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## CONSTRUCTION QUALITY ASSURANCE PLAN IN SUPPORT OF LDA FOR GO EAST

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#### ACRONYMS

ASTM	American Society for Testing and Materials
CQA	Construction Quality Assurance
CQC	Construction Quality Control
EPA	United States Environmental Protection Agency

## **FORWARD AND ACKNOWLEDGEMENT**

This CQA plan has been developed specifically for the Go East Landfill closure. The document draws upon information presented in the United States Environmental Protection Agency (EPA) Technical Guidance Document "Quality Assurance and Quality Control for Waste Containment Facilities" (EPA/600/R-93/182, September 1993). The EPA document provides information and guidance for developing comprehensive quality assurance plans and for carrying out quality control procedures at waste containment sites. Additionally, the document has benefited from guidance received from Solid Waste Handling Standards, Washington Administrative Code (WAC) 173-350.

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## **1. CONSTRUCTION QUALITY ASSURANCE CONCEPTS AND OVERVIEW**

### **1.1 Introduction**

This construction quality assurance (CQA) plan is for the Go East Landfill closure. It has been prepared by PACE Engineers for P&GE, LLC. This CQA plan describes the actions the owner will undertake to assure and to document that the project is constructed in general accordance with the project plans and specifications.

### **1.2 Preparation of Construction Assurance Quality Plan**

This plan has been prepared under the direction of Mr. Kenneth H. Nilsen, Professional Engineer, registered in Washington. Mr. Nilsen's Washington Professional Engineer registration number is 25427. Signature and professional stamp are located on the last page.

### **1.3 Project Description**

The proposed final closure construction for the landfill includes the construction and placement of a geomembrane and soil layer for the final cover of the Go East Landfill. The current landfill is to be reduced in size by relocating landfill material from the edges and placing it on the top of the remaining landfill. This will reduce the size of the remaining landfill to about 6 acres. The steeper northeast slope below approximate elevation 190 feet is to be left undisturbed. At the conclusion of the grading operation, the site will receive an application of Hydroseed to stabilize the surface of the landfill, and possibly some small shrubs and trees for landscaping. A detention pond, emergency access, trails, pathway and recreation facilities are to be constructed on the closed landfill.

### **1.4 Scope**

Construction quality assurance is widely recognized as a critically factor in overall quality management for waste containment facilities.

This CQA plan provides guidance:

- For specific inspections, observations, and tests;
- For documentation of the observed quality of materials and work; and
- Serves as a reference source for personnel performing and monitoring construction of the closure of the Go East Landfill.

The inspections, observations, testing, and documentation will be performed by the owner's CQA team.

This CQA plan does not establish construction requirements. Construction requirements are established in the LFCP and resulting plans and specifications and are not restated here. The criteria for acceptance will be as defined in these documents.

This CQA plan does not establish procedures to control or guide the operations of the manufacturer of materials or the contractor or relieve them of their contractual responsibility to set up the necessary procedures and controls within their organizations to produce the quality of work called for in the plans and specifications.

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This CQA plan is not intended to function as or to replace the contractor's quality control program.

### 1.5 Definitions

It is critical to define and understand the differences between construction quality control (CQC) and CQA and to counterpoint where the different activities contrast and/or complement one another. The following definitions are made to add clarity:

**CQC:** A planned system of inspections that is used by the contractor to directly monitor and control the quality of the construction project. CQC for installation of the lining, for example, is normally performed by the geosynthetics installer, or by the earthwork contractor for soil materials, to insure the necessary quality in the constructed or installed system is achieved. CQC refers to measures taken by the installer or contractor to determine compliance with the requirements for materials and workmanship as stated in the plans and specifications for the project.

**CQA:** A planned system of activities that provides the owner and permitting agency assurance that the facility was constructed as specified in the design. CQA includes inspections, verifications, audits, and evaluations of materials and workmanship necessary to determine and document the quality of the constructed facility. CQA refers to measures taken by the CQA organization to assess if the installer or contractor is in compliance with the plans and specifications for the project.

CQA is performed independently from CQC. Although CQA and CQC are separate activities, they have similar objectives, and in a smoothly running construction project, the processes will complement one another. Conversely, an effective CQA program can lead to identification of deficiencies in the CQC process, but a CQA program by itself (in complete absence of a CQC program) is unlikely to lead to acceptable quality management. Quality is best ensured with effective CQC and CQA programs.

### 1.6 Responsibility and Authority

**Permitting Agency:** The permitting agency for this project is Snohomish Health District (SHD). SHD is supported by the Washington State Department of Ecology. It is the responsibility of the permitting agency to review the owner's permit application, including the site-specific CQA plan, for compliance with the agency's regulations and to make a decision to issue or ask for additional information. The permitting agency also has the authority to review all CQA documentation during or after construction of a facility, possibly including visits to the construction site to observe the CQC and CQA practices, to confirm that the approved CQA plan was followed and that the facility was constructed as specified in the design.

**Owner:** This is the organization that will own the facility. The current owner is P&GE, LLC. The owner is responsible for the closure of the facility. This responsibility includes complying with the requirements of the permitting agency, the submission of CQA documentation, and assuring the permitting agency that the facility was constructed as specified in the construction plans and specifications and as approved by the permitting agency. The owner has the authority to select and dismiss organizations charged with design, construction, and CQA.

**Owner's Representative:** The owner's representative, or construction manager, is responsible to administer the construction program for the owner. This responsibility includes communications to other members in the owner's organization, permitting

agency, general contractor, and CQA engineer who, in this case, needs to be professionally certified in identifying hazardous waste and landfill closures.

**Design Engineer:** PACE Engineers is the design engineer. The design engineer's primary responsibility is to design the facility so that it fulfills the operational requirements of the owner, complies with accepted design practices for waste containment facilities, and meets or exceeds the minimum requirements of the permitting agency. The design engineer may be requested to change some aspects of the design if unexpected conditions are encountered during construction (e.g., a change in site conditions, unanticipated logistical problems during construction, or lack of availability of certain materials). Because design changes during construction are not uncommon, the design engineer is a major and essential part of the CQA process.

**Manufacturer:** The manufacturer is responsible for the manufacture of its materials and for quality control during manufacture. The manufacturer is responsible for certifying that its materials conform to the plans and specifications. The quality control steps taken by a manufacturer are critical to overall quality management in construction of waste containment facilities. Such activities often take the form of process quality control, computer-aided quality control, and the like. As requested, the manufacturer should provide information to the owner, permitting agency, design engineer, fabricator, installer, or CQA engineer that describes the quality control steps that are taken during the manufacturing of the product. In addition, the manufacturer should be willing to allow the owner, permitting agency, design engineer, fabricator, installer, and CQA engineer to observe the manufacturing process and quality control procedures if they so desire.

**Fabricator:** Some materials are fabricated from manufactured components. For example, certain geomembranes are fabricated by seaming together smaller, manufactured geomembrane sheets at the fabricator's facility. The fabricator is responsible for certifying that its materials conform to the plans and specifications. The quality control steps taken by a fabricator are critical to overall quality in construction of waste containment facilities. As requested, the fabricator should provide information to the owner, permitting agency, design engineer, installer, or CQA engineer that describes the quality control steps that are taken during the fabrication of the product. In addition, the fabricator should be willing to allow the owner, permitting agency, design engineer, installer, or CQA engineer to observe the fabrication process and quality control procedures if they so desire.

**General Contractor:** The general contractor has overall responsibility for construction of the project and for CQC during construction. The general contractor arranges for purchase of materials that meet specifications, enters into a contract with one or more fabricators (if fabricated materials are needed) to supply those materials, contracts with an installer (if separate from the general contractor's organization), and has overall control over the construction operations, including scheduling and CQC. The general contractor has the primary responsibility for ensuring that a facility is constructed in accord with the plans and specifications that have been developed by the design engineer and approved by the permitting agency. The general contractor is also responsible for informing the owner's representative of the scheduling and occurrence of all construction activities.

**Installation Contractor:** Manufactured products (such as geosynthetics) are placed and installed in the field by an installation contractor who is the general contractor or

a subcontractor to the general contractor. The installer's personnel may be employees of the manufacturer or fabricator, or they may work for an independent installation company hired by the general contractor. The installer is responsible for handling, storage, placement, and installation of manufactured and/or fabricated materials. The installer will have a CQC plan to detail the proper manner that materials are handled, stored, placed, and installed.

**Earthwork Contractor:** The earthwork contractor is responsible for grading the site to elevations and grades shown on the plans and for constructing earthen components of the project (e.g., compacted soil liners, granular drainage layers, and embankments) according to the specifications. In this case, the earthwork contractor is responsible for excavation, relocation, placement and compaction of the "wedge areas" landfill being relocated. The earthwork contractor may be hired by the general contractor. In some cases, the general contractor's personnel may serve as the earthwork contractor. The earthwork contractor is responsible not only for grading the site to proper elevations but also for obtaining suitable earthen materials, transport and storage of those materials, preprocessing of materials (if necessary), placement and compaction of materials, and protection of materials during and (in some cases) after placement. Earthwork functions must be carried out in accord with plans and specifications approved by the permitting agency. The earthwork contractor should have a CQC plan and is responsible for CQC operations aimed at controlling materials and placement of those materials to conform with project specifications.

**CQC Personnel:** Construction quality control personnel are individuals who work for the general contractor, installation contractor, or earthwork contractor and whose job it is to ensure that construction is taking place in accord with the plans and specifications.

**CQA Engineer/Professional:** The CQA professional has overall responsibility for construction quality assurance. For this landfill closure, the individual also needs to be certified and experienced in identifying hazardous waste material such as asbestos, lead paint and other substances. (Alternatively, a person working under the Engineer could have such certifications.) The engineer is an individual experienced in a variety of activities, although particular specialists in soil placement, hazardous waste determinations and mitigation, polymeric materials, and geosynthetic placement may be involved with the project. The CQA engineer is responsible for reviewing the CQA plan as well as general plans and specifications for the project so that the CQA plan can be implemented with no contradictions or unresolved discrepancies. Other responsibilities of the CQA engineer include education of inspection personnel on CQA requirements and procedures, scheduling and coordinating of CQA inspection activities, ensuring that proper procedures are followed, ensuring that testing laboratories are conforming to CQA requirements and procedures, confirming that test data are accurately reported and that test data are maintained for later reporting, and preparation or oversight of all reports. The CQA engineer will review all documentation on a daily basis.

The most important duty of the CQA engineer is overall responsibility for confirming that the facility was constructed in general accord with plans and specifications approved by the permitting agency. In the event of nonconformance with the project specifications or CQA plan, the CQA engineer should notify the owner as to the details and, if appropriate, recommend work stoppage and possibly remedial actions. The CQA engineer is an authorized representative of the owner. The CQA engineer



will be on the construction site on a regular basis during all major construction operations. This person is required to be onsite and overseeing all landfill excavation and relocation activities.

The CQA engineer is responsible for certifying to the owner and permitting agency that, in his or her opinion, that the compacted soil layer has been constructed in general accord with plans and specifications and CQA plan approved by the permitting agency. The certification statement is accompanied by a final CQA report that contains all the appropriate documentation, including daily observation reports, sampling locations, test results, drawings of record, and other relevant data.

**Geotechnical Engineer:** The natural soil components require specialized geotechnical expertise for observing excavation to native ground (of landfill material), placement and testing. This will be provided by a qualified geotechnical engineer for the placement of the compacted soil layer.

**CQA Personnel:** Construction quality assurance personnel are responsible for making observations and performing field tests to ensure that a facility is constructed in general accord with the plans and specifications approved by the permitting agency. CQA personnel shall not revoke, alter, or relax the provisions of the plans and specifications. CQA personnel report to the CQA engineer.

**Testing Laboratory:** Many CQA tests are performed by commercial laboratories. The testing laboratory should have its own internal quality control plan to ensure that laboratory procedures conform to the appropriate American Society for Testing and Materials (ASTM) standards or other applicable testing standards. The testing laboratory is responsible for ensuring that tests are performed in accordance with applicable methods and standards, for following internal quality control procedures, and for reporting data. The testing laboratory must be willing to allow the owner, permitting agency, design engineer, installer, or CQA engineer to observe the sample preparation and testing procedures or record-keeping procedures, if they so desire.

## 1.7 Personnel Qualifications

The key individuals involved in CQA and their minimum qualifications are listed in Table 1-1.

<b>Table 1-1: Personnel Qualifications</b>	
<b>Individual</b>	<b>Minimum Qualifications</b>
Design Engineer	Registered Professional Engineer
Owner's Representative	The specific individual designated by the owner with knowledge of the project, its plans, specifications, and <b>CQA</b> documents.
CQA Engineer/Professional	Employed by an organization that operates separately from the contractor and owner (consultant hired by the owner), who is a registered Professional Engineer who has shown competency and experience in similar projects and specifically "certified and experienced in identifying hazardous waste material such as asbestos, lead paint, and other substances."

Individual	Minimum Qualifications
Geotechnical Engineer	Registered Professional Engineer or Engineering Geologist licensed in Washington, experienced in landfill closures.

### 1.8 Written CQA Plan

Quality assurance begins with a quality assurance plan. This CQA plan is the owner's written plan for CQA activities. This CQA plan has been tailored to this specific project and coordinated with the project plans and specifications. It includes a detailed description of all CQA activities that will be used during construction to manage the installed quality of the facility.

A copy of the plans and specifications, CQA plan, and CQA documentation will be retained at the project site during the project. The plans, specifications, and CQA documents may be reviewed during a site inspection by the permitting agency and will be the chief means for the facility owner to demonstrate to the permitting agency that CQA objectives for this project are being met.

### 1.9 Documentation

A major purpose of the CQA process is to provide documentation for those individuals who were unable to observe the entire construction process (e.g., representatives of the permitting agency) so that those individuals can make informed judgments about the quality of construction for this project. CQA procedures and results must be thoroughly documented.

#### A. Inspection Reports

Routine reporting and documentation procedures are required. Inspectors will prepare written daily inspection reports that will ultimately be included in the final CQA document. The reports will include information about work that was accomplished, tests and observations that were made, and descriptions of the adequacy of the work that was performed. As a minimum, the reports will contain the following:

- Date, project name, location, personnel involved in major activities, and other relevant identification information.
- Description of weather conditions, including temperature, cloud cover, and precipitation.
- Summaries of any meetings held and actions recommended or taken.
- Specific work units and locations of construction underway during that particular day.
- Equipment and personnel being utilized in each work task, including subcontractors.
- Identification of areas or units of work being inspected.
- Unique identifying sheet number of geomembranes for cross referencing and document control.

- Description of offsite materials received, including any quality control data provided by the supplier.
- Calibrations or recalibrations of test equipment, including actions taken as a result of recalibration.
- Decisions made regarding approval of units of material or of work and/or corrective actions to be taken in instances of substandard or suspect quality.
- Unique identifying sheet numbers of inspection data sheets and/or problem reporting and corrective measures used to substantiate any CQA decisions described in the previous item.
- Pictures showing progress and key elements.
- Signature of the CQA engineer or designated representative.

#### **B. Inspection and Testing Reports**

All observations, results of field tests, and results of laboratory tests performed on site or off site will be recorded on a suitable data sheet. Recorded observations may take the form of notes, charts, sketches, photographs, or any combination of these. Where possible, a checklist may be useful to ensure that pertinent factors are not overlooked.

As a minimum, the inspection data sheets will include the following information:

- Description or title of the inspection activity.
- Location of the inspection activity or location from which the sample was obtained.
- Type of inspection activity and procedure used.
- Unique identifying geomembrane sheet number for cross-referencing and document control.
- Recorded observation or test data.
- Results of the inspection activity (e.g., pass/fail); comparison with specification requirements.
- Personnel involved in the inspection besides the individual preparing the data sheet.
- Signature of the CQA inspector.

#### **C. Problem Identification and Corrective Measures Reports**

A problem is defined as material or workmanship that does not meet the requirements of the plans, specifications, or CQA plan for the project or any obvious defect in material or workmanship. Problem identification and corrective measures reports will contain the following information:

- Location of the problem.
- Description of the problem (in sufficient detail and with supporting sketches or photographic information where appropriate) to adequately describe the problem.

- When and by whom the problem was located (reference to inspection data sheet or daily summary report).
- Corrective measure(s) as developed by the contractor.
- Who approved the corrective measure(s)?
- Documentation of correction if corrective action was taken and completed prior to finalization of the problem and corrective measures report (reference to inspection data sheet, where applicable).
- Signature of the CQA inspector and review signature of the CQA engineer.

**D. Drawings of Record**

Drawings of record (also called "as-built" drawings) will be prepared to document the actual lines and grades and conditions of each component of the project and to specify the source of the information (i.e. contractor redlines, field observation, survey, etc.).

**E. Final Documentation and Certification**

At the completion of a project, the owner will submit a final report to the permitting agency. This report will include all of the contractor's submittals, daily inspection reports, inspection data sheets, problem identification and corrective measures reports, and other documentation such as quality control data provided by manufacturers or fabricators, laboratory test results, photographs, record drawings, internal CQA memoranda or reports with data interpretation or analyses, and design changes made by the design engineer during construction. The document will be certified by the CQA engineer as follows:

*In accordance with project CQA Plan, the undersigned professional engineer states that:*

*A designated representative under the supervision of a licensed professional engineer was present during construction to observe construction activities, and that person has reviewed the results of the field testing of materials, and to the best of the person knowledge, and belief, the following project, Go East Landfill was constructed in accordance with the approved construction documents and the materials used in construction were in general conformance with the specifications. Based on the foregoing, the project can begin post-closure requirements.*

**F. Document Control**

Original documents and digital copy (scanned) will be kept and indexed for all CQA and CQC documents. This will allow easy access to all documents and will enable a reviewer to identify and retrieve submittals, inspection reports, or data sheets for any completed work element.

**G. Storage of Records**

During construction, the CQA engineer will be responsible for all CQA documents. This includes a copy of the design criteria, plans, specifications, CQA plan, and originals of all data sheets and reports. Duplicate records will

be kept at another location to avoid loss of this valuable information if the originals are destroyed.

Once construction is complete, the document originals will be stored by the owner in a manner that will allow for easy access while still protecting them from damage (digitally stored). An additional copy will be forwarded to SHD for their future reference use. All documentation is to be maintained through the operating and post-closure monitoring periods of the facility by the owner and the SHD agency in an agreed-upon format (hard copy and digital copy).

## 1.10 Meetings and Site Visits

Periodic meetings of all parties involved with the construction of various elements of the Project are required to establish work schedules, resolve problems, and generally maintain good lines of communication. An onsite trailer/office is to be available onsite to maintain records and host meetings. These meetings are outlined in the following sections.

### 1.10.1 Preconstruction Meeting

The Preconstruction meeting is held in advance of the start of construction to introduce all parties, confirm responsibilities and lines of communication, resolve any particular issues prior to the commencement of work, and clarify the requirements for CQA. The CQA Plan shall be made available to all parties, and the particular requirements for testing of the geosynthetics shall be noted. In addition, the following points shall be discussed.

- The lines of authority and communication.
- The standards for QC procedures used for the geosynthetics in the context of the CQA Plan and a methodology for review and acceptance agreed between the CQA Engineer and the Contractor.
  - Review of the requirements for seaming, testing, monitoring, and documenting installation and repairs and the repair procedures that will be required for different types of flaws or damages.
  - Review of the precautions to be taken to protect the subgrade during installation, and exposure to weather conditions prior to placement of the liner materials.
  - Manufacturer material submittals, including samples taken at the manufacturer's plant, required from the Contractor **PRIOR** to items being shipped to the site.
- The Contractor's schedule and critical path items.
- Assignment of the responsibilities to each party, and confirmation that the personnel provided shall be sufficient to meet these requirements.
- Confirmation of the timing and distribution of reports for both work schedules and CQA documentation.
- Sensitivity to local residents, both around the landfill and located along roads to the landfill.
- The time and place of the first Progress Meeting.

Either as part of the Preconstruction Meeting or separately, additional topics pertinent to the CQA Program should be discussed and agreed upon by the CQA Engineer.

- A site walk to determine the status of condition of the landfill and to review potential material storage and soil stockpiles locations on site.
- The specific methods of deployment to be used for the geomembrane material and pipe materials.
- The standards for QC procedures used for the CQA Plan and a method for review and acceptance agreed between the CQA Engineer and the Contractor.
- Confirmation of equipment laydown areas and construction worker parking.
- Review Contractor's Traffic Control Plan and anticipated variations throughout the term of the Contract.
- Review the list documents Contractor will need to produce per technical specifications.

This meeting shall be fully documented by the CQA Engineer and meeting minutes will be circulated to all parties present at, or affected by, the meeting.

#### 1.10.2 Progress Meetings and Reports

The CQA Engineer shall conduct regularly scheduled Progress Meetings, a minimum of once per week, to review the status of the schedule, problem issues, and measures for resolution of problems related to the CQA Program. These meetings shall be documented, as required, and the decisions reached shall be circulated to all affected parties. The frequency of Progress Meetings may be modified by the Snohomish Health District (SHD), if considered warranted by the CQA Engineer, based on the performance of the Contractor.

The time of the first Progress Meeting shall be determined during the Preconstruction Meeting. During each Progress Meeting, the time of the next Progress Meeting shall be confirmed. The Progress Meetings shall be designated as Progress Meeting 1, Progress Meeting 2, and so on.

The CQA Engineer shall prepare Field Inspection Daily Reports documenting the activities of the Contractor for each day worked. In addition, the CQA Engineer shall prepare for SHD meeting minutes of a weekly Progress Meeting, summarizing progress, problems, and resolutions. Areas of concern and potential future problems shall also be identified and then addressed at the next planned Progress Meeting, unless it is of sufficient importance or urgency as to warrant an *ad hoc* meeting.

#### 1.10.3 Site Visits

The CQA Engineer is to be on site at all times that the Contractor is performing work to review the progress and methodology of the construction. A Design Engineer and the SHD Representative, at a

minimum, should attend the weekly Progress Meeting at the site to be informed of the progress, problems, and resolutions. While at the site, the Design Engineer shall review any aspects of the Project that are particularly critical to the performance of the system being constructed. If the CQA Engineer has any issues arise that cannot be easily resolved or which impacts the design, the Design Engineer and/or geotechnical engineer shall make an *ad hoc* site visit to review the issue and provide resolution. A professional qualified in detecting hazardous waste shall be on site when landfill waste is being relocated. This professional may be different than the CQA Engineer.

#### **1.11 Weather**

The contractor or installer is responsible for complying with the LFCP requirement and contract plans and specifications. It is the responsibility of the CQA personnel to make sure that the weather restrictions are observed during construction. Maximum onsite driving speeds while landfill activity is ongoing is 15mph. The landfill closure activity will be shut down during any type of high winds.

#### **1.12 Work Stoppages**

The CQA engineer should notify the general contractor during stoppages for their evaluation to determine (1) whether in-place materials are covered and protected from damage (e.g., lifting of a geomembrane by wind or premature hydration of geosynthetic clay liners); (2) whether partially covered materials are protected from damage (e.g., desiccation of a compacted soil liners); and (3) whether manufactured materials are properly stored and properly or adequately protected (e.g., whether geotextiles are protected from ultraviolet exposure). The cessation of construction should not mean the cessation of CQA inspection and documentation. Failure to notify the general contractor does not relieve the general contractor of the responsibility of protecting all construction activities and materials.

Note: the maximum area of landfill that can be uncovered at any one time is one (1) acre. Any uncovered landfill area that is not covered with at least 6 inches of cover sands must be covered with visqueen and anchored to prevent wind from dislodging the visqueen.

## 2. LANDFILL CLOSURE AND ESTIMATED SCHEDULE

These activities and associated schedule are developed by the engineer as a general outline of the sequence of construction activities. The final construction schedule will be the responsibility of, and developed in detail by, the contractor at a later date.

The landfill closure construction work may be closely correlated to the preliminary plat construction work. Construction can not start until all necessary permits are in place, including an SHD Landfill Closure permit, LDA (Land Disturbance Activity) permit, DOE NPDES Permit, Haul Road and Route approval, and other environmental development permits such as the WDFW HPA and JARPA. The applicant will closely communicate with SHD regarding updates as more certain information is available. It is anticipated that the following general landfill closure construction sequence may be completed within a year after the site permits and approvals have been issued. The general sequence of landfill closure activity is presented on Sheet 9 of the LDA "Go East" project drawings.

For more detailed proposed schedule refer to Chapter 9 "Construction Requirements and Sequence" of the LFCP.



### 3. GRADING & EXCAVATION

Portions of this section are included for general information and may not contain specific CQA requirements.

#### 3.1 Proposed Grading Conditions

Trees and vegetation will be removed from an area of approximately 8.4 acres of the landfill surface to accommodate the site grading and landfill cover area. A total of about 20 acres of site will be cleared and the balance of the 41-acre property will remain in its existing and natural condition with current vegetation.

The northern half of the property will generally be graded to meet the appropriate landfill cover requirements and graded to allow for future uses. Suitable onsite soil material will be used for fill and landfill cover material to the maximum extent feasible. This will require re-grading of areas adjacent to the landfill so onsite soils can be used in the grading effort to minimize imports. The goal is to minimize the imported structural fill material to be used so the grading plan has been designed to nearly balance cut and fill quantities on site. Exposed and scattered landfill debris will be cleaned up, placed in low-lying areas of the landfill and covered per the landfill cover system requirements in Section 4 of this report, or removed from the property.

The landfill area will be capped with a protective earthen cover supplemented by a geomembrane liner layer system described in Chapter 4 of this report. The earthen cap will include a minimum of the top 12 inches of vegetated material to support a grassy recreation area, or increased as needed to support shrubs and possibly small trees, and a detention and water quality treatment pond. The main landfill area will be graded to roughly a 5% slope to drain to the stormwater detention pond. The detention pond will be graded to its final configuration during the landfill closure and the associated storm pipe conveyance systems will be installed to collect and adequately discharge stormwater run-off safely down the piped conveyance system north of the sloped landfill area. The detention and water quality treatment pond will be graded to final elevations and used as the temporary sediment pond for landfill closure erosion control purposes. The pond will be graded with gentle side slopes of 3:1 or flatter to provide a park feel with four-foot-high fences, only provided for safety. The landfill area above the northeast slope will be sloped to drain to the stormwater pond for water quality treatment and controlled discharge to the downstream drainage system.

Residential lots will be placed around the perimeter of the landfill except for the northeast corner of the landfill. The LFCP requires that the lot area outside the landfill have a program to verify no hidden materials exist. See pages 22 and 23 of LFCP and Sheet 9 of the LDA drawings for specific requirements to be accomplished. This portion of the property contains slopes that extend down into the north east facing ravine to the toe of slope.

#### 3.2 Waste Removal Area

An irregular-shaped area containing waste materials along the perimeter of the landfill will be excavated during initial site closure grading. This area, referred to as the "wedge area," will then be backfilled with structural fill material to accommodate future land development options. These areas of earthen structural fill will be compacted to 95% of the modified Proctor maximum density using ASTM-D1557

(per the Geotechnical Engineering Report). The footprint and boundary of the landfill will be reduced and therefore will represent a reduction of area previously impacted by storm water infiltration. The waste between the existing perimeter of the landfill (0 foot depth line) and inward towards the landfill, including the area to be developed with lots and roads, will be removed ("wedge area"). The excavation may extend several more horizontal feet inward and then continue at roughly a 1½:1 slope up to meet existing grade (actual slope, as required to provide a safe working environment). A new perimeter gravel filled trench will become the boundary of the capped landfill, about 5.1 acres. The northeast slope about 1.3 acres will be left undisturbed. The existing landfill area is approximately 9.6 acres. The irregular-shaped area to be excavated ("wedge area"), represents the limit of excavation of approximately 3.2 acres. 46,000-60,000 cubic yards of material is estimated to be excavated and relocated onto the landfill area. The excavated area will be filled with suitable structural compacted material. Refer to the LDA plans that provide details on the landfill closure plans.

### **3.3 Landfill Debris Screening Plan**

To date there have been over 65 soil test logs excavated into the landfill with depths up to and over 25 feet for the purpose of inventorying the type of debris and depths of material contained in the landfill. Individual soil logs are recorded by the geotechnical engineer observing the excavations and are all contained in Appendix A of the closure plan. There is a requirement to test landfill material (see page 29 of 60 of the LFCP) prior to being excavated and relocated from the landfill "wedge area" to provide information to allow proper worker protection during construction. This will allow documentation of the material being relocated from the landfill "wedge area" to the center of the landfill. None of the excavated material will be hauled off site for disposal unless it contains asbestos, lead paint, or hazardous material (see LDA drawing Sheet 9 for testing and relocation requirements) in which case these materials will be placed in covered containers and disposed of offsite at an approved facility.

The area to the west of the proposed detention/water quality treatment pond will be used as the landfill debris screening location. Materials will be visually inspected by the CQA professional representative for evidence of asbestos, including board and tiles, and onsite swab testing for lead paint on painted boards that are located in that area. Representative samples of suspect materials will be collected and tested. A certified asbestos professional will be on site to visually inspect excavated materials. Materials with detectable levels of lead paint and asbestos will be handled appropriately in accordance with the current solid waste handling standards as outlined in WAC 173-350 and transported offsite to an appropriate facility for disposal. The CQA will include on daily reports results of these observations and testing. Should hazardous material of any kind be observed, direction shall be provided to the contractor as to how to proceed with separation and removal to onsite containment.

In an effort to further control and contain dust during excavation, a fire hydrant/meter, to be located onsite, will be used for an onsite water truck. Materials shall be sprinkled with water and the runoff contained as needed. The Washington State Department of Ecology (WA DOE) best management practice (BMP) for dust control shall be followed as set forth in the DOE's 2019 Stormwater Management Manual for Western Washington BMPs. This BMP can also be used for controlling dust due to

disturbance of other areas. The BMP also discusses other ways to control potential dust such as covering stockpiles with a wind-resistant fabric. Also see Section 3.6.2 and 3.6.3 for specific requirements. The CQA professional shall direct need for water to contain dust from leaving the site.

Prior to excavation and relocation of the wedge area, materials will be tested for contamination (see Table G-4, as taken from Volume IV of the DOE's 2005 SWMMWW) and pH level. These materials will be sampled and analyzed at the following frequency of one sample for every 500 cubic yards for the first 2,500 cubic yards of soil and then one sample approximately every 2,500 cubic yards thereafter. In the event that changes in color, texture, or other characteristics are observed that indicate a possible different source of the soil, a sample will be collected even when the frequency exceeds one sample per 2,500 cubic yards. More sampling may be required if field testing indicates that additional assessment is needed due to high levels of one or more of the potential contaminants. The results of the testing will be compared to the MTCA values listed in Table 3-1 to allow the contractor to determine the level of worker protection required. Additional air monitoring may be required to determine respiratory protection if fugitive dust is an issue. The results of TCLP analyses will be compared to the TCLP values in Table 3-1 to document that dangerous waste is not present and not being relocated onto the landfill area. Should TCLP values exceed the dangerous waste criteria listed in Table 3-1, special handling and disposal requirements will be implemented. The CQA Professional is responsible to oversee that proper testing is being accomplished by the contractor, verify test results, direct actions to protect workers and impacts to surrounding areas, and provide daily logs as to any issues discovered and remedial action taken.

**Table 3-1: Recommended Parameters and Suggested Values for Determining Reuse and Disposal Options**

Parameter	Suggested Maximum Value (MTCA) <sup>(1)</sup>	TCLP Maximum Value <sup>(2)</sup>
Arsenic, Total	20.0 mg/kg	5.0 mg/l
Cadmium, Total	2.0 mg/kg	1.0 mg/l
Chromium, Total	42 mg/kg	5.0 mg/l
Lead, total	250 mg/kg	5.0 mg/l
Nickel	100 mg/kg	Na <sup>(3)</sup>
Zinc	270 mg/kg	Na
Mercury (Inorganic)	2.0 mg/kg	0.2 mg/l
PAHs (Carcinogenic)	0.1 – 2.0 mg/kg	
TPH (Heavy Fuel Oil)	200 - 460 mg/kg	Na
TPH (Diesel)	200 – 460 mg/kg	Na
TPH (Gasoline)	100 mg/kg	Na
Benzene	0.03 mg/kg	0.5 mg/l
Ethylbenzene	6 mg/kg	Na
Toluene	7 mg/kg	Na
Xylenes (Total)	9 mg/kg	Na
pH <sup>(4)</sup>	6.5-8.5	6.5-8.5

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<b>Parameter</b>	<b>Suggested Maximum Value (MTCA) <sup>(1)</sup></b>	<b>TCLP Maximum Value <sup>(2)</sup></b>
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- Notes: <sup>(1)</sup>Model Toxics Control Act Method A values for unrestricted site use or protection of terrestrial organisms.  
<sup>(2)</sup>Maximum Concentrations of Contaminants for the Toxicity Characteristic per WAC 173-303-090.  
<sup>(3)</sup>Na = No value given  
<sup>(4)</sup>pH range considered to be neutral

## 4. LANDFILL CAP COVER SYSTEMS

Portions of this section are for general information and may not contain CQA requirements.

### 4.1 Overview

The proposed cover systems will encompass a total area of approximately 5 acres (Cover Systems 1 and 2). The minimum requirements for the final landfill cover system for proper closure are stated in WAC 173-350-400(e)(ii) A&B. This project is proposing to exceed the minimal requirements as described by the WAC 173-350-400. The cover systems are described in the main report. This text provides an overview of each system. Additionally, plans, cross-sectional views, and details are provided in the LDA drawings prepared for the landfill closure.

For this project there are two separate cover systems. Cover Systems 1 and 2 both incorporate a geomembrane layer covered with earthen (non-compacted) material.

**Note: The details contained in LDA # 1 drawings for Cover Systems 1 & 2 supersede the following descriptions and details.**

**Cover System 1:** For the larger plateau area and slopes up to 3:1, the area will be covered by a 40-mil LLDPE geomembrane liner, plus two feet of earthen material and 6 to 12 inches of organic material suitable for supporting native and seed grasses. The geomembrane liner is discussed in detail in Appendix F of the LFCP and the LDA drawings.

**Cover System 2:** For the area of the proposed stormwater detention pond and conveyance ditches, a second 40-mil LLDPE geomembrane liner layer will be provided for additional protection against water infiltration. See LDA drawings for details.

**Cover System 3:** This cover system has been deleted.

### 4.2 Earthen Cap Layer and Geomembrane (Cover Systems 1 and 2)

Cover System 1 encompasses the largest area, approximately 5 acres.

This cover system will require a geomembrane liner, plus a minimum of 2 feet of earthen material and 6 to 12 inches of organic material suitable for supporting grasses. The geomembrane liner is discussed in more detail in Section 4.2C of this Appendix E of the LFCP.

#### A. Soil Fill Material Layer

The soil cover material layer will consist of about 2 feet of local sands and organic soils as required to achieve the proposed grades. This fill material will be generated from areas of onsite cut materials in combination with possible imported soils as recommended in the Geotechnical Engineering Report and as shown on the grading plans contained in the LDA drawings. The CQA Professional is to verify minimum depth of material has been placed properly.

#### B. Sub-Grade Layer

The sub-grade layer will consist of 6 inches of compacted foundation material. This layer is intended to serve as a flat surface, onto which the geomembrane liner will be placed, and to prevent any puncture from waste below and help

minimize differential settlement of the waste. The CQA Professional is to verify 6-inch foundation material is compacted, graded, and with no material protruding that would damage the geoliner.

C. **Geomembrane Layer**

Over the sub-grade layer, the geomembrane liner will provide extra protection against stormwater infiltration into the landfill. This project proposes to use a minimum 40-mil LLDPE geomembrane liner which is commonly used for capping landfills and lining ponds. The liner membrane will be flexible and capable to elongate to accommodate any possible differential settlement that may occur over time. The liner is intended to limit or minimize moisture penetration downwards and gas migration upwards.

For further information on the geomembrane liner layer, see Appendix E. For testing of the geomembrane liner layer, see "Northwest Linings and Geotextile Products, Inc., Construction Quality Control Manual for Containment Membrane Field Installations" included in Appendix E of this report. The sample specifications and materials and installation warranties for the geomembrane liner are included in Appendix E. This liner, or equal, shall be used for this project. Directly on the membrane will be placed a geotextile cushion material. The CQA Professional is to verify and monitor contractor's installers for compliance with installation specifications.

D. **Soil Cover Layer**

A 2-foot thick soil layer of soil is to be placed over the geotextile cushion per geotechnical engineer recommendations. Section 10.3 of the Geotechnical Engineering Report recommends, "This material be placed in maximum loose lift thickness of 12 inches." The top 12 inches will be as described in paragraph E below. See paragraph A above.

E. **Vegetative Soil Cover Layer**

The vegetative soil cover layer will be at least 12 inches deep and will consist of organic soils to promote and sustain plant and/or grass growth. The vegetative soil depth may be deeper as required to develop adequate plant root systems.

#### **4.3 Final Approval**

Upon completion, the soil layers must be accepted and approved by the CQA engineer prior to deployment or construction of the next overlying layer. Acceptance and approval will be based on all the CQC and CQA observations, data, and test results.

## 5. QUALITY ASSURANCE RESPONSE REQUIREMENTS

*To assure proper level of follow up is conducted, the following procedures shall be used.*

### 5.1 Submittal Review

The CQA Engineer has ten (10) working days to review and return submittals plus an additional one week for submittals that deviate from the Contract Documents. The CQA Engineer will review only those items required by the Contract Documents. Information submitted by the Contractor not required will be returned marked "Information Only." In the event a single submittal contains both required and on-required information, only the required information is subject to CQA Engineer review.

Submittal will be marked to indicate the result of CQA Engineer review, as follows.

- "NO EXCEPTION TAKEN" – Revision of drawing or data will not be required.
- "MAKE CORRECTION NOTED" – Contractor shall revise the drawing or data, as indicated. Resubmittal is not required.
- "REVISE AND RESUBMIT" - Contractor shall revise the drawing or data and shall resubmit the revised drawing or data to the CQA Engineer for review and acceptance.
- "REJECTED" - Submittal does not conform to Contract Documents. Contractor shall resubmit in a form that conforms to Contract Documents to the CQA Engineer for review and acceptance.

Copies marked "NO EXCEPTION TAKEN" or "MAKE CORRECTION NOTED" authorizes the Contractor to proceed with construction or fabrication covered by those Design Drawings or data sheets with corrections, if any, incorporated.

### 5.2 Summary of Quality Assurance Functions

Table 5-1 provides a summary of QA functions to assure proper oversight. Sections not listed typically provide for general oversight responsibilities.

**Table 5-1: CQA Response Requirements Summary**

Action Item	Action for CQA	Item	Notes
Measurement and Payment Procedures	Review	Contractor progress estimates – lump sum	Per contract or agreement
Measurement and Payment Procedures	Review	Contractor time and material documentation	
Administrative Requirements	Review	Draft forms	Review and approve
	Schedule	Preconstruction meeting	Provide agenda and list of required items for Contractor to submit or present at the meeting. Prepare and distribute meeting minutes.
	Schedule	Weekly project meetings	Prepare, coordinate, convene, arrange, and direct. Provide direction to the contractor for preparation of weekly meetings. Prepare and distribute meeting minutes.
	Schedule	RFI Meetings	Direct and lead meetings. Provide direction to the contractor for preparation of meeting including ensuring required individuals are present and prepared to discuss RFIs in detail. Prepare and distribute meeting minutes.
Project Schedule	Review	Baseline schedule	
	Review	Schedule monthly updates	
Quality Assurance and Quality Control	Testing	Laboratories	Approval of lab.
Surveying	Execution	Completed Work Verification Survey	Review
Temporary Facilities and Utilities	Execution	Temp facilities	Available space
		Construct watermain, hydrant, and service	Coordinate Silver Lake Water & Sewer District requirements
Traffic Controls	Plan review	Traffic Control Plan	Review (based on SC permit)
	Execution	Flagger cards	Prior to commencing work
		Inspect, maintain, remove and replace signage	As necessary
Product Requirements	Execution	Products (all)	Review, as necessary
		Product substitutions	Review Substitution Request Form
Closeout Procedures	Execution	Red-line record document coordination	Weekly
Removal of Hazardous Materials and Dangerous Waste	Plan review	Pollution Prevention Site Plan	Approve prior to mobilizing to site
	Execution	Identify dangerous waste by sampling and observation	Observe excavation, and sample as necessary during excavation, or when notification of potential by others



Action Item	Action for CQA	Item	Notes
Removal of Hazardous Materials and Dangerous Waste (cont.)	Execution (cont.)	Inform Contractor of the presence of Dangerous Waste	Instruct Contractor on how to proceed
		Direct additional Dangerous Waste characterization by Contractor	As required
		Provide Waste Profile form and/or HWM information to the Contractor	As required
		Temporary Dangerous Waste storage location	Identify available space/containers
		Lead and asbestos	Direct proper action for cleanup
		Cleanup	Approve alternative methods for cleanup. Inform Contractor when clean-up is adequate
		Equipment and vehicle decontamination	Inform Contractor when clean-up is adequate
		Collect Hazardous Waste Manifests	Within 30 days of disposal
Geotextiles	Review	Results of geotextile manufacturer's source quality control tests for all rolls of geotextile shipped to site	Review
	Product	Notification 10 working days prior to shipping date by Contractor	Acceptance
		Review product specs and manufacturer test results – conformance test	Acceptance
	Execution	Installation compliance with specifications	Acceptance
		Installation completion	Acceptance, as appropriate
Linear Low-Density Polyethylene (LLDPE) Geomembrane	Plan review	Installation and Sequencing Plan	Acceptance
	Product	Review product specs and manufacturer test results	Acceptance
		Conformance test – pre-shipment samples	Acceptance
		Notification 10 working days prior to shipping	Acceptance
		Shipment	Verify and check bills of lading against sample submittals
		Delivery of rolls	Inspect and determine if damaged
	Submittal review	Review product specs and manufacturer test results	Acceptance
		Certification of installation in accordance with Contract Documents	Acceptance
	Execution	Periodic verification, checking, or testing	Observe and document
		Subgrade	Observe daily
		Installation at ambient temperature other than between 50 and 70 degrees Fahrenheit	Approve in writing
		Trial welds greater than 2 per day	Direct as appropriate
		Working day QC documentation	Acceptance prior to commencing next day's work
		Panel identification	Coordinate coding with Contractor

Action Item	Action for CQA	Item	Notes
Linear Low-Density Polyethylene (LLDPE) Geomembrane	Execution	Seam numbering system	Coordinate coding with Contractor
		Seam welding accessories	Approve apparatus
		Solvent and adhesive use	Approve in writing
		Welding and cap stripping	Observe
		Destructive testing locations and numbering	Select
		Destructive testing	Retain portion for archive storage
		Welded seams	Acceptance
		Repairs	Approve
		Record Drawings	Acceptance
		Material and seam test results, weld test summary report and installation completeness	Acceptance, as appropriate
Installation completeness	Acceptance		
Trenching, Backfilling, and Compacting for Utilities	Execution	Underground piping and utilities	Provide all available information to Contractor
		Unsuitable conditions	Approve excavation below grade
		Plan for controlling site water during trench excavation	Review
		Excavation by machinery	Approve
		Field survey notes	Maintain at the job site throughout the Work
		Grade and alignment control during excavation	Provide to Contractor
		Grade control device	Provide
		Testing	In-place density and moisture content
		Installation completeness	Acceptance, as appropriate
Earthwork	Plan review	Construction Plan	Approve prior to any earthwork
		Moisture conditioning methodology	Acceptance
	Review	Surface preparation	Review prior to commencement of proof-rolling
		Compaction equipment for proof rolling	Approve
		Unsuitable screenings	Designate stockpile location
	Product	Preliminary testing, Request for Approval of Material Source form	Perform and provide, respectively
		Trench Backfill	Determine if unsuitable and use local sands as needed for compaction.
		Correction of excessively wrinkled geosynthetic products	Approve
		Conformance test	Perform as appropriate
		Imported materials delivery to site	Written acceptance
Testing for final acceptance	Approve		

Action Item	Action for CQA	Item	Notes
Earthwork (cont.)	Product (cont.)	Preconstruction material quality evaluations	Review prior to incorporation
		Vegetative soil blending	Verified prior to hauling for final placement
	Execution	Excavation limits – verify	Direct – Pothole as required
		Refuse excavation	Approve
		Unsuitable materials excavation and placement	Written approval
		Fill material placement	Approve suitable condition of underlying surface
		Stop fill placement temporarily other than unsuitable weather conditions	Approve
		Compaction methods	Approve
		Fill low spots with topsoils/local sand material and minimally grade high spots	Approve
		Finish grade compaction for hydroseeding	Verify Visually
		Condition of underlying geosynthetic products prior to placement of soil	Approve
		Excavate soft or loose zones	Approve depth of excavation
		Riprap and quarry spall placement	Approve
		Backfill material for structures other than native material	Approve
Earthwork completeness	Written acceptance, as appropriate		
Refuse Excavation and Handling	Submittal review	Refuse relocation meetings: preconstruction meeting, weekly coordination meetings, repair meetings (as necessary)	Coordinate
	Execution	Prohibited wastes (hazardous)	Verify
Erosion and Sedimentation Control	Plan review	Temporary Erosion and Sedimentation Control Plan that includes Dust Control Plan	Approve prior to commencement of work (updated weekly)
		Temporary surface water control treatment systems plan and detention pond	Approve
	Execution	Surface water runoff monitoring – comply with NPDES Permit	Monitor pH and turbidity at monitoring points identified in the Landfill Closure Plan
		Ensure certified CESCL engineer reviews TESCP facilities	Verify
		Removal of sediment from detention pond and outlet chamber	Direct removal
		Silt Fence Locations	Acceptance/Coordinate with CESCL engineer
		Rock Silt/Check Dams	Approve locations
		Application of straw mulch as temporary stabilization method	Direct use in areas with slopes 3:1 or steeper
		Areas outside the Limits of Construction	Approve
		Dust control	Acceptance
Application of water for dust control	Per Landfill Closure Plan		

Action Item	Action for CQA	Item	Notes
Erosion and Sedimentation Control (cont.)	Execution (cont.)	Street sweeping disposal	Dispose of offsite
		Application and reapplication of temporary soil stabilization for turbidity control in stormwater	Direct application when appropriate
		Straw mulch application in areas with Temporary Soil Stabilization cover	Direct use where appropriate
		Concrete wash water residue disposal	Approve, not near landfill
		Plastic sheeting (visqueen) installed on erodible embankment slopes and exposed landfill areas	Provide direction and approve installation, and secure with sandbags
		Location of stockpile for sandbags not currently in use	Approve
Rolled Erosion Control Products (RCEP)	Execution	RECP edge subject to wind- or water-related instability (sandbags)	Require securing, as needed
		RCEP installation	Approve
Vegetative Soil and Hydroseed	Plan review	Topsoil Testing report	Acceptance (from source of material)
	Product	Soil amendment supplier's material certification	Acceptance
	Execution	Completion of subgrade preparation	Observe
		Completion of topsoil preparation	Observe
		Completion of finish grade prior to seeding	Observe
		Seeding and other work has been completed	Observe
		Conclusion of one-year Guarantee Period	Observe
		Areas where erosion has washed seed and soil away	Review and provide solution
		Filling of stormwater pond as watering technique	Approve, after plants have grown to sufficient height to withstand flooding
		Onsite water source	Coordinate with Silver Lake Water & Sewer District
		Finish grade of seeded areas	Acceptance prior to seeding
		Seeding at times of year other than between March 15 and May 15	Written approval
		Monthly inspection during maintenance period	Written notice of failure, as necessary
Final acceptance	Acceptance		
Precast Concrete Utility Structures	Execution	Pipe placement	Approve
		Backfilling	Review and approve all pipe in place as to line, grade, bedding, and proper joint construction
		Solid pipe leak tests (water line)	Observe and signed acceptance
		Completion and required documentation from material supplier and Contractor	Acceptance
Piping Systems	Execution	Alternate pipe installation grade or line	Direct, based on settlement, as needed
		Notice of intent to cover a pipe or structure	Observe
		Final acceptance	Acceptance

Action Item	Action for CQA	Item	Notes
Piping Systems (cont.)	Execution (cont.)	Inspection of new pipes and culverts after installation and during connection of pipe joints and fittings	Observe
Solid Wall PVC Piping	Submittal Review	Testing plan	Approval
	Execution	Testing	Monitor
		Repair leakage	Approve
		Inspection	Acceptance
Piping/Perforated PVC pipe	Submittal review	1-foot long sample of each solid and perforated pipe	Acceptance
	Execution	Testing	Monitor
		Repair leakage	Approve
		Inspection	Acceptance
Landfill Gas Collection System	Submittal review	Testing Plan	Approve
		Landfill Gas System Construction Plan and Schedule	Approve prior to disconnection of existing piping
	Product	Structures, piping collection system	Approve
	Execution	LFG System Construction Plan	Approve
		LFG pipe labeling	Designate
		Final as-built pipeline information	Measure and record
		Completion	Acceptance

## **6. LINEAR LOW-DENSITY POLYETHYLENE GEOMEMBRANE**

This Section presents information regarding QA for the Linear Low-Density Polyethylene (LLDPE) geomembrane products associated with the Work. The geomembrane material, consisting of polyethylene resin is manufactured in 40-mil thick sheets for the LLDPE, textured on both sides, and delivered to the site in rolls. The rolls are typical 500 to 700 feet long and 20 to 25 feet wide. This section provides additional QC procedures supplementing those contained in Appendix E of the LFCP.

### **6.1 Geomembrane Manufacturing**

The CQA Engineer shall review all geomembrane manufacturer QC certificates and other submittals required by the Specifications and provided by the contractor for conformance with the Specifications prior to material shipment to the site. This includes samples taken at the place of manufacture and tested locally.

Once conformance is confirmed and the materials have arrived at the site, the CQA Engineer shall certify that the materials on site correspond to the materials for which the manufacturing documentation has been prepared.

Any discrepancies shall be reported to Owner and contractor with details of the Discrepancies and the nature of the materials actually on site. Conformance certifications shall be included in the Final CQA Report.

### **6.2 Geomembrane Conformance Testing**

Conformance testing is required to be completed by the Manufacturer to confirm that the geomembrane that the Contractor intends to ship to the site has the appropriate physical and mechanical properties.

#### **6.2.1 Sampling Procedures**

Geomembrane samples for pre-shipment conformance testing shall be sent from the geomembrane manufacturer's facility to the Contractor, at the minimum rate of one per 100,000 square feet of geomembrane supplied. Samples shall only be collected from material that will be delivered to the site. Geomembrane samples for conformance testing shall be in accordance with the Specifications and sufficiently large as to provide enough material to meet the test requirements. The samples shall not include material from the outermost wrapping of the roll.

The Contractor will be responsible for ensuring that the manufacturer's documentation and sample preparation conforms to the Specifications included in Appendix E of the Landfill Closure Plan. Upon receipt, the Contractor shall trace a pattern of each sample and submit to the CQA Engineer along with the required manufacturer's documentation. The Contractor shall forward the samples to the laboratory for testing. Upon receipt of acceptable test results, the CQA Engineer may authorize shipment.

Upon delivery of the materials to the site, the CQA Engineer shall verify the shipment and check bills of lading against sample submittals. The Contractor shall provide access for the CQA Engineer to the sampled ends of the geomembrane for CQA Engineer verification that the patterns made from the samples match the actual cuts in the geomembrane.

### 6.2.2 Conformance Test Procedures

Testing shall be carried out by the Laboratory in accordance with the ASTM test methods indicated in Table 6-1.

<b>Test</b>	<b>Test Designation</b>
Sheet Thickness	ASTM D5994
Density	ASTM D1505
Tensile Strength at Break	ASTM D6693
Elongation at Break	ASTM D6693
Tear Resistance	ASTM D1004
Puncture Resistance	ASTM D4833
Carbon Black Content	ASTM D1603
Carbon Black Dispersion	ASTM D5596

### 6.2.3 Conformance Test Results

Conformance test results shall be reported to the CQA Engineer who shall review the results for conformance with the Specifications. Conformance test results shall be reported to the Owner and the Contractor.

Non-conformance test results will require re-sampling for re-testing. Geomembranes represented by non-conformance test results may not be deployed until conformance with the Specifications has been demonstrated. If a second round of tests confirms non-conformance of the sample, the roll from which the sample was taken shall be rejected, as well as any other rolls represented by that sample. CQA personnel shall determine which rolls are represented by the sample from a review of the geosynthetic material manufacturer's QC testing and certification.

Additional sampling and testing may be conducted on unsampled rolls represented by the non-conforming sample. Additional sampling and testing will be conducted at the expense of the Contractor to determine conformance of those rolls with the Specifications.

The CQA Engineer shall include the results of all conformance testing in the Final CQA Report.

### 6.3 Geomembrane Receiving, Handling, and Storage

The CQA Engineer shall perform receiving inspection on all geomembrane material in compliance with procedures described in the Specifications. The CQA Engineer shall also confirm that transportation, handling, and storage of geomembrane materials are performed in accordance with the Specifications, and shall determine the condition of rolls of geomembrane upon delivery to the site.

The CQA Engineer shall verify that the rolls delivered match the lot numbers of those included in the conformance testing.

## 6.4 Geomembrane Liner System Installation

CQA personnel shall monitor and document all aspects of geomembrane liner system installation. The CQA Engineer shall document that geomembrane placement and seaming activities are performed in accordance with the Specifications, particularly that required materials, methods, and testing procedures are employed. The CQA Engineer shall also review documentation submitted by the geomembrane installer, testing laboratories, and other parties, as listed in the Specifications. Seams or repaired areas that do not pass the tests shall be repaired and retested, as described in the Specifications, until a passing result is achieved. Requirements for geomembrane installation and testing are described in detail in the Specifications and are summarized in the following subsections.

### 6.4.1 Subgrade Surface Inspection

Immediately prior to geomembrane deployment, the CQA Engineer and installer shall confirm that the surface upon which the geomembrane will be installed is suitably prepared and will not damage the geomembrane.

Details of required observations are presented in the Specifications. In general, the geomembrane subgrade surface shall be free of clods, rocks, sticks, abrupt changes in grade, ruts, protrusions not to exceed  $\frac{3}{8}$  inch, standing water, frozen material, sharp objects, and other conditions that could damage the geomembrane. The CQA Engineer shall observe the geomembrane subgrade daily to the appropriate lines and grades and the thickness of material.

### 6.4.2 Deployment

The CQA Engineer shall monitor and document geomembrane deployment. Installation shall not begin until Contractor has submitted the previous day's quality control documentation to the CQA Engineer. Deployment shall be in accordance with the Specifications and the accepted seam and panel layout drawing submitted prior to construction. The CQA Engineer shall document the time and location of material placement and make note of any damage to the materials. The CQA Engineer shall record weather, ambient temperature, temperature of the geomembrane, and subgrade conditions to ensure conformance with the Specifications.

For any damage to the materials, the Specifications define the repair method to be used, based on the nature and size of the damage. All repairs shall be performed in accordance with the Specifications.

### 6.4.3 Seaming/Welding

All field seaming shall conform to the accepted seam and panel layout. Field seaming operations must be completely monitored and documented by the CQA Engineer to ensure conformance with the Specifications.

- Verify that only seaming methods and equipment that have been previously accepted are used, and that equipment and gages are in current calibration, as applicable. Obtain copies of calibration certificates for project files.
- Observe trial seaming procedure and record test results. If questions arise concerning seam failure or other aspects of the trial seam, the CQA Engineer will make the final determination as to whether the seam is acceptable.



- Monitor weather conditions, measure ambient temperature, and notify the installer if conditions are outside of the acceptable limits or if conditions have changed so that new trial seams are required.
- Verify that the geomembrane installer superintendent or lead welder foreman is present during all seaming operations.
- Prior to seaming, verify that panels have been prepared in accordance with the Specifications and are clean and dry.
- During seaming, monitor and record nozzle, preheat extrudate, wedge, or other temperatures, as appropriate for the particular apparatus. For automated apparatus, record seaming apparatus speed.

Documentation shall include (as a minimum):

- A record of the trial seams, including date, time, welder identification (ID), machine ID and settings, and associated test results.
- The seam number, based on a seam numbering system agreed to by the CQA Engineer and Contractor.
- Date, time, welder ID, machine ID and settings for each seam.
- The ambient temperature and temperature of the material.

#### 6.4.4 Seam Testing

For seam testing, the CQA Engineer shall perform the following activities.

- Verify that test equipment is suitable and in working order and that gages are in current calibration, as applicable. Obtain copies of calibration certificates for project files.
- Continuously monitor and record the results of all non-destructive testing.
- Determine locations for destructive test samples, based on the required sampling frequency and seaming observations. Destructive samples will not be taken from critical areas, such as areas that could be expected to be under a leachate head for extended periods of time, or from places that would be hard to patch. The Installer shall not be informed in advance of the locations where the seam samples will be taken.
- Observe removal of destructive test samples. Assign a number to each sample, and record the sample number and location on the layout drawings.
- The Contractor shall send the destructive test sample to QA testing laboratory. The results of the Laboratory destructive testing shall be made available to the CQA Engineer and Contractor not more than two (2) working days after the samples have been received by the laboratory.
- Observe all repair procedures and non-destructive testing of sample locations.
- Determine whether additional sampling and testing is required, such as in tie-in areas, or when there is cause to suspect the presence of excess crystallinity, contamination, offset welds, or any other potential defect. Notify the CQA Engineer of the need and location for extra tests.
- Document all actions taken in conjunction with destructive test failures.

#### 6.4.4.1 Nondestructive Seam Testing

The purpose of nondestructive testing is to detect discontinuities or holes that may exist in the seams, and to indicate whether a seam is continuous or has non-welded sections. Nondestructive tests for geomembrane include vacuum testing and air pressure testing. Fusion welded seams that, in the opinion of the CQA Engineer cannot be pressure tested shall be vacuum tested. Nondestructive testing must be performed over the entire length of all seams, in accordance with the Specifications. The Contractor shall perform non-destructive seam testing.

CQA personnel shall observe and document the testing to verify compliance with the Specifications and document any seam defects and necessary repairs. Documentation shall include, at a minimum, the date, time, location, and pass or fail for each test. CQA personnel shall identify the failed areas by marking the area with a waterproof marker compatible with the geomembrane, notify the Contractor of any required repairs, and record the repair needed.

#### 6.4.4.2 Destructive Seam Testing

Destructive seam tests will be performed at an initial interval as set forth in Appendix E, as described in the CQC Manual for Field Installations, one test for each geomembrane seam, as set forth in Appendix E. CQA personnel may require additional tests if there are seams that do not appear to meet Specification requirements. At the Preconstruction Meeting, the Contractor, CQA Engineer, and SHD will agree to this minimum testing frequency of seam length.

Reasons for selecting test locations may include, but are not limited to:

- Wrinkling in seam area
- Excess crystallinity
- Suspect seaming equipment or techniques
- Weld contamination
- Insufficient overlap
- Adverse weather conditions
- Possibility of moisture, dust, dirt, debris, or other foreign material in the seam
- Failing tests

CQA personnel will select locations where seam samples will be cut for destructive testing, as follows.

- The minimum testing frequency as stated above of seam length is an average frequency for the entire installation. Individual samples may be taken at greater or lesser intervals.
- If the number of failed samples exceeds five (5) percent of the tested samples, this frequency may be increased solely at the discretion of the CQA personnel. Samples taken as a result of failed tests do not count toward the total number of required tests.

CQA personnel shall not inform the Contractor in advance of destructive sample locations.

The Contractor shall collect samples in accordance with the Specifications. CQA personnel shall:

- Observe the sample cutting operations.
- Mark each sample with an identifying number that contains the seam number, destructive test number, welder ID, machine ID, date and time.
- Record the sample location and reason for taking the sample.

Destructive testing must be performed concurrently with seaming operations, not at the completion of the entire installation.

#### 6.4.5 Laboratory Testing

CQA personnel shall forward one part of all samples for destructive testing to the laboratory to verify seam quality. Testing includes bonded seam strength (shear) and peel adhesion (peel). Both tests shall be completed in accordance with the Specification. The purpose of peel and shear tests is to evaluate seam strength and to evaluate long-term performance. Shear strength measures the continuity of tensile strength through the seam and into the parent material. Peel strength addresses weld quality. At least five (5) specimens from each sample must be tested in each method used. Minimum test values are presented in the Specifications. The Laboratory must provide test results to the CQA personnel within 24 hours of receipt. Certified test results shall be provided within five (5) days. The CQA Engineer must immediately notify the Contractor in the event of a calibration discrepancy or failed test results.

CQA personnel must record the results of the laboratory testing on a destructive seam test form, the panel/seam log, and the panel layout drawing.

If the laboratory test fails in either peel or shear, the Contractor shall follow the failed weld procedures outlined in the Specifications. This process shall be repeated until passing tests bracket the failed seam section. All seams must be bounded by locations from which passing laboratory tests have been taken. Laboratory testing governs seam acceptance. In no case can field testing of repaired seams be used for final acceptance.

#### 6.4.6 Repairs

Any portion of the geomembrane with a flaw that fails a nondestructive or destructive test, where destructive tests were cut, or where nondestructive tests left cuts or holes, must be repaired in accordance with the Specifications. CQA personnel must locate and record all repairs on the Record Drawings. CQA personnel shall monitor and document all repairs to ensure that they are completed in accordance with the Specifications.

### **6.5 Post-Seaming**

After field seaming operations have been completed, CQA personnel shall perform the following activities.

- Upon completion of work in any given area, examine that area to determine whether all waste and extraneous materials have been removed and that the area has been left in a satisfactorily clean condition to allow placement of materials on top of the geomembrane.
- Monitor ambient weather conditions to verify that materials above the geomembrane are placed only within the acceptable temperature limits as defined in the Specifications.
- If soil materials are placed over the geomembrane, verify that the type of equipment meets Specification requirements.
- If soil materials are placed over the geomembrane, observe the placement operations to verify that minimum thickness is maintained, and that placement is done in a manner which will not cause wrinkles in, or damage to, the geomembrane.
- Review the Contractor's Record Drawings for the liner system.

#### **6.6 Geomembrane Boots**

CQA personnel shall observe and photo-document that all geomembrane boots are constructed per details on the Design Drawings and:

- Form a watertight and airtight seal.
- Do not pull or cause stress on the geomembrane material.

#### **6.7 Geomembrane Lined Ditches**

CQA personnel shall observe construction of geomembrane ditches, associated anchor trenches, and geomembrane connection between lifts and:

- Verify that ditch slopes are uniform and conform to the grades (slopes) shown on the Construction Drawings. CQA personnel shall verify that the contractor's ditch layout meets the requirements shown on the plans relative to change in slope and locally increased berm height.
- Ensure that existing cross-slope anchor trenches are not damaged during removal of existing CSW ditch in preparation for the next lift of refuse.

Observe the contractor's installation of the soil bentonite plug as well as seaming of LLDPE cover at the connection to the existing anchor trench per Construction Drawings.

#### **6.8 Construction Hold Points**

Internal hold points for the polyethylene geomembrane component of the Project are identified in Table 6-2. At these points, the Contractor, manufacturer, or installer shall cease work on the affected activity until it has been reviewed and accepted by the CQA Engineer. The schedule for hold points will be determined when the Contractor develops his procurement and construction schedule for the Project. The Contractor shall update and submit the schedule to the CQA Engineer on a weekly basis.

**Table 6-2: Construction Hold Points for Geomembrane Components**

<b>Feature</b>	<b>Inspection Point</b>	<b>Inspection Activity</b>
Subgrade for Final Cover	Prior to deployment	Manufacturer's/Installer's documentation
Subgrade for Cover 1 and 2	Prior to Deployment of 6" foundation material	Observe proof-rolling subgrade free of deleterious material, protrusions greater than 3/8 inch, and other conditions that could damage the Geomembrane. CQA Compaction testing for subgrade
Subgrade for Interim Cover 1 and 2	Before Deployment of Geomembrane	Manufacturer's/Installer's documentation CQA Review of compaction testing Installer's panel layout Observe proof-rolling subgrade free of deleterious material, protrusions greater than 3/8 inch, and other conditions that could damage the Geomembrane.

**6.9 Geomembrane Cushion**

Install a geomembrane cushion, PermeaTex 4035 or approved equal, directly over the top of the geomembrane in compliance with manufacturer's requirements. Geomembrane cushion material shall meet the requirements set forth in the table contained at the end of this Plan.

## 7. EARTHWORK

Earthwork for the Project includes excavation, dewatering, fill, backfill, compaction, grading, processing, stockpiling, disposal of unsuitable materials, aggregates, embankment, and subgrade preparation. Prior to the start of earthwork activities, the Contractor shall submit a Preconstruction Plan and schedule to CQA personnel for acceptance. This plan shall include a description of the methods to be used for all material processing, excavation, backfilling, soil placement, compaction, and grading operations. CQA personnel shall review this plan for conformance with Specification requirements.

Note that contours shown within landfill areas on the Design Drawings reflect surface conditions at the time field topography was accomplished. Over the course of time, differential settlement of the landfill will occur. If at any time during construction any CQA personnel detect a significant difference between actual and design grades, immediately notify the CQA Engineer.

### 7.1 Excavation for Construction Activities

Equipment and tools used in the performance of this work shall be approved by the CQA Engineer prior to commencement of work. During excavation, CQA personnel shall generally observe the excavated material and subgrade conditions and shall perform the following activities.

- Observe stripping and excavation to document that there are no moisture seeps and that all soft, organic, and otherwise undesirable materials are removed to the appropriate stockpile.
- Observe construction activities near existing wells and during exposure of existing geomembrane. Photograph and otherwise document any observed damage and secure an appropriate and documented repair.
- Review the Contractor's work and confirm that the depth and slope of the excavations, sumps, ramps, trenches, surface water drainage ditches, roadways, and other pertinent features meet design requirements. The extent of confirmation surveying performed by the CQA Engineer may be modified as the work progresses.

Observations shall be recorded on daily field monitoring report forms, including Record Drawings or photographs, as appropriate.

### 7.2 Stockpile Excavation

During excavation of stockpiles for haul or for processing, the CQA Engineer shall generally observe the excavated material and subgrade conditions and shall perform the following activities.

- Observe stripping and excavation to document that there are no moisture seeps and that all soft, organic, and otherwise undesirable materials are removed to the appropriate stockpile.
- Observe the material for changes in moisture content or material properties (e.g., clay, glacial till, color, etc.). Refer to LFCP and Geotechnical Report for testing requirements.

### 7.3 Soil Materials Selection

Any imported soil materials require the review and written acceptance of the CQA Engineer prior to shipment. Final acceptance by the CQA Engineer shall be based on tests made on samples of material taken from the completed and compacted course. Laboratory test results and samples shall be prepared by the CQA Engineer. The CQA Engineer and the Design Engineer will determine if the material is in conformance with the Specifications and either accept or reject. Specific testing requirements are detailed in the Specifications contained on Sheets 9 and 13 of the LDA drawings for Go East and Geotechnical Report contained in the Landfill Closure Plan.

### 7.4 Placement and Compaction

The CQA Engineer shall perform the following activities.

- Prior to placement of any structural backfill, drain sand, topsoil, screened embankment, or roadway materials, verify that the subgrade has been prepared (scarified, moisture-conditioned and compacted to the densities specified) in accordance with Geotechnical Report requirements.
- Review soil testing data to verify that materials satisfy Specification requirements.
- Visually observe soils for unwanted debris or deleterious material.
- During placement of fill, embankment, select embankment, and roadway materials, conduct tests and observations to document that the quality of compacted material meets the Project Specifications. This will include visual observation, measurement of lift thickness, verification of grain size analysis, determination of moisture-compaction characteristics, measurement of in-place density and moisture content, and other tests identified in the Specifications.
- Verify that final lines and grades conform to design requirements and that minimum thicknesses have been achieved prior to placing overlying layers. Verify gravel gas trench material is placed to the depths indicated on the plans.
- Monitor and inspect all soil material placement, track walking, and compaction to verify compliance with the Specifications. This is critical during placement of soil above the geosynthetic components of the liner system to avoid damage to these materials.
- Compaction effort and moisture control are critical in achieving required compaction within the exposed geomembrane anchor trenches. If adjustments are deemed necessary, the Contractor shall modify his technique in order to achieve the required density for backfilled materials.
- Visually observe to detect any damage to underlying geosynthetics, if present. Ensure that cover materials within trenches are not folded or wrinkled.
- After placement of soils, check required final grades to ensure that design surface grades, ditch lines, etc., conform to the Design Drawings.

At locations where *in situ* testing indicates moisture contents or densities are outside acceptable Specification limits, the failing area shall be reworked or removed and

replaced. These areas shall be retested and the repair process repeated, as necessary, until passing results are achieved.

Observations shall be recorded on daily field monitoring report forms, Record Drawings, and test data forms.

## 7.5 Soil Testing

Soil testing shall be completed in both a laboratory and/or the field, as appropriate, for the purpose of materials selection and CQA. All testing shall be done in accordance with the associated ASTM standard or other procedures as listed in this CQA Plan and the Specifications (Geotechnical Report, Appendix A of LFCD). Quality Assurance testing will be performed by the CQA Engineer. For on-site borrow or recovered material, the CQA Engineer is to perform those tests as specified.

### 7.5.1 Laboratory Soil Testing

Laboratory testing of the soil materials to be used shall be carried out for the purpose of materials selection QA during construction operations. All equipment shall be in current calibration, traceable to nationally recognized standards. CQA personnel shall obtain copies of calibration certificates for the Project records.

The CQA Engineer shall be responsible for collection of samples for conformance testing from materials delivered to the site. The CQA Engineer shall be responsible for shipping of samples to the laboratory responsible for conformance testing of soil materials. Prior to the start of construction, the Contractor, the CQA Engineer, and the Owner shall evaluate test results.

Additional testing will be performed during construction for QA purposes. This testing ensures that the materials do not vary significantly or adversely during the course of the Work and that the materials consistently meet the Specifications.

It should be noted that in all cases at least one test shall be carried out regardless of the quantity of materials placed and compacted, where relevant. The CQA Engineer shall review all laboratory test results and forward an evaluation of all testing to the Owner.

### 7.5.2 Laboratory Soil Testing

CQA personnel shall monitor the Contractor who shall be responsible for providing *in situ* testing of soils to determine appropriate moisture conditioning for compaction. After placement and compaction, CQA personnel shall verify conformance with the Specifications using *in situ* moisture and density measurements and Proctor Compaction test results.

Additional testing will be performed during construction for QA purposes to ensure that the materials do not vary significantly or adversely during the course of the Work and that the materials consistently meet the Specifications.

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## PermeaTex Nonwoven Geotextiles

PermeaTex™ 4035 consists of nonwoven, polypropylene, needlepunched geotextile products that are recommended for drainage, filtration, separation, and soil reinforcement applications. Specific areas of use are subdrainage under roadways and playing fields, foundations, railway construction, rock buttresses, and slope drains. These geotextile products are resistant to ultraviolet degradation and to biological and chemical environments found in normal soils.

PHYSICAL PROPERTY	UNIT US Values	TEST METHOD	4030	4035	4040	4045	4060	4070	4080	4100	4120	4160
Weight (Typical)	oz./sy	ASTM D3776	3.1	3.5	4	4.5	6	7	8	10	12	16
Grab Tensile	lbs	ASTM D4595	80	90	100	120	160	180	205	250	300	380
Grab Elongation	%	ASTM D4632	50	50	50	50	50	50	50	50	50	50
CBR Puncture	Lbs	ASTM D6241	175	250	280	310	410	455	525	650	790	1025
Trapezoidal Tear	Lbs	ASTM D4533	25	40	45	50	60	75	80	100	115	145
Mullen Burst	psi	ASTM D3786	130	185	215	240	315	350	400	520	600	750
A.O.S.	U.S. Sieve	ASTM D4751	50	50	70	70	70	70	80	100	100	100
Water Permeability	cm/sec	ASTM D4491	0.22	0.25	0.22	0.22	0.22	0.34	0.38	0.30	0.29	0.27
Water Flow Rate	gpm/s.f.	ASTM D4491	150	150	140	120	110	100	90	80	75	50
Water Permittivity	sec	ASTM D4491	2.20	2.20	2.00	1.80	1.60	1.50	1.40	1.20	1.00	0.70
U.V. Resistance (500 Hours)	%	ASTM D4355	70	70	70	70	70	70	70	70	70	70

Note: Minimum average roll values are based on a 95% confidence level

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