2.2 Conformance Testing

Conformance samples of the geomembrane will be tested by the CQA CONSULTANT prior to shipment to the PROJECT site. Geomembrane shall not be shipped prior to testing without CQA CONSULTANT approval. Geomembrane shipped to the PROJECT site without approved conformance test results shall be sampled and tested upon delivery to the PROJECT site by the CQA CONSULTANT. All costs associated with collecting and shipping samples from the PROJECT site will be the CONTRACTOR'S responsibility. The following conformance tests will be conducted by the CQA GEOSYNTHETICS LABORATORY according to TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner:

TABLE 02700-4 REQUIRED CONFORMANCE TESTING

TEST METHOD/PROPERTY	FREQUENCY (MINIMUM)
ASTM D7466/D7466M - 10(2015)e1 Asperity Height	1 per 100,000 SF
ASTM D5994/D5994M - 10(2015)e1 Thickness	1 per 100,000 SF
ASTM D4218-20 Carbon Black Content	1 per 100,000 SF
ASTM D5596-03(2021) Carbon Black Dispersion	1 per 100,000 SF
ASTM D1505-18 or ASTM D792-20 Density	1 per 100,000 SF
ASTM D6693/D6693M-20 Type IV Tensile Properties	1 per 100,000 SF
ASTM D5321/D5321M-20 Interface Friction Angle Geomembrane/Subbase	1 per 200,000 SF
ASTM D5321/D5321M-20 Interface Friction Angle Geocomposite/Geomembrane	1 per 200,000 SF
ASTM D5321/D5321M-20 Interface Friction Angle Soil/Geocomposite	1 per 200,000 SF

Notes: Refer to TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner for ASTM D5321 Interface Friction Angle test requirements.

Prior to the deployment of the geomembrane, the CQA CONSULTANT shall review all conformance test results and report any non-conformance to the OWNER, INSTALLER, and MANUFACTURER. The CQA CONSULTANT shall be responsible for verifying all test results meet or exceed the property values listed in TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner. If failing test results may be the result of the sampling process or due to the Manufacturing Quality Control incorrectly conducting the test, the MANUFACTURER may request a retest to be conducted at the CQA GEOSYNTHETICS LABORATORY, at no cost to the OWNER, in the presence of a representative of the MANUFACTURER.

All material from a lot represented by a failing test result shall be rejected, or additional conformance test samples may be taken to isolate the portion of the lot not meeting the TECHNICAL SPECIFICATIONS (this procedure is valid only when rolls in a lot are consecutively produced and numbered from one manufacturing line). Additional samples shall be taken from rolls on either side of the failing roll, until passing test results are achieved, to establish the range of failure within the lot. All rolls lying within this range of failure shall be rejected.

The MANUFACTURER may also have the sample retested at the MANUFACTURER'S own expense at two different laboratories approved by the OWNER. If both laboratories report passing results, the material shall be accepted. If both laboratories do not report passing results, all geomembrane material from the lot representing the failing sample will be considered not meeting the TECHNICAL SPECIFICATIONS and will be rejected.

6.3 GEOMEMBRANE FIELD QUALITY CONTROL

6.3.1 Panel Identification

The CQA CONSULTANT shall verify each field panel is given a unique identification code (number or letter-numbered) consistent with the layout plan. This identification code shall be agreed upon by the CQA CONSULTANT and INSTALLER. The CQA CONSULTANT and INSTALLER shall establish a table or chart showing correspondence between roll numbers and field panel identification codes. The field panel identification code shall be used for all CQA documentation.

The CQA CONSULTANT shall verify field panels are installed at the location indicated in the INSTALLER'S layout plan, as approved or modified, and that the INSTALLER has marked the identification code and roll number on each installed panel. The CQA CONSULTANT and INSTALLER shall also verify the condition of the supporting soil has not changed detrimentally during installation. The CQA CONSULTANT shall record the identification code, location, and date of installation of each field panel.

6.3.2 Panel Placement and Deployment

The geomembrane shall be installed in accordance with the MANUFACTURER'S recommendations and the CONTRACT DOCUMENTS and TECHNICAL SPECIFICATIONS. In case of a conflict between these documents, the more stringent requirements shall apply. Any deviations from these procedures must be reviewed and accepted by the CQA CONSULTANT and/or DESIGN ENGINEER prior to construction.

Geomembrane panel placement shall not be during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in areas of ponded water, or in the presence of strong winds.

MANUFACTURER'S recommendations or the TECHNICAL SPECIFICATIONS should be followed, whichever is more stringent, for extreme ambient temperature conditions.

Assign each panel a simple and logical identifying code. The coding system shall be subject to approval by the CQA CONSULTANT and shall be determined at the PROJECT site.

Panels shall be oriented according to the INSTALLER'S panel layout drawing as approved by the CQA CONSULTANT. Seams shall be located outside of areas of potentially high-stress conditions, at slope intersections and corners, or other areas considered critical. The CQAR shall review the seam orientations prior to seaming operations to determine if these conditions are satisfied.

The CQA CONSULTANT shall verify the geomembrane handling equipment used does not pose the risk of damage to the geomembrane or Intermediate Cover, and that the INSTALLER'S personnel take care in handling the geomembrane at all times. Contact between the Intermediate Cover and the geomembrane shall be maintained in all areas. The INSTALLER shall take into account ambient temperature and its effect on the thermal expansion and contraction of the geomembrane. The geomembrane materials shall be deployed in a manner that minimizes wrinkling. Partial backfilling of anchor trenches and adequate loading of the toe of the slope during lower ambient temperatures are recommended to prevent displacement by bridging. The CQA CONSULTANT shall also verify and notify the CONTRACTOR that:

- Equipment used does not damage the geomembrane during trafficking, handling, excessive heat, or other means.
- The method of deploying the geomembrane does not cause excessive scratches or crimps in the geomembrane and does not damage the approved Intermediate Cover.
- Personnel walking on the product shall not engage in activities or wear footwear that could damage the material. Smoking shall not be permitted on or near the geosynthetics.
- The geomembrane is protected by appropriate means in areas of excessive traffic.
- Adequate ballasts (e.g., sand bags) have been placed to prevent wind uplift and are not likely to damage the geomembrane. Continuous loading is recommended along edges of panels in high winds, or when WORK is terminated for several days or longer periods.

The CQAR shall visually inspect each panel for defects or damage after placement and prior to seaming. Damaged panels or portions of damaged panels shall be marked and repaired, or removed from the WORK area. Repairs shall be made according to procedures described in the TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner.

6.3.2.1 Personnel Requirement

The INSTALLER shall be pre-qualified in accordance with the TECHNICAL SPECIFICATIONS and approved by the OWNER. The INSTALLER'S superintendent shall be qualified based on previously demonstrated experience, management ability, and authority. The superintendent is responsible for the INSTALLER'S field crew and will represent the INSTALLER at all PROJECT meetings.

6.3.2.2 Seam Layout

Prior to the installation of the geomembrane, the INSTALLER shall provide the OWNER and CQA CONSULTANT with a panel layout drawing of each showing all expected major panel seams. The CQA CONSULTANT shall approve in writing the panel layout drawing.

6.3.2.3 Seaming Methods

Accepted seaming methods include double wedge fusion welding and extrusion welding which will result in seams that meet testing requirements as indicated in TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner for both destructive and non-destructive samples.

- Fusion-welding apparatus shall be an automated, roller-mounted device. The fusion-welding apparatus shall be equipped with gauges indicating the applicable temperatures. The CQAR shall log ambient, seaming apparatus, and geomembrane surface temperatures.

- Extrusion-welding apparatus shall be equipped with gauges indicating the temperature in the apparatus and at the nozzle.

- The CQAR shall log apparatus temperatures, extrudate temperatures, ambient temperatures, and geomembrane surface temperatures at appropriate intervals.

The INSTALLER shall provide documentation regarding the extrudate to the CQA CONSULTANT, and shall certify that the extrudate is compatible with TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner and is comprised of the same resin as the geomembrane sheeting.

6.3.2.4 Seam Preparation

The CQAR shall verify the following:

- Seams are aligned with the fewest possible number of wrinkles and “fishmouths.”

- Prior to seaming, the seam area is clean and free of moisture, dust, dirt, debris of any kind, and foreign material.

- If seam overlap grinding is required, the process is completed according to the MANUFACTURER’S instructions within two hours of the seaming operation and does not damage the geomembrane.

- For cross seams, the edge of the cross seam is ground to a smooth incline (top and bottom) prior to welding.

- A smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage.

- The geomembrane is protected from damage in heavily-trafficked areas.

- A movable protective layer (i.e., waste geomembrane) may be used as necessary directly below each overlap of geomembrane that is to be seamed to prevent the buildup of moisture between the sheets.

- Align seam overlaps consistent with the requirements of the welding equipment being used. The panels of the geomembrane have a finished overlap of 4 inches for extrusion welding and 6 inches for fusion welding, but in any event, sufficient overlap shall be provided to allow peel tests to be performed on the seam.

- The procedure used to temporarily bond adjacent panels together does not damage the geomembrane.

6.3.2.5 Seaming Procedures

If the INSTALLER proposes to conduct seaming operations outside of the approved conditions as specified herein (i.e., outside the weather parameters or night operations), written information and supporting data verifying seam quality can be maintained shall be submitted to the CQA CONSULTANT for review and approval 48 hours in advance. Alternate seaming operations will not be allowed without prior approval from the CQA CONSULTANT. If during the course of the WORK, the CQA CONSULTANT or OWNER decides the WORK is inadequate, the CONTRACTOR shall adjust operations as required or WORK shall be ceased. The TECHNICAL SPECIFICATIONS for placing and seaming the geomembrane shall apply to all WORK conditions.

Seams shall meet the following requirements:

- To the maximum extent possible, orient seams parallel to the line of the slope, i.e., down and not across the slope.

- Minimize the number of field seams in corners, odd-shaped geometric locations, and outside corners.

- Use a sequential seam numbering system compatible with the panel numbering system that is agreeable to the CQA CONSULTANT and INSTALLER.

- Align seam overlaps consistent with the requirements of the welding equipment being used. The panels of the geomembrane have a finished overlap of 4 inches for extrusion welding and 6 inches for fusion welding, but in any event, sufficient overlap shall be provided to allow peel tests to be performed on the seam.

- Seaming shall extend to the outside edge of panels placed within the anchor trench.

6.3.2.6 Extrusion Welding

- Hot-air tack adjacent pieces together using procedures that do not damage the geomembrane.

- Clean geomembrane surfaces by disc grinder or equivalent.

- Purge welding apparatus of heat-degraded extrudate before welding.

6.3.2.7 Hot Wedge Welding

- Welding apparatus shall be a self-propelled device equipped with an electronic controller which displays applicable temperatures.
- Clean seam area of dust, mud, moisture, and debris immediately ahead of hot wedge welder.
- Protect against moisture build-up between sheets.

6.3.2.8 Trial Welds

The CQAR will observe and document the trial welds conducted by the INSTALLER.

- Perform trial welds on geomembrane samples to verify welding equipment is operating properly.
- Make trial welds under the same surface and environmental conditions as the production welds, i.e., in contact with subgrade and similar ambient temperature.
- Minimum of 2 trial welds per day, per welding apparatus, 1 made prior to the start of WORK, and 1 completed at mid-shift (typically after lunch break). Additionally, perform trial welds at any time the welding equipment is shut down and restarted.
- Cut four, 1 inch wide by 6 inch long test strips from the trial weld.
- Quantitatively test specimens for peel adhesion and then for shear strength.
- Trial weld specimens for the geomembrane shall meet requirements in accordance with the TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner.
- Repeat the trial weld, in its entirety, when any of the trial weld samples fail in either peel or shear.
- No welding equipment or welder shall be allowed to perform production welds until equipment and welders have successfully completed passing trial welds.

6.3.3 Field Seam Testing

6.3.3.1 Non-destructive Testing

The INSTALLER shall non-destructively test all field seams over their full length using a vacuum test unit, air pressure test (double fusion seams only), or other approved method. The purpose of this testing is to determine the continuity of the seams only. Non-destructive testing shall be performed as WORK progresses, not at completion.

The INSTALLER shall complete required repairs in accordance with the TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner. The CQA CONSULTANT shall observe the repair and testing of the repair, document the location, date, name, and outcome of all testing and mark on the geomembrane the repair has been completed. All repairs shall be shown on the Record Drawings

(e.g. the panel layout sheet) and in repair logs and on daily reports. The CQAR shall inform the INSTALLER and CONTRACTOR of required repairs.

- Vacuum Box Testing - Equipment and methods are discussed in TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner. Air pressure testing procedures are applicable to fusion-welding that produces a double seam with an enclosed air channel.

- Air Pressure Testing - Shall be performed in accordance with in TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner.

6.3.3.2 Destructive Testing

Destructive seam tests shall be performed on seam samples cut from the geomembrane locations selected by the CQA CONSULTANT. The purpose of these tests is to evaluate seam strength. Seam strength testing shall be done as the seaming work progresses, not at the completion of all field seaming. The CQA CONSULTANT shall select locations where seam samples will be cut by the INSTALLER for laboratory testing. Those locations shall be established as follows:

- Installed geomembrane shall be tested at a rate of one test per 500 linear feet of fusion welded seam at locations selected by the CQA CONSULTANT.

- At least one location for each seaming machine each day.

- At locations where the CQAR suspects that inadequate seaming methods or conditions occurred or other factors causing to reduce seam strength exist. The INSTALLER shall not be informed in advance of the locations where the destructive seam samples will be taken.

6.3.3.2.1 Destructive Sample Procedures

Samples shall be cut by the INSTALLER at locations selected by the CQAR as the seaming progresses, such that laboratory test results are available before the geomembrane is covered by another material. The CQAR shall observe the sample cutting, assign a number to each sample, and mark it accordingly, and record the sample location on the layout drawing. All holes in the geomembrane resulting from destructive seam sampling shall be immediately repaired in accordance with specified repair procedures. The continuity of the new seams in the repaired area shall be non-destructively tested according to procedures described herein and TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner.

The INSTALLER shall remove the sample with the seam centered lengthwise, approximately 12 inches wide across the seam by 16 inches long. The sample shall be cut into three segments and distributed as follows:

- A 12 inch by 14 inch portion to the CQA CONSULTANT for Third-Party Laboratory Quality Assurance testing.

- A 12 inch by 16 inch portion shall be retained by the INSTALLER for field testing.

- A 12 inch by 16 inch portion to the OWNER for archive storage.

Testing performed on each sample shall include geomembrane peel adhesion and seam strength.

Seam peel strength and shear strength shall meet the requirements specified in TABLE 02700-5 MINIMUM PEEL AND SHEAR SEAM STRENGTH VALUES. The CQA CONSULTANT is responsible for packaging and shipping samples to the CQA GEOSYNTHETICS LABORATORY in a manner that will not damage the samples.

TABLE 02700-5 MINIMUM PEEL AND SHEAR SEAM STRENGTH VALUES

TEST METHOD/PROPERTY	VALUE (MINIMUM)
ASTM D6392 Peel Strength	
Wedge Weld	50 (lb/in width)
Extrusion Weld	50 (lb/in width)
Peel Separation	<25 (%)
ASTM D6392 Shear Strength	
Wedge Weld	50 (lb/in width)
Extrusion Weld	50 (lb/in width)
Peel Separation	<25 (%)

- Field Testing - Ten 1-inch wide strips shall be cut from the CONTRACTOR portion of the sample and these shall be tested using a tensiometer in the field by the INSTALLER, 5 for peel and 5 for shear. If any field test sample fails to pass the TECHNICAL SPECIFICATIONS then the procedures outlined in TECHNICAL SPECIFICATIONS Section 02700 LLDPE Geomembrane Liner shall be followed.

6.3.3.3 CQA Geosynthetics Laboratory

Testing by the CQA CONSULTANT will include seam strength and peel adhesion. A total of 5 specimens will be tested from each sample for each test method. All of the 5 specimens must pass the minimum values listed in TABLE 02700-5 MINIMUM PEEL AND SHEAR SEAM STRENGTH VALUES. Specimens will be selected from the samples and tested alternately, by test (i.e. peel, shear, peel, shear).

All specimens must separate by FTB failure for each test in order for the seam to pass destructive test sampling. If the failure is FTB but an AD-BRK with an incursion of 25% or greater occurs the test will be considered a failure. The results will not be averaged. The CQA CONSULTANT will provide test results to the CONTRACTOR no more than 48 hours after the samples are received at the laboratory. The only exception shall be weekends or official holidays when the laboratories are closed. Arrangements to schedule testing of destructive samples on weekends and holidays shall be approved by the CQA CONSULTANT 48 hours in advance. Additional costs for lab work on holidays or weekends shall be at no additional expense to the OWNER and shall be paid by the CONTRACTOR.

6.3.3.4 Procedures for Destructive Test Failures

The following procedures shall apply whenever a sample fails a destructive test, whether the test is conducted by the CQA CONSULTANT laboratory or the CONTRACTOR by field tensiometer. The geomembrane INSTALLER shall have two options.

- The geomembrane INSTALLER can reconstruct the seam between any two passed test locations.

- The geomembrane INSTALLER can trace the welding path to an intermediate location at 10 feet, minimum, from the location of the failed test in each direction, and take a specimen for an additional field test at each location. If these additional specimens pass the test, then full laboratory destructive samples shall be taken. If these laboratory samples pass, then the seam shall be reconstructed between these locations. If either sample fails, then the process shall be repeated to establish the zone in which the seam should be reconstructed. In any case, all acceptable seams must be bounded by two locations from which samples passing laboratory destructive tests have been taken. In cases exceeding 100 feet of reconstructed seam, a sample taken from within the reconstructed zone must pass destructive testing. Whenever a sample fails, additional testing may be required for seams that were welded by the same welder and/or welding apparatus or welded during the same time shift.

6.3.4 Defects, Repairs, and Wrinkles

All seams and non-seam areas of the geomembrane shall be inspected by the INSTALLER and CQA CONSULTANT for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of observation. The geomembrane surface shall be brushed, blown, or washed by the CONTRACTOR if the amount of dust, mud, or debris inhibits observation. The CQA CONSULTANT shall decide if cleaning of the geomembrane is needed to facilitate observation.

WORK shall not proceed with any materials that will cover locations that have been repaired until the CQA CONSULTANT has re-examined the repaired area and applicable laboratory test results with passing values are available. Panels or portions of panels that are, in the opinion of the CQA CONSULTANT, damaged beyond repair shall be removed from the site and replaced. Damage, which in the opinion of the CQA CONSULTANT, can be repaired may be repaired or replaced. Any portion of the geomembrane exhibiting a flaw or failing a destructive or non-destructive test shall be repaired. The final decision as to the appropriate repair procedure shall be agreed upon between the CQA CONSULTANT and INSTALLER by using one of the following repair methods:

- Patching - Patches shall be round or oval in shape, made of the same geomembrane, and extend a minimum of 4 inches beyond the edge of defects. All patches shall be of the same compound and thickness as the geomembrane specified. All patches shall have their top edge beveled with an angle grinder prior to placement on the geomembrane. Patches shall be applied using approved methods only.

- Abrading and Re-welding - Used to repair short sections of a seam.

- Spot Welding - Used to repair pinholes or other minor, localized flaws, or where geomembrane thickness has been reduced.

- Capping - Used to repair long lengths of failed seams.

- Remove the unacceptable seam and replace with new material.

Each repair shall be numbered and logged. Each repair shall be non-destructively tested. In addition, the CQA CONSULTANT may require a destructive seam sample be obtained from a repaired seam.

Repairs that pass the non-destructive and/or destructive test shall be taken as an indication of an adequate repair. Large caps (over 150 feet) shall require destructive test sampling. In the case of failed tests, the repair shall be redone and retested until a passing test result. The CQA CONSULTANT shall observe all repairs and all non-destructive testing of repairs, note on the geomembrane that it has been repaired, and document each repair thoroughly.

When seaming of the geomembrane is completed (or when seaming of a large area of the geomembrane is completed) and prior to placing overlying materials, the CQA CONSULTANT shall indicate which wrinkles shall be cut and re-seamed by the INSTALLER. Wrinkle size shall be evaluated during the time of day and under conditions similar to those expected when overlying material is to be placed. All wrinkles higher than they are wide (across their base) or more than 6 inches high shall be removed by repair methods and retested.

7.0 GEOCOMPOSITE MATERIAL

7.1 GEOCOMPOSITE MANUFACTURING AND DELIVERY

This CQA Plan has been created to verify the specified geocomposite is manufactured and tested according to TECHNICAL SPECIFICATIONS Section 02931 Geocomposite.

7.1.1 Manufacturing

7.1.1.1 Manufacturer Quality Control Documentation

The GEOCOMPOSITE MANUFACTURER shall provide documentation and certification the material meets the requirements outlined in TECHNICAL SPECIFICATIONS Section 02931 Geocomposite and MQC measures have been implemented during the manufacturing process. The following information will be provided by the GEOCOMPOSITE MANUFACTURER to the CQA CONSULTANT prior to shipment of the geocomposite to the PROJECT site:

- A list of materials which comprise the geotextile and geonet (geocomposite) and a specification for each which includes all properties contained in TECHNICAL SPECIFICATIONS Section 02931 Geocomposite measured using the appropriate test methods.

- A specification for the fused geotextile and geonet (geocomposite) which includes all properties contained in TECHNICAL SPECIFICATIONS Section 02931 Geocomposite measured using the appropriate test methods.

- A written certification signed by an officer or the Quality Control Manager that the geocomposites delivered for the project have minimum average roll value properties which meet or exceed the properties provided in the TECHNICAL SPECIFICATIONS and are guaranteed by the MANUFACTURER.

- A written certification that the MANUFACTURER has continuously inspected the geotextile for the presence of needles and has found the geotextile to be needle-free.

- MQC test results performed by the MANUFACTURER in accordance with test methods and frequencies required by the TECHNICAL SPECIFICATIONS to verify the geotextile meets the TECHNICAL SPECIFICATIONS.

- MQC certifications, which shall include roll identification numbers, sampling procedures, and quality control test results for the geotextile, geonet, and geocomposite signed by a responsible party employed by the MANUFACTURER.

All rolls of geocomposite shall be identified by the MANUFACTURER with the following:

- MANUFACTURER'S Name
- Product Identification
- Lot Number
- Roll Number
- Roll Dimensions.

The CQA CONSULTANT shall examine the rolls of geocomposite upon delivery to the PROJECT site and any deviation from the above requirements shall be reported by the CQA CONSULTANT to the INSTALLER and CONTRACTOR

7.1.1.2 Manufacturer Quality Control Certificates

The GEOCOMPOSITE MANUFACTURER shall be required to perform, at a minimum, the tests listed in TECHNICAL SPECIFICATIONS Section 02931 Geocomposite. Prior to shipment to the PROJECT site, the GEOCOMPOSITE MANUFACTURER shall provide the CQA CONSULTANT the MQC certificates for the geocomposite, written on the MANUFACTURER'S company letterhead, for each roll of geocomposite, signed by a responsible party employed by the GEOCOMPOSITE MANUFACTURER. The MQC certificates shall include, at a minimum, the roll identification numbers and the MQC test results (listed individually). The CQA CONSULTANT shall review the MQC certificates and verify the required testing frequencies and results meet the requirements specified according to TECHNICAL SPECIFICATIONS Section 02931 Geocomposite and the MANUFACTURER'S guaranteed minimum values for all materials and rolls. The CQA CONSULTANT shall report any noncompliance to the OWNER, INSTALLER, and GEOCOMPOSITE MANUFACTURER.

7.1.1.3 Manufacturer Quality Control Testing

LLDPE resin testing during manufacturing shall be accomplished by the GEOCOMPOSITE MANUFACTURER laboratory. The MANUFACTURER shall test the resin batches per the frequency, at a minimum, that conforms to TABLE 02931-1 RESIN MQC TESTING as required by TECHNICAL SPECIFICATIONS Section 02931 Geocomposite. The finished rolls shall be identified by a roll number corresponding to the resin batch used.

TABLE 02931-1 RESIN MQC TESTING

TEST METHOD/PROPERTY	SPECIFIED VALUE	FREQUENCY (MINIMUM)
ASTM D1505 Polymer Density	minimum 0.940 g/cm3	1 per batch
ASTM D1238 Polymer Melt Flow Index	maximum 1.0 g/10min	1 per batch

Geonet shall be tested during manufacturing for compliance with TABLE 02931-1 GEONET PROPERTIES. Minimum test frequencies shall be observed according to TABLE 02931-2 GEONET MQC TESTING.

TABLE 02931-2 GEONET MQC TESTING

TEST METHOD/PROPERTY	FREQUENCY (MINIMUM)
ASTM D5199 Thickness	1 per 50,000 SF
ASTM D7179 Tensile Strength	1 per 100,000 SF
ASTM D4218 Carbon Black	1 per 100,000 SF
ASTM D1505 Polymer Density	1 per 100,000 SF
ASTM D1238 Polymer Melt Index	1 per 100,000 SF

Geotextile shall be tested during manufacturing for compliance with TABLE 02931-2 GEOTEXTILE PROPERTIES. Minimum test frequencies shall be observed according to TABLE 02931-3 GEOTEXTILE MQC TESTING.

TABLE 02931-3 GEOTEXTILE MQC TESTING

TEST METHOD/PROPERTY	FREQUENCY (MINIMUM)
ASTM D4491 Permittivity	1 per 100,000 SF
ASTM D5261 Mass per Unit Area	1 per 100,000 SF
ASTM D4751 AOS	1 per 100,000 SF
ASTM D4632 Grab Tensile	1 per 100,000 SF
ASTM D4632 Grab Elongation	1 per 100,000 SF
ASTM D4533 Trapezoidal Tear Strength	1 per 100,000 SF
ASTM D6241 CBR Puncture	1 per 100,000 SF

Upon fusion of the geotextile and geonet, the product shall be tested during manufacturing for compliance with TABLE 02931-3 GEOCOMPOSITE PROPERTIES. Minimum test frequencies shall be observed according to TABLE 02931-4 GEOCOMPOSITE MQC TESTING.

TABLE 02931-4 GEOCOMPOSITE MQC TESTING

TEST METHOD/PROPERTY	FREQUENCY (MINIMUM)
ASTM D4716 Transmissivity	1 per 100,000 SF
ASTM D7005 Ply Adhesion	1 per 100,000 SF

7.1.2 Delivery, Handling, and Storage

7.1.2.1 Delivery and Handling

Geocomposites shall be protected from ultraviolet light exposure, precipitation, mud, puncture, cutting, or other deleterious conditions during shipment, handling, and storage. Geocomposite rolls shall be shipped and stored in relatively opaque and watertight wrapping which shall be removed shortly before deployment.

The INSTALLER shall handle all geocomposite rolls in such a manner as to minimize damage, and the following shall be complied with:

- All deployed geocomposite shall be stabilized with sandbags or equivalent ballast in the presence of wind. Such sandbags shall remain until replaced with cover material.
- The entire surface of the geocomposite shall be visually inspected to ensure that no potentially harmful foreign objects are present.
- During placement of the geocomposite, care shall be taken not to entrap any dirt or excessive dust in the geocomposite that could cause clogging of the drainage system and/or stones that could damage the adjacent geomembrane or hamper subsequent seaming. If dirt or excessive dust is entrapped in the geocomposite, it should be hosed clean prior to placement of the next material on top of it.
- On slopes, the geocomposite shall be secured in the anchor trench and the material rolled down the slope in such a manner as to continually keep the geocomposite sheet in tension. If necessary, the geocomposite shall be positioned by hand after being unrolled to minimize wrinkles.
- Geocomposites shall be cut using an approved cutter only. If in place, special care must be taken to protect other materials from damage that could be caused by the cutting of the geocomposite.
- The INSTALLER shall take any necessary precautions to prevent damage to underlying layers during the placement of the geocomposite.
- After installation, a visual examination of the geocomposite shall be carried out over the entire surface, to verify that no potentially harmful foreign objects, such as needles or staples, are present.
- The CQA CONSULTANT shall report any noncompliance to the OWNER and INSTALLER.

7.1.2.2 Storage

Storage of the geocomposite rolls shall be the responsibility of the CONTRACTOR. The materials shall be unloaded by the CONTRACTOR in areas designated by the OWNER. The CONTRACTOR shall provide the proper equipment and labor necessary to unload the material. Rolls shall not be stacked upon one another to the extent that deformation of the core or flattening of the rolls occurs. At a minimum, the storage location for geocomposite material shall provide protection from theft, vandalism, traffic, light, punctures, abrasions, excessive dirt, and moisture that may damage the geocomposite material.

7.2 GEOCOMPOSITE CONFORMANCE TESTING

7.2.1 Conformance Sample Collection

The geocomposite conformance samples will be selected and collected at the required frequency according to TECHNICAL SPECIFICATIONS Section 02931 Geocomposite by the CQA CONSULTANT or the OWNER'S REPRESENTATIVE prior to shipment of the material to the PROJECT site. Geocomposite shall not be shipped prior to testing without CQA CONSULTANT approval. Geocomposite shipped to the PROJECT site without approved conformance test results shall be sampled and tested upon delivery to the PROJECT site by the CQA CONSULTANT. All costs associated with collecting and shipping samples from the PROJECT site will be the CONTRACTOR'S responsibility.

7.2.2 Conformance Testing

Conformance samples of the geocomposite will be tested by the CQA CONSULTANT prior to shipment to the PROJECT site. Geomembrane shall not be shipped prior to testing without CQA CONSULTANT approval. Geocomposite shipped to the PROJECT site without approved conformance test results shall be sampled and tested upon delivery to the PROJECT site by the CQA CONSULTANT. All costs associated with collecting and shipping samples from the PROJECT site will be the CONTRACTOR'S responsibility.

The conformance samples shall be sent to the CQA GEOSYNTHETICS LABORATORY for conformance testing. Samples shall not include the first complete revolution. The sample shall be a minimum of four feet, as measured along the width of the roll, and extend three feet along the roll. Samples shall be taken at a rate of at least one sample per lot, but at a rate not less than one conformance test per every 1 per 100,000 SF or portion thereof. Samples shall not include any portion of a roll which has been subjected to excess pressure or stretching. All lots of material and the particular test sample that represents each lot will be defined before the samples are obtained. The following conformance tests will be conducted by the CQA GEOSYNTHETICS LABORATORY according to TECHNICAL SPECIFICATIONS Section 02931 Geocomposite:

TABLE 02931-5 GEONET PROPERTIES

TEST METHOD/PROPERTY	SPECIFIED VALUE	FREQUENCY (MINIMUM)
ASTM D5199 Thickness (Top Slope)	330 mil (min. avg.)	1 per 100,000 SF
ASTM D5199 Thickness (Side Slope)	300 mil (min. avg.)	1 per 100,000 SF
ASTM D7179 Tensile Strength [1]	60 lbs/in (min. avg.)	1 per 100,000 SF
ASTM D4218 Carbon Black	2.0 - 3.0%	1 per 100,000 SF
ASTM D1505 Polymer Density	0.940 g/cc (min. avg.)	1 per 100,000 SF
ASTM D1238 Polymer Melt Index	1.0 g/10min (max)	1 per 100,000 SF

Notes:

1. Machine direction.

TABLE 02931-6 GEOTEXTILE PROPERTIES

TEST METHOD/PROPERTY	SPECIFIED VALUE	FREQUENCY (MINIMUM)
ASTM D5261 Mass per Unit Area	6 oz/yd2 (MARV)	1 per 100,000 SF
ASTM D4751 AOS	#70 sieve (0.212 mm) (MaxARV)	1 per 100,000 SF
ASTM D6241 CBR Puncture	435 lbs (MARV)	1 per 100,000 SF
ASTM D4491 Permittivity	1.5 sec-1 (Min.)	1 per 100,000 SF
ASTM D4632 Grab Tensile	170 lbs (MARV)	1 per 100,000 SF
ASTM D4632 Grab Elongation	50 lbs (MARV)	1 per 100,000 SF
ASTM D4533 Trapezoidal Tear Strength	65 lbs (Min.)	1 per 100,000 SF

TABLE 02931-7 GEOCOMPOSITE PROPERTIES

TEST METHOD/PROPERTY	SPECIFIED VALUE	FREQUENCY (MINIMUM)
ASTM D7005 Ply Adhesion	1 lbs/inch (Avg.)	1 per 100,000 SF
ASTM D4716 Transmissivity [1](Top Slope)	3.3 x 10-3 m2/sec (Min.)	1 per 100,000 SF
ASTM D4716 Transmissivity[1] (Side Slope)	1.72 x 10-3 m2/sec (Min.)	1 per 100,000 SF
ASTM D5321 Interface Friction Angle Protective Cover Material/Geocomposite	20.5 degrees (Min.)	1 per 100,000 SF
ASTM D5321 Interface Friction Angle Geocomposite/Geomembrane	20.5 degrees	1 per 100,000 SF

7.3 GEOCOMPOSITE FIELD QUALITY CONTROL

Prior to the deployment of the geocomposites, the CQA CONSULTANT shall review all conformance test results and report any non-conformance to the OWNER, INSTALLER, and MANUFACTURER. The CQA CONSULTANT shall be responsible for verifying that all the test results meet or exceed the property values listed in TECHNICAL SPECIFICATIONS Section 02931 Geocomposite.

7.3.1 Deployment

The geocomposite shall be installed in accordance with the MANUFACTURER'S recommendations and the CONTRACT DOCUMENTS and TECHNICAL SPECIFICATIONS. In case of a conflict between these documents, the more stringent requirements shall apply. Any deviations from these procedures must be reviewed and accepted by the CQA CONSULTANT and/or DESIGN ENGINEER prior to construction.

Geocomposite shall be rolled down the slope in such a manner as to continually keep the material in tension. If necessary, the material shall be positioned by hand after unrolling to minimize wrinkles. The material shall not be unrolled laterally (i.e., across the slope).

7.3.2 Roll Joining Methods

Lap Seams - The bottom layer of geotextile shall be lap seamed. Lap seaming is accomplished by overlapping adjacent geotextiles a minimum of 4 inches.

Nylon Ties - The geonet shall be overlapped and fastened with nylon ties. Nylon ties shall be yellow or white in color to facilitate observation.

Machine Sewn Seams - The top layer of geotextile shall be sewn. Sewing shall be accomplished with a lock-stitching sewing machine, stitch Type 401. The thread shall be polymeric thread which complies with MANUFACTURER'S recommendations. The seam shall be placed at a minimum of 4 inches from the geotextile edges. The finished seam shall be folded to one side.

7.3.3 Roll Joining Requirements

Roll Ends - The end of each roll of geocomposite shall be overlapped a minimum of 6 inches. The geonet portion shall be shingled, with the uphill end overlapping the downhill end. The geonet portion shall be tied 2 feet on center at a minimum. The bottom layer of geotextile shall be overlapped a minimum of 6 inches. The upper layer of geotextile shall be machine-sewn. Where the geocomposite is to terminate, the upper geotextile shall be folded over the ends with a minimum of 6 inches of geotextile placed under the geocomposite. Butt seams should be staggered. Heat seal the top layer of geotextile.

Adjacent Roll Sides - At roll sides, the material shall be overlapped a minimum of 6 inches. The bottom geotextile shall be overlapped. The geonet shall be overlapped and tied a minimum of 2 feet on center with nylon ties as described above. The upper layer of geotextile shall be machine-sewn.

7.3.4 Defects and Repairs

Limitations - In general, damaged, soiled, or delaminated products shall be discarded. Products that have major damage that require extensive repairs or replacement shall be discarded as directed by the OWNER at the CONTRACTOR'S expense.

Minor Damage - Minor damage is defined as a hole 2 inches or smaller in diameter in the product. Minor damage shall be repaired by snipping out protruding geonet and machine sewing or thermal bonding a geotextile patch over the hole. The patch shall be a minimum of 6 inches larger than the damaged area in all directions. If thermal bonding is conducted, care shall be taken to prevent excessive heat damage to the surrounding geosynthetics.

Major Damage - Major damage is defined as a hole larger than 2 inches diameter through the product. Major damage shall be repaired by replacing the entire panel width.

7.3.5 Placement of Soil Materials

The CONTRACTOR or INSTALLER shall place all soil materials on top of a geotextile in such a manner as to prevent:

- Damage to the geocomposite.
- Slippage of the geocomposite on underlying layers.
- Excess wrinkles and tensile stresses in the geocomposite.

The CQAR shall report any noncompliance to the OWNER and CONTRACTOR or INSTALLER.

8.0 GEOTEXTILE MATERIAL

8.1 GEOTEXTILE MANUFACTURING AND DELIVERY

8.1.1 Manufacturing

This CQA Plan has been created to verify the specified geocomposite is manufactured and tested according to TECHNICAL SPECIFICATIONS Section 02940 Geotextile.

8.1.1.1 Manufacturer Quality Control Documentation

The GEOTEXTILE MANUFACTURER shall provide documentation and certification the material meets the requirements outlined in TECHNICAL SPECIFICATIONS Section 02940 Geotextile and MQC measures have been implemented during the manufacturing process. The following information will be provided by the GEOTEXTILE MANUFACTURER to the CQA CONSULTANT prior to shipment of the geotextile to the PROJECT site:

- A list of materials that comprise the geotextile and a specification for the geotextile which includes all properties contained in the TECHNICAL SPECIFICATIONS, measured using the appropriate test methods.

- A written certification signed by an officer or the Quality Control Manager that the geotextile delivered for the PROJECT has minimum average roll value properties which meet or exceed the properties provided in the TECHNICAL SPECIFICATIONS and is guaranteed by the MANUFACTURER.

- Written certification that the MANUFACTURER has continuously inspected the geotextile for the presence of needles and found the geotextile to be needle-free.

- MQC test results performed by the MANUFACTURER in accordance with test methods and frequencies required by the TECHNICAL SPECIFICATIONS to verify the geotextile meets TECHNICAL SPECIFICATIONS Section 02940 Geotextile.

- MQC certifications, which shall include roll identification numbers, sampling procedures, and MQC test results signed by a responsible party employed by the MANUFACTURER. The TECHNICAL SPECIFICATIONS will indicate the minimum, MQC test results.

All rolls of geotextile shall be identified by the MANUFACTURER with the following:

- MANUFACTURER'S Name.

- Roll Number.

- Product Identification.

- Roll Dimensions.

8.1.1.2 Manufacturer Quality Control Certificates

The GEOTEXTILE MANUFACTURER shall be required to perform, at a minimum, the tests listed in TECHNICAL SPECIFICATIONS Section 02940 Geotextile. Prior to shipment to the PROJECT site, the GEOTEXTILE MANUFACTURER shall provide the CQA CONSULTANT the MQC certificates for the geotextile, written on the MANUFACTURER'S company letterhead, for each roll of geotextile, signed by a responsible party employed by the GEOTEXTILE MANUFACTURER. The MQC certificates shall include at a minimum the roll identification numbers and the MQC test results (listed individually). The CQA CONSULTANT shall review the MQC certificates and verify the required testing frequencies and results meet the requirements specified according to TECHNICAL SPECIFICATIONS Section 02940 Geotextile and the MANUFACTURER'S guaranteed minimum values for all materials and rolls. The CQA CONSULTANT shall report any noncompliance to the OWNER, INSTALLER, and GEOTEXTILE MANUFACTURER.

8.1.1.3 Manufacturer Quality Control Testing

Testing during manufacturing shall be accomplished by the GEOTEXTILE MANUFACTURER laboratory. The MANUFACTURER shall test the material per the frequency, at a minimum, that conforms to TABLE 02940-1 GEOTEXTILE PROPERTIES as required by TECHNICAL SPECIFICATIONS Section 02940 Geotextile.

TABLE 02940-1 GEOTEXTILE PROPERTIES

TEST METHOD/PROPERTY	SPECIFIED VALUE	FREQUENCY (MINIMUM)
ASTM D5261 Mass per Unit Area	6 oz/yd2	1 per 100,000 SF
ASTM D4751 AOS	#70 sieve (0.212 mm)	1 per 100,000 SF
ASTM D4491 Permittivity	110 gal/min/ft2	1 per 100,000 SF
ASTM D6241 CBR Puncture	435 lbs/in	1 per 100,000 SF
ASTM D4632 Grab Tensile	365 x 170 lbs	1 per 100,000 SF
ASTM D4533 Trapezoidal Tear Strength	115 x 65 lbs/in	1 per 100,000 SF

8.1.2 Delivery, Handling, and Storage

8.1.2.1 Delivery and Handling

Geotextile shall be protected from ultraviolet light exposure, precipitation, mud, puncture, cutting, or other deleterious conditions during shipment, handling, and storage. Geotextile rolls shall be shipped and stored in relatively opaque and watertight wrapping which shall be removed shortly before deployment.

The INSTALLER shall handle all geotextile in such a manner as to minimize damage, and the following shall be complied with:

- All deployed geotextiles shall be stabilized with sandbags or the equivalent ballast in the presence of wind. Such sandbags shall remain until replaced with cover material.
- The entire surface of the geotextile shall be visually inspected to ensure that no potentially harmful foreign objects are present.
- On slopes, the geotextiles shall be securely anchored in the anchor trench and rolled down the slope in such a manner as to continually keep the geotextile sheet in tension.
- Geotextiles shall be cut using an approved geotextile cutter only. If in place, special care must be taken to protect other materials from damage that could be caused by the cutting of the geotextiles.
- The INSTALLER shall take any necessary precautions to prevent damage to underlying layers during the placement of the geotextile.
- Care shall be taken not to entrap stones, excessive dust, or moisture within the geotextile that could damage the geomembrane, result in clogging of drains or filters, or hamper subsequent seaming.
- After installation, a visual examination of the geotextile shall be carried out over the entire surface, to verify that no potentially harmful foreign objects, such as needles or staples, are present.

8.1.2.2 Storage

Storage of the geotextile rolls shall be the responsibility of the CONTRACTOR. The materials shall be unloaded by the CONTRACTOR in areas designated by the OWNER. The CONTRACTOR shall provide the proper equipment and labor necessary to unload the material. Rolls shall not be stacked upon one another to the extent that deformation of the core or flattening of the rolls occurs. At a minimum, the storage location for geotextile material shall provide protection from theft, vandalism, traffic, light, punctures, abrasions, excessive dirt, and moisture that may damage the geotextile material.

8.2 GEOTEXTILE CONFORMANCE TESTING

8.2.1 Conformance Sample Collection

The geotextile conformance samples will be selected and collected at the required frequency according to TECHNICAL SPECIFICATIONS Section 02940 Geotextile by the CQA CONSULTANT or the OWNER'S REPRESENTATIVE prior to shipment of the material to the PROJECT site. Geotextile shall not be shipped prior to testing without CQA CONSULTANT approval. Geotextile shipped to the PROJECT site without approved conformance test results shall be sampled and tested upon delivery to the PROJECT site by the CQA CONSULTANT. All costs associated with collecting and shipping samples from the PROJECT site will be the CONTRACTOR'S responsibility.

Samples shall not include the first complete revolution. The sample shall be a minimum of four feet, as measured along the width of the roll, and extend three feet along the roll. Samples shall be taken at a rate of one per lot, but at a rate not less than one conformance test per 1 per 100,000 SF or portion thereof. Samples shall not include any portion of a roll which has been subjected to excess pressure or stretching. All lots of material and the particular test sample that represents each lot will be defined before the samples are obtained. These conformance samples shall be sent to the CQA GEOSYNTHETICS LABORATORY for testing to verify conformance to the values listed in TECHNICAL SPECIFICATIONS Section 02940 Geotextile. These tests shall be performed prior to the installation of the geotextile.

8.2.2 Conformance Testing

Conformance samples of the geotextile will be tested by the CQA CONSULTANT prior to shipment to the PROJECT site. Geotextile shall not be shipped prior to testing without CQA CONSULTANT approval. Geotextile shipped to the PROJECT site without approved conformance test results shall be sampled and tested upon delivery to the PROJECT site by the CQA CONSULTANT. All costs associated with collecting and shipping samples from the PROJECT site will be the CONTRACTOR'S responsibility.

The conformance samples shall be sent to the CQA GEOSYNTHETICS LABORATORY for conformance testing. Samples shall not include the first complete revolution. The sample shall be a minimum of four feet, as measured along the width of the roll, and extend three feet along the roll. Samples shall be taken at a rate of at least one sample per lot, but at a rate not less than one conformance test per every 1 per 100,000 SF or portion thereof. Samples shall not include any portion of a roll which has been subjected to excess pressure or stretching. All lots of material and the particular test sample that represents each lot will be defined before the samples are obtained. The following conformance tests will be conducted by the CQA GEOSYNTHETICS LABORATORY according to TECHNICAL SPECIFICATIONS Section 02940 Geotextile:

TABLE 02940-2 GEOTEXTILE CONFORMANCE PROPERTIES

TEST METHOD/PROPERTY	SPECIFIED VALUE	FREQUENCY (MINIMUM)
ASTM D5261 Mass per Unit Area	6 oz/yd2 (MARV)	1 per 100,000 SF
ASTM D4751 AOS	#70 sieve (0.212 mm) (MaxARV)	1 per 100,000 SF
ASTM D6241 CBR Puncture	435 lbs (MARV)	1 per 100,000 SF
ASTM D4491 Permittivity	1.5 sec-1 (Min.)	1 per 100,000 SF
ASTM D4632 Grab Tensile	160 lbs (MARV)	1 per 100,000 SF
ASTM D4632 Grab Elongation	50 lbs (MARV)	1 per 100,000 SF
ASTM D4533 Trapezoidal Tear Strength	65 lbs (Min.)	1 per 100,000 SF

8.3 GEOTEXTILE FIELD QUALITY CONTROL

Prior to the deployment of the geotextile, the CQA CONSULTANT shall review all conformance test results and report any non-conformance to the OWNER, INSTALLER, and MANUFACTURER. The CQA CONSULTANT shall be responsible for verifying that all the test results meet or exceed the property values listed in TECHNICAL SPECIFICATIONS Section 02940 Geotextile.

8.3.1 Deployment

The geotextile shall be installed in accordance with the MANUFACTURER'S recommendations and the CONTRACT DOCUMENTS and TECHNICAL SPECIFICATIONS. In case of a conflict between these documents, the more stringent requirements shall apply. Any deviations from these procedures must be reviewed and accepted by the CQA CONSULTANT and/or DESIGN ENGINEER prior to construction.

8.3.2 Seaming Procedures

Geotextile shall be overlapped as shown in the CONSTRUCTION DRAWINGS. Overlapped material can be sewn to maintain overlap during backfilling operations. On slopes steeper than 10 feet horizontal to 1 foot vertical (10H:1V), all geotextiles shall be continuously sewn. Sewing shall be done using polymeric thread with chemical or ultraviolet light-resistant properties equal to or greater than those of the geotextile.

8.3.3 Defects and Repairs

Holes or tears in the geotextile shall be repaired with a patch of the same geotextile double-sewn or heat-tacked into place. Repairs occurring on slopes steeper than 10H:1V shall be double-sewn in place. Should any tear exceed ten percent of the width of the roll, that roll shall be removed and replaced. Soil or other material which may have penetrated the torn geotextile shall be removed. The CQAR shall observe any repairs and report any noncompliance to the INSTALLER and OWNER.

8.3.4 Placement of Soil Materials

The CONTRACTOR or INSTALLER shall place all soil materials on top of the geotextile in such a manner as to minimize:

- Damage to the geotextile.
- Slippage of the geotextile on underlying layers.
- Excess tensile stresses in the geotextile.

Any noncompliance shall be noted by the CQAR and reported to the INSTALLER and CONTRACTOR.

9.0 LANDFILL GAS SYSTEM IMPROVEMENTS

Care shall be taken during improvements to the existing LFGCCS to not damage the existing pipe, pipe fittings, and other related LFG appurtenances. All new materials will be used on the PROJECT and will be submitted to the CQA CONSULTANT for approval as part of the Shop Drawing submittal process outlined in TECHNICAL SPECIFICATIONS Section 01300 Contractor Submittals. New and existing materials shall meet all requirements outlined in the appropriate section of the TECHNICAL SPECIFICATIONS. The CQA CONSULTANT shall examine all pipes to be reused for any visual damage, cut, gouges, etc. The CQA CONSULTANT will review and ultimately approve all products that will be installed on the PROJECT prior to installation as part of the Shop Drawing submittal process. All installed LFGCCS pipes will undergo pressure testing as a final step to ensure material integrity.

9.1 LANDFILL GAS IMPROVEMENT CONSTRUCTION SEQUENCING

The construction will be conducted in Construction Stages to coincide with each Stage of closure activity. During each Construction Stage, the LFGCCS will be kept operational and continue to meet the facility's regulatory compliance requirements. Shutdown of the LFGCCS for short durations is anticipated in order to connect improvements to the existing LFGCCS. The CONSTRUCTION DRAWINGS indicate requirements for each LFGCCS Construction Stage. Refer to additional requirements outlined in the appropriate section of the TECHNICAL SPECIFICATIONS.

9.2 LANDFILL GAS WELL INSTALLATION

9.2.1 Verification Survey

Prior to drilling, the CONTRACTOR will perform a survey, performed by a professional land surveyor licensed in the state of Florida, to verify the horizontal and vertical location of each proposed gas well, and that the survey data confirms the following:

- The horizontal position of the gas well boring is within the requirements of the TECHNICAL SPECIFICATIONS and data provided on the gas well schedule.
- The northings, eastings and elevation coordinates are written on the stakes marking the position of the gas well boring.

- Verify that the total depth of well boring as indicated on the gas well schedule will result in a boring that terminates at the designed elevation and the minimum separation from the bottom liner system.

- Make this verification by comparing the surveyed elevation of the proposed well boring at the existing ground surface to the as-built bottom liner elevation where the bottom of the well is terminated at the same horizontal coordinates as the top of the well.

- Confirm verification data is provided to the OWNER and CQA CONSULTANT and that drilling does not start until the OWNER and CQA CONSULTANT concurs that OWNER'S survey data and CONTRACTOR'S survey data both confirm the planned depth of the well boring will terminate at the designed elevation and the designed vertical separation from the bottom geomembrane.

9.2.2 Drilling

In general, during well drilling the CQAR and CONTRACTOR will verify the following:

- Borings are drilled at the locations determined by the CQA CONSULTANT and verified by the CONTRACTOR.

- The well boring is terminated at the designed vertical separation above the bottom liner system.

- Verify refuse generated from drilling operations is disposed at an area on-site as directed by the OWNER.

9.2.3 Obstructions and Saturated Conditions

In general, during well drilling, if obstructions or saturated conditions are encountered the CQAR and CONTRACTOR will verify the following:

- Reasonable efforts are made to drill through obstructions and saturated conditions.

- If an impenetrable obstruction is encountered, drilling operations are ceased and the CQA CONSULTANT is notified immediately.

- If wet conditions remain, the boring is terminated and the length of perforated pipe adjusted by CQA CONSULTANT, or the well is relocated.

- If wet conditions cease (e.g., due to trapped water layer), drilling continues to design depth; and

- Borings are not abandoned unless approved by the CQA CONSULTANT.

9.2.4 Boring Abandonment and Redrilling

In general, during well drilling if a boring is abandoned the CQAR and CONTRACTOR will verify the following:

- The depth of completed boring is measured.
- The incomplete boring is backfilled with clean soil from a borrow source.
- A new (replacement) boring is drilled at a new location designated by the CQA CONSULTANT.
- Drilling of the new boring does not begin until the CQA CONSULTANT has provided a design depth in writing to the CONTRACTOR.

9.2.5 Well Construction Logs

At the end of each day, the CONTRACTOR shall provide copies of the handwritten well boring and completion logs for each well drilled on that day. Independent of the CONTRACTOR, the CQAR will verify well logs and construction diagrams for all wells drilled. The CONTRACTOR and CQAR well logs will include the following, at a minimum:

- Northing, easting, and elevation.
- Total depth of boring.
- Static water level.
- Length of slotted, perforated, and solid wall pipe installed.
- Waste characteristics.
- Composition (household refuse, soil, construction debris, etc.).
- Depth, thickness, approximate and description of soil or waste strata, and the occurrence of any water-bearing zones.
- Approximate depth of noticeable change in waste composition, degree of decomposition, and degree of saturation.

9.3 GAS WELL ABANDONMENT

During gas well abandonment, verify the pipe is removed to a depth of at least 1 foot below ground surface by:

- Overdrilling the pipe with an auger or other drilling tool with a diameter at least equal to the original borehole, or
- Excavating to the required depth and cutting the pipe.
- Perform the required pipe boot liner welding.

During pipe backfilling, verify:

- The pipe is backfilled with soil up to the ground surface.

- A permanent, glued cap is installed on the end of the backfilled pipe.

9.4 LANDFILL GAS SYSTEM RECORD DATA

Verify the following record data is obtained and provided to the OWNER and CQA CONSULTANT. Refer to additional requirements outlined in the appropriate section of the TECHNICAL SPECIFICATIONS.

- Horizontal and vertical location of the top of new gas well casings, abandoned borings, and the top of abandoned well casings.

- Horizontal and vertical location of the top of all new LFG conveyance pipe runs at 25 foot intervals, at fittings, at changes in the vertical or horizontal direction, and at connections to existing systems.

- Record survey information and associated point data are obtained on the same datum and coordinate basis as the CONSTRUCTION DRAWINGS. Shall be provided by the CONTRACTOR.

10.0 DOCUMENTATION

An effective CQA Plan depends largely on the recognition of all construction activities that shall be monitored and on assigning responsibilities for the monitoring of each activity. This is most effectively accomplished and verified by the documentation of quality assurance activities. The CQA CONSULTANT shall document that quality assurance requirements have been addressed and satisfied. The CQA CONSULTANT shall maintain at the site a complete file of CONTRACT DRAWINGS, TECHNICAL SPECIFICATIONS, test procedures, daily logs, and other pertinent documents.

10.1 REPORTS

Standard reporting procedures shall include preparation of a daily report which, at a minimum, shall consist of:

- A daily summary report including memoranda of meetings and discussions with the OWNER and CONTRACTOR.

- Observation logs detailing construction activities for the day, and test results, as appropriate.

Other forms of daily record-keeping to be used as appropriate include construction problem and solution data sheets and photographic reporting datasheets. This information shall be regularly submitted to and reviewed by the OWNER and DESIGN ENGINEER.

10.1.1 Daily Logs and Summary Reports

The CQA CONSULTANT shall prepare daily logs and summary reports which shall include the following information:

- An identifying report number for cross-referencing and document control.

- Date, project name, location, and other identification.

- Data on weather conditions.
- Information on meetings held or discussions that took place including:
    1. Names of parties to the discussion.
    2. Relevant subject matter or issues.
    3. Decisions reached.
    4. Activities and their schedule.
- A reduced-scale site plan or sketch showing work areas and test locations.
- Descriptions and locations of ongoing construction.
- Descriptions and specific locations of areas, or units, of work being tested and/or observed and documented.
- Locations where tests and samples were taken or reference to specific observation logs and/or test data sheets where such information can be found.
- A summary of field/laboratory test results or reference to specific observation logs and/or test datasheets.
- Calibrations of test equipment.
- Off-site materials received, including quality verification documentation.
- Decisions made regarding acceptance of units of work, and/or corrective actions to be taken in instances of substandard quality.
- The CQA CONSULTANT signature.
- Photographs of representative activities.

10.2 OBSERVATION AND TESTING REPORTS

The CQA CONSULTANT shall record observations of construction and CQA-related activities on PROJECT-specific observation and testing reports. At a minimum, the observation and testing reports shall include the following information:

- An identifying sheet numbered for cross-referencing and document control.
- Date, project name, location, and other identification.
- Description or title of activity monitored.
- Location of activity and locations of samples collected.

- Locations of field tests performed and their results.
- Results of laboratory tests received.
- Results of monitoring activity in comparison to the TECHNICAL SPECIFICATIONS.
- The CQAR signature.

Reports describing problem identification, corrective measures reports, or special construction situations shall be prepared by the CQA CONSULTANT and cross-referenced to specific observation and testing reports. These reports shall include the following information:

- An identifying sheet number for cross-referencing and document control.
- A detailed description of the situation or deficiency.
- The location and probable cause of the situation or deficiency.
- How and when the situation or deficiency was found or located.
- Documentation of the response to the situation or deficiency.
- Final results of any responses.
- Any measures taken to prevent a similar situation from occurring in the future.
- The signature of the CQA CONSULTANT and the signature of the OWNER or DESIGN ENGINEER indicating concurrence.

The OWNER and DESIGN ENGINEER shall be made aware of any non-conformance with the TECHNICAL SPECIFICATIONS. The OWNER and DESIGN ENGINEER shall determine the cause of the non-conformance and recommend appropriate changes in procedures or TECHNICAL SPECIFICATIONS. These changes will be approved (as applicable) by the DESIGN ENGINEER. When this type of evaluation is made the results shall be documented and any revision to procedures or project TECHNICAL SPECIFICATIONS will be approved by the OWNER, CQA CONSULTANT, DESIGN ENGINEER, and, if necessary, the PERMITTING AGENCY.

10.3 PHOTODOCUMENTATION AND REPORTING DATA SHEETS

Photo documentation and reporting data sheets shall be cross-referenced with observation and test reports and/or problem identification and corrective measure reports. These photographs will serve as a pictorial record of WORK progress, problems, and mitigation activities. The basic file shall contain color prints with a date stamp. These records will be presented to the OWNER upon completion of the PROJECT. In support of photographic documentation, videotaping may be used to record WORK progress, problems, and mitigation activities.

10.4 DESIGN AND/OR TECHNICAL SPECIFICATIONS CHANGES

Design and/or TECHNICAL SPECIFICATIONS changes may be required during construction. In such cases, the CQA CONSULTANT shall notify the OWNER and the DESIGN ENGINEER. The OWNER shall

then notify the PERMITTING AGENCY if necessary. Design and/or TECHNICAL SPECIFICATIONS changes shall be made only with the written agreement of the OWNER and the DESIGN ENGINEER and shall take the form of an Addendum to the TECHNICAL SPECIFICATIONS.

10.5 PROGRESS REPORTS

The CQA CONSULTANT shall prepare a Progress Report at time intervals established at the Pre-Construction Meeting and submit it to the OWNER and ENGINEER. At a minimum, this report shall include the following information:

- An identifying sheet numbered for cross-referencing and document control.
- Date, project name, location, and other identification.
- A summary of WORK activities during the progress reporting period.
- A summary of construction situations, deficiencies, and/or defects occurring during the progress reporting period.
- A summary of test results, failures, and retests.
- The signature of the CQA CONSULTANT.
- Photographs with a date stamp of construction activities and progress.

The OWNER or CQA CONSULTANT shall distribute copies of the Progress Reports to the PERMITTING AGENCY and, upon request, to the CONTRACTOR or as decided at the Pre-Construction Meeting.

10.6 RECORD DRAWINGS

All field survey notes will be retained by the CONTRACTOR and made available to the CQA CONSULTANT. The results from field surveys will be documented on a set of drawings (as-built) by the CONTRACTOR for submittal to the CQA CONSULTANT. The CONTRACTOR shall certify to the CQA CONSULTANT the results of the survey demonstrates the WORK was completed in accordance with the CONSTRUCTION DRAWINGS and the Construction Permit. Sealed surveys by a professional land surveyor shall depict the information in a topographic format and illustrate actual data points. Refer to TECHNICAL SPECIFICATIONS Section 01050 Site Conditions Survey. Record drawings prepared and certified by the CQA CONSULTANT shall include, but are not limited to, the following information:

- Scale Plans depicting the location of construction.
- Details pertaining to the extent of construction (e.g., final cover, stormwater features, plan dimensions, elevations, excavation, etc.).
- Geomembrane identifying panels with appropriate numbers, destructive seam samples locations, patches, and repairs locations.
- Changes from the CONTRACT DRAWINGS.
- Waste or liner limit markers.

- Vertical and horizontal control for the Intermediate Cover, Protective Cover, Topsoil, location of stormwater components, toe drains, gas vents, gas collection piping, edge of geomembrane liner, etc.

10.7 CERTIFICATION REPORT

At the completion of the PROJECT, the CQA CONSULTANT shall prepare and submit to the PERMITTING AGENCY and OWNER a certification of construction completion report for the PROJECT. At a minimum, the report shall include:

- Description and location of the site.
- A summary of all parties responsible for completing the PROJECT.
- Summary of construction activities.
- Daily reports and forms completed by the CQAR during construction.
- Description of the location, frequency, and results of testing conducted during construction including a geomembrane destructive testing and seam testing report, non-destructive testing, trial welds, and repairs.
- LFGCCS improvements including pipe testing, pipe survey, and well logs.
- A copy or summary of all MQC, CQC, and CQA tests (as applicable).
- Description of steps and methods followed to report and retest failed areas and results of the retesting.
- Geomembrane panel layout drawings and connection of geomembrane with existing geomembranes.
- Changes from the design (with justifying documentation) and material specifications.
- Record Drawings signed and sealed by a professional engineer licensed in the State of Florida.
- Record surveys, provided to the CQA CONSULTANT by the CONTRACTOR, signed by a professional land surveyor licensed in the State of Florida.
- A certification statement signed and sealed by a professional engineer licensed in the State of Florida stating that construction has been completed in substantial conformance with the CONSTRUCTION DRAWINGS, TECHNICAL SPECIFICATIONS, and Construction Permit.

APPENDIX A

DAILY FIELD REPORT

DAILY FIELD REPORT

Page _____ **of** _____

Project: _____ **Project number**: _____

Owner: _____ **Contractor:** _____

Date: _____ **Contract Day:** _____ **Contract Duration** _____

Weather
Temperature: (AM) _____ **(PM)** ____ **Rain** _____ **Rainfall (inches)** _____
Description of weather: _____

List of Active Equipment on site **Equipment Not Used/Down:**

Personnel on site:

No. of Superintendents **No. of Skilled** **No. of Laborers**

Description of Construction Activity

List of Subcontractors

List of Materials Delivered

Contract Issues/Conflicts
Description: _____

Field Representative _____ **Date** _____

DAILY FIELD REPORT

Project _____ **Project Number:** _____
_____ **Date:** _____
_____
_____

Description of Construction Activity

Field Representative _____ **Date** _____

APPENDIX B

GEOSYNTHETIC INSTALLATION FORMS

CERTIFICATE OF INTERMEDIATE COVER ACCEPTANCE

CERTIFICATE OF SUB-BASE ACCEPTANCE

Installer: _____ **Project name:** _____

Address: _____ **Project location:** _____

_____ _____

_____ _____

Owner: _____

I, THE UNDERSIGNED, DULY AUTHORIZED REPRESENTATIVE OF_____
(Geosynthetic Installer)

DO HEREBY ACCEPT THE AREA OF SOIL SURFACE AS DESCRIBED BELOW.

(SKETCH OR DESCRIBE)

Acceptance of the soil surface for which the geomembrane will be placed is based upon visual observations. Acceptance of the subgrade surface considers that at the time the geomembrane is placed, the structure of the underlying soil surface, which is the responsibility of others, meets or exceeds the project specifications.

NAME TITLE

SIGNATURE DATE

Certification received by

NAME TITLE

SIGNATURE DATE

PANEL PLACEMENT LOG

COMPOSITE GEONET PLACEMENT LOG

SHEET _____ of _____
PROJECT TITLE _____
PROJECT NO. _____
DATE _____

PANEL NO.	ROLL NO.	LENGTH	WIDTH	THICK-NESS	ORIENTATION	TIME	WEATHER/CONDITIONS/COMMENTS

PRINT NAME: _____

SIGNATURE: _____

GEOMEMBRANE PLACEMENT LOG

PANEL PLACEMENT LOG

SHEET _____ of _____
PROJECT TITLE _____
PROJECT NO. _____
DATE _____

PANEL NO.	ROLL NO.	LENGTH	WIDTH	THICK-NESS	ORIENTATION	TIME	WEATHER/CONDITIONS/COMMENTS

PRINT NAME: _____

SIGNATURE: _____

TRIAL WELD LOG

TRIAL WELD LOG

SHEET _____ of _____
PROJECT TITLE _____
PROJECT NO. _____
DATE _____

TIME	TECH I.D.	MACH. I.D.	AMB. TEMP	EXTRUSION WELDS		FUSION WELDS		PEEL					SHEAR				P/F
				BARREL TEMP.	PREHEAT TEMP.	WEDGE TEMP	WEDGE SPEED										

PRINT NAME: _____

SIGNATURE: _____

GEOMEMBRANE SEAMING LOG

SCS ENGINEERS

GEOMEMBRANE SEAMING AND TEST OBSERVATION

Extrusion Weld Seaming

Project No.:
Project:
Installer:
Location:
Material:

Date	Seamer ID	Wedge ID	Weld Start Time	Seam ID	Orientation Description	Seam Length (FT)	Destruct Tracking	Destructive Seam Samples	Test Date	Test Start Time	Initial Pressure (PSI)	Test End Time	Final Pressure (PSI)	Pressure Test (Pass/Fail)	Tech ID

NON-DESTRUCTIVE TEST LOG

NON-DESTRUCTIVE TEST LOG

SHEET _____ of _____
PROJECT TITLE _____
PROJECT NO. _____
DATE _____

SEAM NO.	TECH I.D.	AIR TEST							VACUUM BOX P/F	COMMENTS
		PRESSURE (psi)			TIME			P/F		
		START	END	DROP	START	END	DURATION			

PRINT NAME: _____

SIGNATURE: _____

DESTRUCTIVE TEST LOG

DESTRUCTIVE TEST LOG

SHEET: of
PROJECT TITLE:
PROJECT NO:
DATE:

SAMPLE NO.	SEAM I.D.	MACHINE NO.	WELD TYPE	DATE SEAMED	DATE SAMPLED	TEST STATUS PASS/FAIL			COMMENTS
						INSTALLER	SCS	ARCH	

PRINT NAME: _____

SIGNATURE: _____

GEOMEMBRANE REPAIR LOG

GEOMEMBRANE REPAIR LOG

SHEET _____ of _____
PROJECT TITLE _____
PROJECT NO. _____
DATE _____

DATE REPAIRED	REPAIR NO.	SEAM /PANEL ID	LOCATION	DEFECT CODE	SIZE OF REPAIR	TECH ID	MACHINE NO.	DATE TESTED	TESTED BY	COMMENTS

DEFECT CODES:

AD	-ANIMAL RELATED DAMAGE	DS	-DESTRUCTIVE SAMPLE	IO	-INSUFFICIENT OVERLAP	SS	-START/STOP
B	-UNDISPERSED RESIN BEAD	EE	-EARTHWK EQUIP DAMAGE	LB	-LEISTER BURN	SSI	-SOIL SURFACE IRREGULARITY
BO	-BURN OUT	EXT	-EXTENSION	MOT	-MACHINE OFF TRACK	T	-MULTIPLE PANEL INTERSECTION
BS	-BOOT SKIRT	FB	-FUSION WELDER BURN	N	-NODULE	VL	-VACUUM TEST LEAK
C	-COUPON	FD	-FACTORY DAMAGE	PTC	-PRESSURE TEST CUT	WC	-WRINKLE CUT
CO	-CHANGE OF OVERLAP	FM	-FISH MOUTH	SI	-SUBGRADE IRREGULARITY	WR	-WRINKLE
CR	-CREASE	FS	-FAILED SEAM	SL	-SLAG ON TEXTURED SHEET	WS	-WELDER RESTART
D	-INSTALLATION DAMAGE	HT	-HEAT TACK BURN	SO	-SHARP OBJECT		

PRINT NAME: _____

SIGNATURE: _____