SECTION 5

CONSTRUCTION QUALITY ASSURANCE PLAN

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5 CONSTRUCTION QUALITY ASSURANCE PLAN

Introduction

The purpose of this Construction Quality Assurance (CQA) Plan is to provide an organizational framework for testing, observation and monitoring activities that will be performed during construction of the Chemical Waste Unit in order to document that the constructed cells will meet or exceed all design criteria, drawings and specifications. The CQA Plan also outlines the organization, the implementation and the review of the various CQA activities, the responsibilities of the parties involved in the program, and provides sampling and testing programs to be carried out during the construction of critical facility components. The ultimate goal of the CQA program is to provide a means of evaluating and controlling the quality of the constructed facility so that the intent of the design has been met. The purpose of this plan is not to detail every aspect of the quality monitoring programs, but rather to provide a framework for which a thorough construction-monitoring program can be implemented.

This plan, at a minimum, applies to the construction of the following features:

- ❑ Landfill foundation and subgrade materials and preparation,
- ❑ Compacted earth liner, materials, placement, compaction, and protection,
- ❑ Geomembrane materials, installation, and protection,
- ❑ Geosynthetic clay liner materials, installation, and protection,
- ❑ Leachate drainage and collection system materials and construction,
- ❑ Final cover materials and construction, and
- ❑ Ponds, ditches, lagoons, and berm construction.

RESPONSIBILITY AND AUTHORITY

Owner

The Owner is responsible for obtaining all required permits for construction and operation of the landfill. The Owner is also responsible for complying with all applicable regulatory requirements of the Regulatory Agency. The Owner has the authority to select and dismiss organizations charged with design, CQA, and construction activities. Although subject to the Regulatory Agency's concurrence, the Owner also has the authority to accept or reject design plans and specifications, CQA plans, project review and recommendations by the CQA Officer, and the materials and/or workmanship of the construction contractors. In addition, the Owner may serve as the construction contractor and/or the Design Engineer.

Design Engineer

The Design Engineer is responsible for designing the facility to meet the design and operational requirements of the Regulatory Agency and the Owner. The Design Engineer shall be properly licensed to provide professional engineering services in the state that the landfill is constructed. The Design Engineer has the additional responsibility and authority for modifying the design as necessary during construction in order to address unexpected

conditions. The Design Engineer also has the authority to recommend and/or specify corrective measures where deviation from the design or failure to meet design criteria is detected by CQA Personnel. All such design and construction changes shall conform to the appropriate regulations, and shall be documented in the CQA Report.

CQA Personnel

The overall responsibility of the CQA Personnel is to observe and test the construction activities and materials in order to confirm whether the work and materials are in conformance with the drawings and specifications. CQA Personnel include the CQA Officer and CQA Technicians.

The CQA Officer shall be independent of the Owner, and shall not be an employee of the Owner, or any companies affiliated with the Owner. The CQA Officer shall be a properly licensed professional engineer in Illinois.

The CQA Officer is responsible for ensuring that all inspections, testing, meetings, and other activities required by this CQA Plan are conducted in accordance with this CQA Plan. Specific responsibilities of the CQA Officer include:

- ❑ Review design criteria, drawings and specifications for clarity and completeness,
- ❑ Assure that the CQA Technicians, Contractor(s) and Manufacturer(s) are knowledgeable regarding the facility design criteria, project drawings and specifications, permit requirements, CQA requirements, and inspection/testing procedures, as related to their work activities,
- ❑ Verify whether a Test Liner is required prior to, or during, each phase of liner construction,
- ❑ Coordinate and schedule CQA activities,
- ❑ Verify that the test equipment in use is appropriate for the test and site conditions, and that the equipment is properly calibrated,
- ❑ Confirm that test data are accurately recorded, reduced, summarized, interpreted, and maintained,
- ❑ Confirm that the facilities are constructed to the lines and grades shown on the drawings,
- ❑ Establish the random sampling program,
- ❑ Identify the need for design modifications and communicate such need to the Design Engineer and/or Owner,
- ❑ Review Contractor's quality control (CQC), Manufacturer's quality control (MQC) and Manufacturer's quality assurance (MQA) data for conformance with the project specifications and this CQA Plan,

- ❑ Identify materials and construction that do not comply with the drawings or specifications, communicate such non-compliance to the Contractor or Manufacturer, and Owner (if necessary), and observe, test, and document work conducted to correct such non-compliance, and

- ❑ Confirm that the required meetings are held.

The CQA Technicians shall possess adequate training and sufficient practical experience to execute the observation and testing activities required. Specific responsibilities of the CQA Technicians include:

- ❑ Observe the work as it is performed to assess compliance with the facility design criteria, drawings, and specifications,

- ❑ Conduct the required sampling and testing,

- ❑ Monitor all tests conducted by the Contractor(s) as may be required by the project specifications and/or this CQA Plan,

- ❑ Perform the required measurements and surveys to verify proper construction grades, lines, depths, thicknesses, elevations, etc.,

- ❑ Promptly report to the Contractor(s) the results of all observations and tests as the work progresses,

- ❑ Promptly report to the CQA Officer the results of all observations and tests, including deficiencies, and

- ❑ Prepare and maintain onsite documentation, including daily reports and photographs, as required by this CQA Plan.

During periods of routine, repetitive activities, the CQA Officer may periodically be absent from the project site and may designate, in writing, a "CQA Officer-in-Absentia." The CQA Officer is responsible for selecting a CQA Officer-in-Absentia that is capable of exercising competent judgment in carrying out the CQA Officer duties. The CQA Officer shall routinely communicate with the CQA Officer-in-Absentia, and is responsible for the actions of the CQA Officer-in-Absentia. The CQA Officer is also responsible for determining the need for his/her personal observations of the onsite construction activities. As a general guidance, however, the CQA Officer should be onsite at least once per week to directly observe the work during periods with continuous construction activities covered under this Plan. During periods of sporadic construction activities covered under this Plan, the CQA Officer should, as a general rule, personally observe onsite construction work no less frequently than about once per five full days of construction activity.

If the CQA Officer is unable to perform the duties as defined herein, the Owner will assign a replacement CQA Officer. The replacement CQA Officer must meet the minimum requirements as set forth herein. Multiple CQA Officers are allowed provided each CQA Officer is assigned to a specific task and follows previously defined communication protocol that is compatible with the procedures described herein.

Contractor(s)

The Contractors have the responsibility to construct the facility in accordance with the design criteria, drawings, and specifications to the satisfaction of the CQA Officer and Owner. Contractors are required to implement the quality control programs described in the specifications. The Contractors may implement their own supplemental quality control program for purposes of monitoring their respective construction.

Manufacturer(s)

The Manufacturers are responsible for manufacturing and/or fabricating their respective components in accordance with the design criteria, drawings, and specifications to the satisfaction of the CQA Officer and Owner. The Manufacturers are required to implement the MQA and MQC programs described in the specifications. The Manufacturers may implement their own supplemental quality assurance/quality control program for purposes of monitoring the manufacture or fabrication of their respective components.

PROJECT MEETINGS

Meetings shall be held periodically during the course of the project to enhance communication and coordination between the various involved organizations. Required meetings are described in the following sections.

Preconstruction Meeting

A Preconstruction Meeting will be held prior to, or at the onset of, each substantial phase of the construction activities that are subject to this CQA Plan. Representatives of the Owner, Design Engineer, CQA Officer, and Contractor shall attend the Preconstruction Meetings. The purpose of these meetings is to:

- ❑ Provide each organization with all relevant CQA documents and supporting information,
- ❑ Familiarize each organization with the site-specific CQA Plan and its role relative to the design criteria, plans, and specifications,
- ❑ Determine any changes to the CQA Plan that are needed to ensure that the facility will be constructed to meet or exceed the specified design,
- ❑ Review the responsibilities of each organization,
- ❑ Review lines of authority and communication for each organization,
- ❑ Discuss the established procedures or protocol for observations and tests including sampling strategies,
- ❑ Discuss the established procedures or protocol for handling construction deficiencies, repairs and retesting,
- ❑ Review methods for documenting and reporting test data,
- ❑ Review methods for distributing and storing documents and reports,

- ❑ Review work area security and safety protocols,
- ❑ Discuss procedures for the location and protection of construction materials and for the prevention of damage to the materials from inclement weather or other adverse events,
- ❑ Conduct a site walk-around to review construction material and testing equipment storage locations, and
- ❑ Establish contractors intended work schedule.
- ❑ The Owner will coordinate the Preconstruction Meetings. Meeting minutes will be recorded and distributed to each attendee.

Progress Meetings

Progress Meetings shall be held periodically to discuss ongoing or upcoming construction activities. Progress Meetings shall be held no less frequently than weekly during periods of ongoing construction activities that are subject to this CQA Plan. The purpose of the meeting is to:

- ❑ Review the construction progress, accomplishments, and outstanding unresolved deficiencies,
- ❑ Review the work location and activities for upcoming new construction activities,
- ❑ Identify the contractor's personnel and equipment assignments for the new activities, and
- ❑ Discuss any potential construction problems.

Any involved party can call a Progress Meeting; however, CQA Personnel are responsible for ensuring that Progress Meetings are held at least weekly during periods of ongoing construction activities. At a minimum, the Contractor and CQA Personnel shall attend Progress Meetings. Progress Meetings shall be documented in the CQA Personnel field notes.

Problem or Work Deficiency Meetings

Special meetings may be held when and if a problem or deficiency is present or likely to occur. At a minimum, the Contractor and CQA Personnel will attend the meeting. The CQA Officer shall attend those meetings that address severe or recurring problems. The CQA Personnel, Contractor, Owner, or the Design Engineer can request the meeting. The purpose of the meeting is to define and resolve the problem or work deficiency in the following manner:

- ❑ Define and discuss the problem or work deficiency,
- ❑ Review alternative solutions (as appropriate), and
- ❑ Implement a plan to resolve the problem or deficiency.

Any solutions requiring a design change or significant change in construction procedures shall be reviewed and approved by the Design Engineer. Any changes requiring a permit modification shall be reviewed and approved by the IEPA prior to implementation. If deemed necessary by any involved party, an additional meeting may be held to review the success of the actions taken to resolve the problem or deficiency.

At a minimum, the CQA Personnel shall document the meeting in the field notes. At the discretion of the CQA Officer, or as requested by the Contractor, formal minutes of meetings that address severe and/or recurring problems shall be prepared and distributed to all meeting attendees, the Owner, and the Design Engineer.

TEST LINER

An earthen test liner has been constructed at the existing Clinton Landfill No. 3 MSW Unit in order to assure that any full-scale liner would meet the construction specifications and regulatory requirements using the anticipated Earth Liner materials, construction procedures, and construction equipment. The results of this testing demonstrated compliance with specifications. Materials which will be used to construct the earthen liner beneath the proposed Clinton Landfill No. 3 Chemical Waste Unit will be similar to those at the adjacent Clinton Landfill No. 3 MSW Unit. Should the earth materials, equipment or construction methods vary substantially from those during previous test liner construction, an additional test liner (or liners) will be constructed. Specifically, an additional Test Liner shall be constructed if, in the opinion of the CQA Officer, any of the following occur:

- ❑ The earth liner material is derived from a geologic unit differing from the geologic unit from which the previous test liner material was derived,
- ❑ The Earth Liner material within the geologic unit varies substantially in the opinion of the CQA Officer,
- ❑ The compaction equipment is smaller, lighter, or is otherwise believed to result in less compactive energy in the opinion of the CQA Officer, or
- ❑ The construction methods are expected to result in less compactive energy than the construction methods used during previous test liner construction.

FIELD OBSERVATION AND TESTING ACTIVITIES

This section describes the nominal field observation and testing activities that shall be performed by the CQA Personnel. The results of these observation and testing activities shall be compared to the project specifications and drawings to determine work conformance. Any specification referred to within the remainder of this CQA plan is provided in Appendix K.

Landfill Foundation

The landfill is designed to ensure that the foundation provides a structurally stable subgrade to support the overlying liner system under the loads that will result from the waste. The foundation is also designed to minimize the possibility of groundwater contamination in the event the liner system is breached. The landfill foundation shall consist of competent native soil, compacted clay foundation fill, or compacted random fill containment berms. The following observation and testing activities shall be performed by CQA Personnel to ensure that the landfill foundation conforms to the intent of the design, drawings, and specifications.

Containment Berms

The CQA Personnel shall observe and test the subgrade preparation, placement, and compaction of the Random Fill that comprise the containment berms. Material specifications are provided in Part 2.02 of Specifications Section 02200; placement and compaction specifications are provided in Part 3.07 of the Earthwork Specifications (Specifications Section 02200).

CQA Personnel shall assess the suitability of the Random Fill to be placed in the containment berms prior to construction. As part of this assessment, CQA Personnel shall visually reconnoiter the stockpile(s) and/or borrow areas from which the fill is to be derived to check that the soil appears to meet the criteria included in the specifications (e.g. uniformity of gradation, texture, and moisture content, and free of excessive organic material, frozen materials, and oversized stones/clods). At least one representative sample of each type of soil to be used as Random Fill in containment berms shall be collected and tested for the following:

- ❑ Unconfined compressive strength to compare to the strength criteria provided in Part 2.02 of the Earthwork Specifications. Unconfined compressive strength shall be tested on samples remolded to the minimum specified dry density and maximum specified moisture content in accordance with ASTM Test Methods D2166 or D2850.

- ❑ Maximum dry density/moisture content relationship (i.e. Proctor test) by ASTM Test Methods D698.

During construction, the CQA Personnel shall:

- ❑ Verify that the area to receive fill has been stripped and cleared of organic materials, organic-rich soil, and other deleterious materials,

- ❑ Observe the fill foundation for evidence of groundwater seepage. The Design Engineer shall be notified if significant seepage is found prior to placing fill,

- ❑ Observe the fill subgrade for soft soil. Excessively soft soil that prevents the first lift of Random Fill from achieving the specified compaction shall be removed and replaced as described in the specifications, or as otherwise allowed by the Design Engineer,

- ❑ Verify that the fill material is relatively uniform in gradation, texture, and moisture content, and free of excessive organic material, frozen materials, and oversized stones/clods,

- ❑ Verify that the fill material is represented by a Proctor Curve established during pre-construction testing,

- ❑ Verify, at a nominal frequency of one measurement per acre per lift, that the fill lift thickness does not exceed that specified,

- ❑ Test the in-place (field) moisture content and dry density to confirm whether the specified moisture content and relative compaction are achieved, and

- ❑ Confirm that the Contractor is following proper procedures to ensure adequate lift bonding.

Field density and moisture content tests shall be performed using a properly calibrated nuclear densiometer in accordance with ASTM D-2922 and D-3017, or other generally accepted method approved by the CQA Officer. The CQA Personnel shall judgmentally select field density/moisture content test locations to provide uniform testing coverage of the fill. CQA Personnel shall test field density and moisture content at a nominal frequency of one test per 2,500 cubic yards of in-place fill material.

The CQA Personnel shall record the approximate location of all field density and moisture content tests to a nominal accuracy of 10 feet horizontally and 3 inches vertically referencing the project coordinate and elevation system.

Sidewall Excavations

The CQA Personnel shall observe the completed sidewall liner excavations to confirm that the excavation slopes are stable. Specific items to check that, if present, could indicate marginally stable conditions include:

- ❑ Cracks in the ground surface parallel to the slope along and/or near the top of the slope,
- ❑ Presence of weak soils,
- ❑ Bulges along the slope or near the toe of the slope, and
- ❑ Significant groundwater seepage from the excavation slope or near its toe.

Part 3.05 of Specifications Section 02200 detail the actions to be taken in the event saturated sand is encountered in the sidewall excavation. Other evidence of instability shall be reported to the Design Engineer for further evaluation and, if necessary, development of corrective measures to ensure that adequate factors of safety against slope instability are attained.

Groundwater Seepage

Excessive groundwater seepage can result in inadequate fill subgrade conditions (i.e. too soft to allow the first lift of Compacted Clay Fill or Earth Liner to be compacted to the specified density), and/or can result in excessive hydrostatic uplift pressures on the completed liner system.

The CQA Personnel shall observe excavations and fill subgrades for evidence of excessive groundwater seepage. Excessive groundwater seepage is defined as seepage of groundwater into an excavation such that the ongoing earthwork cannot be competed "in the dry".

The CQA Personnel shall notify the Contractor and the Design Engineer in the event that excessive seepage is noted. Work in areas with excessive groundwater seepage shall be suspended until a solution that is acceptable to the Design Engineer and CQA Officer is developed. Example solutions may include allowing the excess seepage water to naturally drain (acceptable for pockets with limited water), installing and temporarily operating a dewatering system until sufficient overburden is placed to resist hydrostatic uplift, and/or installing a drain tile. Typical dewatering and drain tile systems are provided on the drawings

as design guidance. Actual design details will depend upon field conditions. Perforated drain tiles that are to remain operational after waste is placed in the nearby landfill cell shall be maintained at an elevation at least 1 foot above the nearest landfill floor elevation to the extent possible in order to prevent a potential preferential leachate pathway. Where this is not possible, the Operating Permit application shall include a request to include the drain tile discharge in the facility water monitoring plan.

Landfill Floor

The landfill floor is intended to be founded on, or within, stiff to hard clays of the Tiskilwa and/or Berry Clay/Radnor till units. These units are described as brown or gray, dry, with trace amounts of sand and/or pebbles. In some areas, particularly in the northern portions of the landfill, the planned Earth Liner subgrade elevation is within the organic silts of the Robein/Roxana Silt unit. These organic silts are not suitable foundation soil. In these areas, the landfill floor foundation will require overexcavation to remove the organic silts. Such overexcavation, if required, shall extend to the competent Berry Clay/Radnor till and be backfilled with Compacted Clay Fill material (reference the Earthwork Specifications). Note that any fill placed beneath the landfill floor Earth Liner subgrade shall meet the requirements of Compacted Clay Fill.

The CQA Personnel shall observe the soils exposed in the landfill floor and lower portions of the sidewalls to confirm that the floor is directly founded on competent soils as described above and in the Earthwork Specifications. The CQA Personnel shall also observe the cell floor foundation to confirm the absence of fractures, soft soil, frozen soil, organic-rich soil, standing or running water, or saturated sands at the foundation subgrade.

Where unsuitable soils are present at the cell floor foundation elevation, the CQA Personnel may conduct a limited exploration program, such as trenches or observation pits, to delineate the vertical and lateral extent of the unsuitable soils. The unsuitable soil shall be completely removed where only a nominal volume of unsuitable soil exists beneath cell floor. The Design Engineer, however, shall be notified immediately if the limited exploration program indicates a substantial volume of unsuitable soil exists. In that case, the Design Engineer may conduct additional investigations as appropriate to delineate the extent of the unsuitable soil and establish the limits of the overexcavation.

Compacted Clay Foundation Fill

Fill placed beneath the landfill floor Earth Liner shall meet the specified requirement of Compacted Clay Fill, as provided in the Earthwork Specifications (Section 02200).

Compacted Clay Fill Materials

CQA Personnel shall observe and test Compacted Clay Fill material for the following:

- ❑ Confirmation that the Compacted Clay Fill material is derived from the Tiskilwa till or the Berry Clay/Radnor till units,
- ❑ Uniformity of gradation, texture, and moisture content,
- ❑ Soil type according to the United Soil Classification System (visual-manual method), at a minimum testing frequency of one sample each day that Compacted Clay Fill is placed,

- ❑ Atterberg limits and grain-size distribution by ASTM Test Methods D4318 and D422 (including hydrometer), respectively, at a nominal testing frequency of one test per 30,000 cubic yards of Compacted Clay Fill placed,

- ❑ Maximum dry density/moisture content relationship (i.e. Proctor test) by ASTM Test Method D698. Each soil type derived from each geologic unit used for Compacted Clay Fill construction shall be tested. Subsequent testing shall be at the discretion of the CQA Officer; however, at a minimum, one-point "check points" shall be performed and correlated to full Proctor curves at a nominal frequency of one checkpoint per 10,000 cubic yards of Compacted Clay Fill placed. A full Proctor test shall be conducted on material for which the checkpoint does not correlate to a previously completed Proctor curve,

- ❑ Free of excessive organics, frozen materials, and oversized stone/clods,

- ❑ Undrained shear strength. Undrained shear strength shall be tested on samples remolded to the minimum specified dry density and maximum specified moisture content in accordance with ASTM Test Methods D2166, D2850, or D4767 (nominal consolidation pressure of 10,000 psf). Alternatively, undisturbed samples of in-place Compacted Clay Fill may be tested. At least one sample for every 10,000 cubic yards of Compacted Clay Fill placed shall be tested. Undrained shear strength testing is not required where less than 2,000 cubic yards of Compacted Clay Fill is placed during any phase of construction. The average of the samples shall be used to determine compliance with the project specifications; however, no single test result shall be less than 75 percent of the specified strength value, and

- ❑ Hydraulic conductivity. Hydraulic conductivity shall be tested on samples remolded to the minimum specified dry density and maximum specified moisture content in accordance with ASTM Test Methods D2166 or D2850. Alternatively, undisturbed samples of in-place Compacted Clay Fill may be tested. At least one sample for every 10,000 cubic yards of Compacted Clay Fill placed shall be tested. The average of the samples shall be used to determine compliance with the project specifications; however, no single test result shall be more than three times the specified hydraulic conductivity value.

Compacted Clay Fill Subgrade Preparation

Compacted Clay Fill subgrade preparation specifications are provided in the Earthwork Specifications. The intent of the subgrade preparation specifications is to provide a firm base upon which the Compacted Clay Fill can be constructed. In order to ensure a firm subgrade, the specifications require that the Contractor proof-roll the liner subgrade using equipment acceptable to the CQA Officer. The CQA Personnel shall observe the proof-rolling and note any areas that appear unacceptably soft (i.e. too soft to allow the first lift of Compacted Clay Fill to be compacted to the specified relative compaction). The CQA Personnel shall also observe the subgrade to confirm the absence of frozen soil, organic-rich soil, standing or running water, or saturated sands at the foundation subgrade. Such soils shall be delineated, removed, and replaced with Compacted Clay Fill as described in the specifications or as otherwise approved by the Design Engineer.

Compacted Clay Fill Placement and Compaction

CQA Personnel shall observe and test Compacted Clay Fill material as it is placed and compacted for the following:

- ❑ Maximum lift thickness (prior to compaction), at a nominal frequency of two measurements per acre per lift,
- ❑ In-place (field) moisture content and dry density to confirm whether the specified moisture content and relative compaction are achieved,
- ❑ Proper lift bonding, and
- ❑ Measures taken to adequately protect the in-place Compacted Clay Fill from excessive moisture, desiccation, or disturbance.

Field density and moisture content tests shall be performed using a properly calibrated nuclear densiometer in accordance with ASTM D-2922 and D-3017, or other generally accepted method approved by the CQA Officer. The CQA Personnel shall judgmentally select field density/moisture content test locations to provide uniform testing coverage of the fill. CQA Personnel shall test field density and moisture content at a nominal frequency of one test per 2,500 cubic yards of in-place fill material.

The CQA Personnel shall record the approximate location of all field density and moisture content tests to a nominal accuracy of 10 feet horizontally and 3 inches vertically referencing the project coordinate and elevation system.

Liner

Significant earthwork and geosynthetic material installation operations will be required to prepare the landfill liner system subgrade, place and compact the Earth Liner, and install the liner geomembrane. The following observation and testing activities shall be performed by CQA Personnel to ensure that the liner construction conforms to the drawings and specifications.

Earth Liner

Earth Liner is to be constructed along the landfill liner floor and sidewalls. Material and subgrade preparation, placement, and compaction specifications are provided in Parts 2.01 and 3.05, respectively, of the Earthwork Specifications.

Earth Liner Materials

CQA Personnel shall observe and test Earth Liner material for the following:

- ❑ Confirmation that the Earth Liner material is derived from the Tiskilwa till or the Berry Clay/Radnor till units,
- ❑ Confirmation shall be based on a review of the location and elevation of the borrow source with respect to the geologic cross-sections, and a comparison of the physical descriptions (e.g. color and consistency) of the source earth materials and those described for the geologic units.

- ❑ Verification that the Earth Liner material is consistent with that used in a previous successful Test Liner. Verification shall include confirmation that the source materials are derived from the same geologic unit as the materials used for a successful Test Liner.

- ❑ Furthermore, the results of the source material tests described in this section shall be compared to the results of the Test Fill material test results as further confirmation that the Earth Liner material is consistent with that used in a previous successful Test Liner.

- ❑ Uniformity of gradation, texture, and moisture content,

- ❑ Soil type according to the United Soil Classification System (visual-manual method), at a minimum testing frequency of one sample each day that Earth Liner is placed,

- ❑ Atterberg limits and grain-size distribution by ASTM Test Methods D4318 and D422 (including hydrometer), respectively, at a nominal testing frequency of one test per acre of Earth Liner placed,

- ❑ Maximum dry density/moisture content relationship (i.e. Proctor test) by ASTM Test Method D698. Each soil type derived from each geologic unit used for Earth Liner construction shall be tested. Subsequent testing shall be at the discretion of the CQA Officer; however, at a minimum, one-point "check points" shall be performed and correlated to full Proctor curves at a nominal frequency of one checkpoint per acre of Earth Liner placed. The check point results, i.e. fill material moisture content and compacted dry density, shall be plotted on the Proctor Curve believed to be representative of the fill material. The checkpoint results will be considered to correlate with the Proctor Curve provided the checkpoint dry density does not differ from the Proctor Curve by more than 2.0 pounds per cubic foot at the corresponding checkpoint moisture content. A full Proctor test shall be conducted on material for which the checkpoint does not correlate to a previously completed Proctor curve.

- ❑ Free of excessive organics, frozen materials, and oversized stone/clods, and

- ❑ Undrained shear strength. Undrained shear strength shall be tested on samples remolded to the minimum specified dry density and maximum specified moisture content in accordance with ASTM Test Methods D2166, D2850 or D4767 (nominal consolidation pressure of 10,000 psf). At least three samples per phase of liner construction shall be tested. Alternatively, at least three undisturbed samples of in-place Earth Liner may be tested. The average of the three samples shall be used to determine compliance with the project specifications; however, no single test result shall be less than 75 percent of the specified strength value.

Earth Liner Subgrade Preparation

Earth Liner subgrade preparation specifications are provided in Part 3.05 of the Earthwork Specifications. The intent of the subgrade preparation specifications is to provide a firm base upon which the compacted Earth Liner can be constructed to ensure that the full thickness of

the compacted Earth Liner achieves the specified compaction and hydraulic conductivity criteria. In order to ensure a firm subgrade, the specifications require that the Contractor proof-roll the liner subgrade using equipment acceptable to the CQA Officer. The CQA Personnel shall observe the proof-rolling and note any areas that appear unacceptably soft (i.e. is too soft to allow the first lift of Earth Liner to be compacted to the specified relative compaction). The CQA Personnel shall also observe the liner subgrade to confirm the absence of frozen soil, organic-rich soil, standing or running water, or saturated sands at the foundation subgrade. Such soils shall be delineated, removed, and replaced with Compacted Clay Fill as described in the specifications or as otherwise approved by the Design Engineer.

Earth Liner Placement and Compaction

CQA Personnel shall observe and test Earth Liner material as it is placed and compacted for the following:

- ❑ Verification that the compaction equipment, techniques, and minimum number of passes are equivalent to, or better than that used to construct a successful Test Liner,
- ❑ Confirmation that the Earth Liner ties into previously constructed adjacent Earth Liner segments,
- ❑ Maximum lift thickness (prior to compaction), at a nominal frequency of two measurements per acre per lift,
- ❑ In-place (field) moisture content and dry density to confirm whether the specified moisture content and relative compaction are achieved,
- ❑ Proper lift bonding,
- ❑ Measures taken to adequately protect the in-place Earth Liner from excessive moisture, desiccation, or disturbance, and
- ❑ Laboratory hydraulic conductivity of the in-place floor Earth Liner.

Field density and moisture content tests shall be performed using a properly calibrated nuclear densiometer in accordance with ASTM D-2922 and D-3017, or other generally accepted method approved by the CQA Officer. The CQA Personnel shall select field density/moisture content test locations by random and judgmental processes as described in the Statistical Sampling Program Section of this Plan. The testing frequency at randomly selected locations shall be no less than five tests per acre per lift of liner placed (i.e. 30 tests per acre, assuming 6 lifts are placed).

At least one laboratory hydraulic conductivity test shall be performed for every 2 acres (or portion thereof) of landfill floor under construction. Samples for hydraulic conductivity testing shall be collected using thin-wall "Shelby" tubes pushed vertically into the Earth Liner. The sample locations (horizontal and vertical) shall be randomly selected in accordance with the procedures described in the Statistical Sampling Program Section of this Plan. Holes resulting from the hydraulic conductivity sampling activities shall be backfilled with sodium bentonite chips or powder. The bentonite shall be placed in 6-inch lifts; each lift shall be charged with sufficient water to adequately hydrate the bentonite. The ends of the Shelby tube shall be sealed to prevent moisture loss or gain. The Shelby tube samples shall be promptly transported (in a vertical position) to the soils laboratory. Once at the laboratory, the tubes

shall be fully extruded and inspected by laboratory personnel for evidence of disturbance, improper lift bonding and non-uniformity of soil type. Any such evidence shall immediately be reported to the CQA Officer. The sample shall then be trimmed as required and tested in accordance with ASTM D5084 test methods.

The CQA Personnel shall record the approximate location of all field density and moisture content tests and hydraulic conductivity samples to a nominal accuracy of 10 feet horizontally and 3 inches vertically referencing the project coordinate and elevation system. The lift number that is subjected to the testing shall also be recorded.

The CQA Personnel shall survey the edges of the in-place Earth Liner to provide adequate construction documentation and to ease verification that future phases of liner construction tie into the Earth Liner.

Earth Liner Thickness

CQA Personnel are responsible for confirming that the minimum specified Earth Liner thickness is achieved. This shall be accomplished by small diameter probes through the full thickness of the Earth Liner, by surveying the elevations of the subgrade prior to placing Earth Liner and the completed Earth Liner surface, or by other positive means approved by the Regulatory Agency.

The Earth Liner Thickness shall be verified by measurements taken at a maximum of 100-foot intervals. A grid system, consisting of perpendicular lines spaced no more than 100-feet apart, shall be established. Measurements of Earth Liner Thickness shall be verified by measurements at the intersections of the grid lines. Supplemental thickness measurements shall be made at changes in grades along each grid line.

Probe holes shall be backfilled with bentonite chips or powder. The bentonite shall be placed in 6-inch lifts; each lift shall be charged with sufficient water to adequately hydrate the bentonite.

Earth Liner Grades

CQA Personnel shall survey the as-constructed Earth Liner surface to confirm that the Earth Liner was constructed to the lines and grades shown on the Drawings. Line and grade tolerances are provided in Part 1.06 of the Earthwork Specifications.

Geomembrane

The landfill will be lined with three high density polyethylene (HDPE) geomembranes placed; 1) directly above the compacted Earth Liner, 2) above the secondary geocomposite drainage layer, and 3) above the geosynthetic clay liner. Specifications for the manufacture and installation of geomembrane are provided in the Specifications Section 02650.

This Plan details the quality assurance activities related to manufacturing and installing the geomembranes. Geomembrane manufacturing quality control (MQC) activities are the responsibility of the geomembrane Manufacturer and are specified in Part 2.02 of the Geomembranes Specifications. The geomembrane Installer is responsible for the installation quality control requirements that are specified in Part 3.09 of the Geomembrane Specifications.

Geomembrane Preinstallation Activities

The Owner (or the Owner's designee) shall submit a representative sample of the geomembrane and other applicable materials (e.g. earth liner materials, sand drainage layer materials, and geocomposite materials) to a qualified laboratory independent of the geomembrane Manufacturer for interface shear testing. Interface shear testing shall be conducted prior to each phase of geomembrane installation, but no more frequently than once during any 12 month period. Interface shear testing shall be conducted prior to the first phase of sidewall liner installation and shall be retested whenever interface shear testing of the materials to be used has not been conducted during the previous 48 months. Interface shear test methods and criteria shall conform with those provided in Specifications Section 02650.

Prior to each phase of geomembrane installation, the Owner (or the Owner's designee) shall submit representative sample(s) of geomembrane to a qualified laboratory independent of the geomembrane Manufacturer for the following manufacturing quality assurance (MQA) tests:

- ❑ Thickness,
- ❑ Density,
- ❑ Tensile Properties,
- ❑ Puncture Properties,
- ❑ Tear Resistance, and
- ❑ Carbon Content.

At least one MQA test shall be performed for each 50,000 square feet (or portion thereof) of geomembrane to be supplied. Test methods shall conform with those provided in Specifications Section 02650.

Neither interface shear nor MQA testing shall be required for repairs and/or installations totaling less than 1,000 square feet individually, and 10,000 square feet combined over a 12 month period.

CQA Personnel shall conduct the following prior to beginning geomembrane installation:

- ❑ Review all MQC certifications provided by the geomembrane Manufacturer,
- ❑ Review the MQA test results for conformance with the specifications,
- ❑ Review and verify the Installer's inventory of delivered geomembrane rolls,
- ❑ Confirm that the delivered rolls of geomembrane are specifically covered under the Manufacturer's MQC certifications,
- ❑ Confirm that the MQA sample(s) was (were) obtained from roll(s) delivered to the site,
- ❑ Review interface shear test data to confirm that the interface shear strengths conform with the specifications,

- ❑ Review the Installer's Project Superintendent's resume for conformance with Part 1.04 of the Geomembrane Specifications,
- ❑ Review and approve the Installer's panel layout shop drawings,
- ❑ Observe the geomembrane subgrade immediately prior to installation to ensure that the subgrade meets the requirements of Part 3.02 of the Geomembranes Specifications, and
- ❑ Review the Installer's subgrade certification.

Geomembrane Placement and Protection

Specifications for the placement and protection of geomembranes are provided in Parts 3.03 and 3.04 of the Geomembranes Specifications. CQA Personnel shall perform the following during geomembrane placement:

- ❑ Verify that the panels are placed as shown on the approved panel lay-out shop drawing, or as otherwise approved by the CQA Officer,
- ❑ Confirm that the geomembrane protection requirements of the specifications are enforced,
- ❑ Observe geomembrane anchor trenches every 50 feet (plus or minus) for conformance with the Drawings and specifications,
- ❑ Observe the Contractor's methods of placing geomembrane into the anchor trenches, and the Contractor's methods of backfilling and compacting the anchor trench backfill to confirm that such methods do not damage the geomembrane,
- ❑ Verify that the geomembrane anchor trenches are backfilled and compacted as specified,
- ❑ Disapprove geomembrane deployment during inclement weather as described in the specifications, unless specifically approved by the CQA Officer,
- ❑ Observe the geomembrane for defects,
- ❑ Confirm that adjoining panels are overlapped and shingled as specified,
- ❑ Observe for excessive slack or wrinkles in the geomembrane, and
- ❑ Confirm that the in-place geomembrane is adequately ballasted to prevent displacement.

Geomembrane Welds and Defect Repairs

Specifications for welding geomembrane seams and repairing defects are provided in Parts 3.05 and 3.06 of the Geomembranes Specifications. CQA Personnel shall perform the following activities:

- ❑ Verify that the seams being welded are not excessively tensioned or wrinkled,

- ❑ Confirm the use of the specified welding techniques and equipment for each seam,
- ❑ Observe each welder's methods for a sufficient amount of time to confirm that the welding procedures are in accordance with the specifications,
- ❑ Verify that each welding equipment/operator combination are properly pre-qualified in accordance with Part 3.09 of the Geomembranes Specifications,
- ❑ Review the Installer's methods of defect repair for conformance with the specifications, and
- ❑ Observe the completed repairs for workmanship.

Geomembrane Field Quality Control

Specifications for the Installer's field quality control are provided in Part 3.09 of the Geomembranes Specifications. CQA Personnel shall perform the following:

- ❑ Verify that the welding equipment/operator pre-qualification testing is conducted in accordance with the specifications,
- ❑ Confirm that all geomembrane seams are non-destructively tested as specified,
- ❑ Randomly select locations for destructive seam tests, as specified. Random locations shall be selected as described in the Statistical Sampling Program Section of this Plan; sampling frequencies are provided in Part 3.09 of the Geomembranes Specifications,
- ❑ Specify other locations for destructive seam tests where, in the CQA Officer's opinion, the seam quality is questionable (if any),
- ❑ Verify that the destructive sample locations are repaired and tested in accordance with the specifications,
- ❑ Review the laboratory test results for conformance with the specifications, and
- ❑ Confirm that failed seams are repaired as specified.

Geosynthetic Clay Liner

A geosythetic clay liner material (GCL) will be installed as part of the liner system as described in Section 3 and shown on the design drawings. The GCL will meet current industry design standards and as outlined in the Specifications (Section 02660 - Geosynthetic Clay Liner).

The CQA officer will ensure that adequate quality control and quality assurance procedures have been followed throughout all of the following operations:

1. Refining of raw materials, based on manufacturer's documentation, and manufacturing of GCL.

2. Storage, handling, and shipment of GCL.

3. Installation of GCL, including:

   a. Proper placement, joining, and repair procedures; and

   b. Proper backfilling or covering procedures.

Documentation

CQA Personnel shall confirm that the Installer maintains the documentation as specified in the Geomembrane and Geosynthetic Clay Liner Specifications.

Leachate Drainage, Collection, and Storage System

The following section describes the CQA activities that shall be conducted to ensure that the leachate drainage, collection, and storage system conforms to the intent of the design, drawings and specifications.

Leachate Collection Pipes and Gravel Envelope

The leachate collection pipes drain leachate into sumps along the edges of the landfill floor for extraction via submersible pumps. The leachate collection pipe system includes cleanout risers. The cleanout risers are intended to provide access to the collection pipe system for cleaning equipment.

The leachate collection pipes are bedded on, and enveloped within Washed Gravel. The Washed Gravel serves three functions: 1) provides proper bedding support for the pipe, 2) serves as a filter to prevent the pipe from clogging with sand and fine-grained materials, and 3) serves as a secondary leachate flow path in the unexpected event of the leachate pipe crushing or clogging. Material specifications for the leachate collection pipe are provided in Parts 2.01 and 2.02 of the HDPE Pipe and Fittings Specifications (Specifications Section 15105); installation and testing requirements are provided in Parts 3.01 and 3.02 of the HDPE Pipe and Fittings Specifications. Material specifications for the Washed Gravel are provided in Part 2.07 of the Earthwork Specifications; placement and compaction requirements are provided in Part 3.10 of the Earthwork Specifications.

At least one sample (per phase of leachate collection pipe construction) of the material to be used as Washed Gravel shall be tested for the following prior to material import:

- ❑ Grain-size distribution in accordance with ASTM D422. Hydrometer analysis of the particles passing the No. 200 sieve is not required, and

- ❑ Reactivity with dilute hydrochloric acid in accordance with ASTM D2488. If visible reaction is observed, a sample shall be tested for carbonate loss in accordance with ASTM D3042.

Certified test results provided by the Washed Gravel supplier are acceptable.

CQA Personnel shall conduct the following activities prior to the Contractor placing the leachate collection and riser pipe:

- ❑ Review the pipe manufacturer's certifications as required by Part 1.04 of the HDPE Pipe and Fittings Specifications to confirm that the pipe and fittings meet the criteria specified in Parts 2.01 and 2.02 of the HDPE Pipe and Fittings Specifications,

- ❑ Verify that the pipe and fittings are properly marked as specified in Part 2.02 of the HDPE Pipe and Fittings Specifications,

- ❑ Visually inspect the pipe and fittings for fractures, cracks, gouges, damaged ends, or other evidence of damage or poor manufacture (reference Part 3.02 of the HDPE Pipe and Fittings Specifications), and

- ❑ Confirm that the leachate collection pipe is perforated in accordance with the perforation details shown on the Drawings.

CQA Personnel shall conduct the following during and after leachate collection and riser pipe, and gravel envelope placement:

- ❑ Observe pipe and gravel placement to confirm that the proper equipment and placement procedures are employed to protect from overstressing the underlying geomembrane and to ensure that geomembrane wrinkles are minimized (reference Part 3.11 of the Earthwork Specifications),

- ❑ Confirm the thickness of the Washed Gravel placed as bedding to verify the minimum specified thickness is provided. Thickness measurements shall occur every 50 feet (plus or minus),

- ❑ Observe the Washed Gravel placement and compaction for conformance with the specifications provided in Part 3.10 of the Earthwork Specifications,

- ❑ Verify that the Washed Gravel directly abuts the leachate collection layer placed during a preceding phase of construction (if any) and that any previously placed rainflap has been removed,

- ❑ Observe the Contractor's method of handling the pipe to ensure that the pipe is not overstressed or otherwise damaged, as described in Part 3.01F of the HDPE Pipe and Fittings Specifications,

- ❑ Observe the Contractor's method of joining the pipe and fittings to verify compliance with the specifications provided in Part 3.01 of the HDPE Pipe and Fittings Specifications,

- ❑ Survey the pipe elevation at 50 feet (nominal) spacings to ensure compliance with the grades shown on the Drawings within the tolerances specified in Part 1.06 of the Earthwork Specifications,

- ❑ Observe the Contractor's pressure testing of the pipe and fittings, and review the pressure test results, for compliance with Part 3.02D of the HDPE Pipe and Fittings Specifications,

- ❑ Verify that adequate measures are taken to protect the Washed Gravel from contamination by fine-grained materials, or other damage due to storm water runon from adjacent parts of the landfill,

- ❑ Confirm that the final connection to a previously installed leachate collection pipe is completed in accordance with the specifications provided in Part 3.01 of the HDPE Pipe and Fittings Specifications.

Leachate Collection Sumps and Sideslope Risers

The leachate collection sumps are sized to prevent excessive leachate pump cycling while maintaining less than 12-inches of leachate head above the liner. The sideslope riser pipes are sized to allow the installation of commercially available submersible pumps on transporters.

Material specifications for the leachate collection sump and sideslope riser pipe are provided in Parts 2.01 and 2.02 of the HDPE Pipe and Fittings Specifications (Specifications Section 15105); installation and testing requirements are provided in Parts 3.01 and 3.02 of the HDPE Pipe and Fittings Specifications.

CQA Personnel shall conduct the following activities prior to the Contractor placing the leachate collection sump and sideslope riser pipe:

- ❑ Review the pipe manufacturer's certifications as required by Part 1.04 of the HDPE Pipe and Fittings Specifications to confirm that the pipe and fittings meet the criteria specified in Parts 2.01 and 2.02 of the HDPE Pipe and Fittings Specifications,

- ❑ Verify that the pipe and fittings are properly marked as specified in Part 2.02 of the HDPE Pipe and Fittings Specifications,

- ❑ Visually inspect the pipe and fittings for fractures, cracks, gouges, damaged ends, or other evidence of damage or poor manufacture (reference Part 3.02 of the HDPE Pipe and Fittings Specifications), and

- ❑ Confirm that the leachate collection sump is perforated in accordance with the perforation details shown on the Drawings.

CQA Personnel shall conduct the following during and after leachate collection sump and sideslope riser placement:

- ❑ Observe pipe placement to confirm that the proper equipment and placement procedures are employed to protect from overstressing the underlying geomembrane and to ensure that geomembrane wrinkles are minimized (reference Part 3.11 of the Earthwork Specifications),

- ❑ Observe the Contractor's method of handling the pipe to ensure that the pipe is not overstressed or otherwise damaged, as described in Part 3.01F of the HDPE Pipe and Fittings Specifications,

- ❑ Observe the Contractor's method of joining the pipe and fittings to verify compliance with the specifications provided in Part 3.01 of the HDPE Pipe and Fittings Specifications,

- ❑ Ensure that the leachate collection sump and sideslope riser pipe is plumb,

- ❑ Confirm that the final connections to the leachate collection pipes are completed in accordance with the specifications provided in Part 3.01 of the HDPE Pipe and Fittings Specifications.

Sand Drainage Layer

The design incorporates a sand drainage layer directly above the landfill floor to drain leachate into the leachate collection piping system. Material specifications for the Sand Drainage Layer are provided in Part 2.05 of the Earthwork Specifications; placement and compaction requirements are provided in Part 3.09 of the Earthwork Specifications.

At least one sample (per phase of Sand Drainage Layer construction) of the material to be used as the Sand Drainage Layer shall be tested for the following prior to material import:

- ❑ Grain-size distribution in accordance with ASTM D422. Hydrometer analysis of the particles passing the No. 200 sieve is not required,
- ❑ Reactivity with dilute hydrochloric acid in accordance with ASTM D2488. If visible reaction is observed, a sample shall be tested for carbonate loss in accordance with ASTM D3042, and
- ❑ Hydraulic conductivity in accordance with ASTM D2434.

Certified test results for grain-size distribution and reactivity provided by the Sand Drainage Layer material supplier is acceptable.

CQA Personnel shall conduct the following during and after Sand Drainage Layer placement:

- ❑ Observe Sand Drainage Layer placement to confirm that the proper equipment and placement procedures are employed to protect from overstressing the underlying geomembrane and to ensure that geomembrane wrinkles are minimized (reference Part 3.11 of the Earthwork Specifications),
- ❑ Measure the thickness of the Sand Drainage Layer to verify the minimum specified thickness is provided. The Sand Drainage Layer Thickness shall be verified by measurements taken at a maximum of 100-foot intervals. A grid system consisting of perpendicular lines spaced no more than 100-feet apart, shall be established. Measurements of Sand Drainage Layer Thickness shall be verified by measurements at the intersections of the grid lines. Supplemental thickness measurements shall be made at changes in grades along each grid line.
- ❑ Verify that the Sand Drainage Layer directly abuts the leachate drainage layer placed during a preceding phase of construction (if any) and that any previously placed rainflap has been removed,
- ❑ Verify that adequate measures are taken to protect the Sand Drainage Layer from contamination by fine-grained materials, or other damage due to storm water runon from adjacent parts of the landfill, and
- ❑ Confirm that the specified protective soil layer on the liner sideslope is placed in accordance with the drawings and specifications (Part 3.11 of the Earthwork Specifications) prior to waste placement.

Geocomposite

Geocomposite is placed above the primary liner (clay liner and lowermost geomembrane) in order to provide a redundant leachate collection system. Material specifications for the geocomposite are provided in Part 2.01 of the Geocomposite Specifications (Specifications Section 02646); installation requirements are provided in Parts 3.01 through 3.03 of the Geocomposite Specifications. Material specifications for the geocomposite are provided in Part 2.01 of the Geocomposite Specifications (Specifications Section 02646); installation requirements are provided in Parts 3.01 through 3.03 of the Geocomposite Specifications).

The Owner (or the Owner's designee) shall submit a representative sample of the geocomposite and other applicable materials (e.g. geomembrane) to a qualified laboratory independent of the geocomposite manufacturer for interface shear testing. Geocomposite - geomembrane interface shear testing shall be conducted prior to the first phase of sidewall liner installation and shall be retested whenever interface shear testing of the materials to be used has not been conducted during the previous 48 months. Interface shear test methods and criteria shall conform with those provided in Specifications Section 02646-Geocomposite.

Interface shear testing shall not be required for repairs and/or installations totaling less than 1,000 square feet individually, and 10,000 square feet combined over a 12-month period.

Prior to geocomposite installation, CQA Personnel shall:

- ❑ Obtain and review the manufacturer's certification of compliance with the material specifications prior to installation (reference Part 1.04 of the Geocomposite Specifications),
- ❑ Observe and record the labeling on the material rolls to confirm delivery of properly certified products, and
- ❑ Review interface shear test data to confirm that the interface shear strengths conform with the specifications.

During or following installation, CQA Personnel shall:

- ❑ At the CQA Officer's discretion, observe the techniques used by the installer to confirm conformance with Part 3.01 of the Geocomposite Specifications,
- ❑ Inspect representative sections of the material to confirm that the material is free of blisters, undispersed raw materials, contamination from foreign matter, or other defects,
- ❑ Confirm that the geocomposite installed on the sidewall liner is anchored in the geomembrane anchor trench as shown on the Drawings,
- ❑ Verify that the installed geocomposite is oriented to provide maximum transmissivity downslope,
- ❑ Confirm the geocomposite is overlapped and fastened in accordance with Part 3.02 of the Geocomposite Specifications,

- ❑ Observe repairs and penetrations to verify conformance with Part 3.03 of the Geocomposite Specifications, and

- ❑ Confirm that the geocomposite is adequately ballasted to prevent displacement by wind.

Geotextile

The design includes a geotextile over the sand drainage layer on the landfill floor to prevent migration of fines into, and clogging of, the leachate drainage and collection system. Material specifications for the geotextile are provided in Part 2.01 of the Geotextile Specifications (Specifications Section 02640); installation requirements are provided in Parts 3.01 and 3.02 of the Geotextile Specifications.

- ❑ CQA Personnel shall perform the following activities prior, during, or after geotextile installation:

- ❑ Review the supplier's certification, as required by Part 1.04 of the Geotextile Specifications, to verify that the geotextile meets the specified material criteria,

- ❑ Confirm that the correct grade of geotextile is placed as specified by Part 2.01B of the Geotextile Specifications,

- ❑ Confirm that the geotextile installed on the sidewall liner is anchored in the geomembrane anchor trench as shown on the Drawings,

- ❑ At the CQA Officer's discretion, observe the techniques used by the geotextile installer to confirm conformance with Part 3.01 of the Geotextile Specifications,

- ❑ Confirm that the geotextile overlaps are as required by Part 3.01 of the Geotextile Specifications,

- ❑ Verify that geotextile repairs and penetrations conform to the requirements of Part 3.02 of the Geotextile Specifications, and

- ❑ Confirm that the geotextile is adequately ballasted to prevent displacement by wind.

Leachate Piping System

Leachate is pumped to the storage tank via a pressure piping system. At the storage tank, pressure piping will be used to transfer leachate from the storage tank to the truck loading facility, whereas a gravity drain will drain any spilled leachate on the truck loading pad back into the storage tank. All leachate piping that is buried outside the waste boundary will be double-wall and incorporate leak detection manholes. The piping and leak detection manholes will be constructed of HDPE. Material specifications for the leachate piping are provided in Parts 2.01 and 2.02 of the HDPE Pipe and Fittings Specifications; installation and testing requirements are provided in Parts 3.01 and 3.02 of the HDPE Pipe and Fittings Specifications. Material specifications for the trench backfill are provided in Parts 2.04 (Random Fill) and 2.06 (Sand Bedding) of the Earthwork Specifications; placement and compaction requirement are provided in Part 3.12 of the Earthwork Specifications.

CQA Personnel shall review the HDPE pipe manufacturer certification for conformance with the material specifications (as required by Part 1.04 of the HDPE Pipe and Fittings Specifications).

At least one sample (per phase of pipe installation) of the material to be used as Sand Bedding shall be tested for grain-size distribution in accordance with ASTM D422 prior to material import. Hydrometer analysis of the particles passing the No. 200 sieve is not required. Certified test results provided by the Sand Bedding supplier is acceptable. Random Fill used as backfill can be approved based on visual observations.

CQA Personnel shall conduct the following during leachate piping system installation:

- ❑ Confirm the thickness of the Sand Bedding at a nominal frequency of every 50 feet to verify the minimum specified thickness is provided,
- ❑ Observe the Sand Bedding and Random Fill placement and compaction for conformance with the specifications provided in Part 3.12 of the Earthwork Specifications,
- ❑ Observe the Contractor's method of handling the pipe to ensure that the pipe is not overstressed or otherwise damaged, as described in Part 3.01F of the HDPE Pipe and Fittings Specifications,
- ❑ Observe the Contractor's method of joining the pipe and fittings to verify compliance with the specifications provided in Part 3.01 of the HDPE Pipe and Fittings Specifications,
- ❑ Survey the as-built pipe crown coordinates and grade for construction documentation, and
- ❑ Observe the Contractor's pressure testing of the pipe and fittings, and review the pressure test results, for compliance with Part 3.02D of the HDPE Pipe and Fittings Specifications.

Leachate Storage Tank(s)

At least one double-wall underground leachate storage tank for the chemical waste unit will be installed to store excess leachate, as required. The storage tank shall be installed in accordance with the tank manufacturer's recommendations.

Prior to installation, CQA Personnel shall confirm that the leachate storage tank and appurtenances conform with fabrication and material specifications.

CQA Personnel shall observe the following during underground storage tank installation:

- ❑ Tank excavation prior to tank installation to confirm suitable dimensions, as specified by the tank manufacturer,
- ❑ The tank bedding and backfill materials. Testing of the bedding and backfill materials shall be at the discretion of the CQA Officer,
- ❑ Placement and compaction of the tank bedding material,

- ❑ Tank installation and ballasting,
- ❑ Placement and compaction (if required) of backfill to the tank springline, and
- ❑ Testing of the transfer pump, leak detection system, and other leachate system controls for proper operation.

Final Cover

The final cover system will be constructed in phases as the landfill is developed. Each phase of final cover construction will include earthwork to construct the Final Cover Barrier Soil and Vegetative Cover, and installation of the HDPE geomembrane. The following sections describe the CQA activities for each component of the final cover.

Final Cover Barrier Soil

Final Cover Barrier Soil is incorporated into the final cover system. Material and subgrade preparation, placement, and compaction specifications are provided in the Earthwork Specifications.

Final Cover Barrier Soil Materials

CQA Personnel shall observe and test Final Cover Barrier Soil material for the following:

- ❑ Confirmation that the Final Cover Barrier Soil material is derived from the Tiskilwa till or the Berry Clay/Radnor till units,
- ❑ Uniformity of gradation, texture, and moisture content,
- ❑ Soil type according to the United Soil Classification System (visual-manual method) at a minimum testing frequency of one sample each day Final Cover Barrier Soil material is being placed,
- ❑ Atterberg limits and grain-size distribution by ASTM Test Methods D4318 and D422, respectively, at a nominal testing frequency of one test for every three acres of Final Cover Barrier Soil placed. Hydrometer analysis of the particles passing the No. 200 sieve is not required,
- ❑ Maximum dry density/moisture content relationship (i.e. Proctor test) by ASTM Test Method D698. Each soil type derived from each geologic unit used for Final Cover Barrier Soil construction shall be tested. Subsequent testing shall be at the discretion of the CQA Officer; however, at a minimum, one-point "check points" shall be performed and correlated to full Proctor curves at a nominal frequency of one check point for every three acres of Final Cover Barrier Soil placed. A full Proctor test shall be conducted on material for which the check point does not correlate to a previously completed Proctor curve, and
- ❑ Free of excessive organics, frozen materials, and oversized stone/clods.

Final Cover Barrier Soil Subgrade Preparation

Final Cover Barrier Soil subgrade preparation specifications are provided in the Earthwork Specifications. The intent of the subgrade preparation specifications is to provide a firm base upon which the compacted Final Cover Barrier Soil can be construction to ensure that the full thickness of the compacted Final Cover Barrier Soil achieves the specified compaction and hydraulic conductivity criteria. In order to ensure a firm subgrade, the specifications require that the Contractor proof-roll the liner subgrade using equipment acceptable to the CQA Officer. The CQA Personnel shall observe the proof-rolling and note any areas that appear unacceptably soft (i.e. too soft to allow proper compaction of the overlying Final Cover Barrier Soil). The CQA Personnel shall also observe the subgrade to confirm the absence of frozen soil, organic-rich soil, standing or running water, or exposed waste material at the foundation subgrade. Such soils shall be delineated, removed, and replaced with compacted Final Cover Barrier Soil as described in the specifications or as otherwise approved by the Design Engineer.

Final Cover Barrier Soil Placement and Compaction

CQA Personnel shall observe and test Final Cover Barrier Soil material as it is placed and compacted for the following:

- ❑ Confirmation that the Final Cover Barrier Soil ties into previously constructed adjacent Final Cover Barrier Soil segments,
- ❑ Maximum lift thickness (prior to compaction), at a nominal frequency of two measurements per acre per lift,
- ❑ In-place (field) moisture content and dry density to confirm whether the specified moisture content and relative compaction are achieved,
- ❑ Proper lift bonding,
- ❑ Measures taken to adequately protect the in-place Final Cover Barrier Soil from excessive moisture, desiccation, freeze damage, or disturbance, and
- ❑ Laboratory hydraulic conductivity of the in-place Final Cover Barrier Soil.

Field density and moisture content tests shall be performed using a properly calibrated nuclear densiometer in accordance with ASTM D-2922 and D-3017, or other generally accepted method approved by the CQA Officer. The CQA Personnel shall judgmentally select field density/moisture content test locations to provide uniform testing coverage of the fill. CQA Personnel shall test field density and moisture content at a nominal frequency of 10 tests per acre of Final Cover Barrier Soil placed.

At least one laboratory hydraulic conductivity test shall be performed for every 5 acres (or portion thereof) of Final Cover Barrier Soil under construction. Samples for hydraulic conductivity testing shall be collected using thin-wall "Shelby" tubes pushed vertically into the Final Cover Barrier Soil. The sample locations (horizontal and vertical) shall be randomly selected in accordance with the procedures described in the Statistical Sampling Program Section of this Plan. Holes resulting from the hydraulic conductivity sampling activities shall be backfilled with sodium bentonite chips or powder. The bentonite shall be placed in 6-inch lifts; each lift shall be charged with sufficient water to adequately hydrate the bentonite. The ends of the Shelby tube shall be sealed to prevent moisture loss or gain. The Shelby tube

samples shall be promptly transported (in a vertical position) to the soils laboratory. Once at the laboratory, the tubes shall be fully extruded and inspected by laboratory personnel for evidence of disturbance, improper lift bonding and non-uniformity of soil type. Any such evidence shall immediately be reported to the CQA Officer. The sample shall then be trimmed as required and tested in accordance with ASTM D5084 test methods.

The CQA Personnel shall record the approximate location of all field density and moisture content tests and hydraulic conductivity samples to a nominal accuracy of 10 feet horizontally and 3 inches vertically referencing the project coordinate and elevation system. The lift number that is subjected to the testing shall also be recorded.

The CQA Personnel shall survey the edges of the in-place Final Cover Barrier Soil to provide adequate construction documentation and to ease verification that future phases of final cover construction tie into the Final Cover Barrier Soil.

Final Cover Barrier Soil Thickness

CQA Personnel are responsible for confirming that the minimum specified Final Cover Barrier Soil thickness is achieved. This shall be accomplished by small diameter probes through the full thickness of the Final Cover Barrier Soil, by surveying the elevations of the subgrade prior to placing Final Cover Barrier Soil and the completed Final Cover Barrier Soil surface, or by other positive means approved by the Regulatory Agency.

The Final Cover Barrier Soil Thickness shall be verified by measurements taken at maximum of 100-foot intervals. A grid system, consisting of perpendicular lines spaced no more than 100-feet apart shall be established. Measurements of Final Cover Barrier Soil Thickness shall be verified by measurements at the intersections of the grid lines. Supplemental thickness measurements shall be made at changes in grades along each grid line.

Probe holes shall be backfilled with bentonite chips or powder. The bentonite shall be placed in 6-inch lifts; each lift shall be charged with sufficient water to adequately hydrate the bentonite.

Geomembrane

The final cover incorporates a high density polyethylene (HDPE) geomembrane placed directly above the Final Cover Barrier Soil. Specifications for the manufacture and installation of the geomembrane are provided in Specifications Section 02650.

This Plan details the quality assurance activities related to manufacturing and installing the geomembrane. Geomembrane manufacturing quality control (MQC) activities are the responsibility of the geomembrane Manufacturer and are specified in Part 2.02 of the Geomembranes Specifications. The geomembrane Installer is responsible for the installation quality control requirements that are specified in Part 3.09 of the Geomembrane Specifications.

Geomembrane Preinstallation Activities

The Owner (or the Owner's designee) shall submit a representative sample of the textured geomembrane and other applicable materials (e.g. or geocomposite) and Final Cover Barrier Soil) to be used on the 4:1 (horizontal to vertical) final cover slopes to a qualified laboratory independent of the geomembrane Manufacturer for interface shear testing. Geomembrane-Final Cover Barrier Soil interface shear testing shall be conducted prior to each phase of

geomembrane installation on the 4:1 (horizontal to vertical) final cover slopes, but no more frequently than once during any 12 month period. Geomembrane-geocomposite) interface shear testing shall be conducted prior to the first phase of 4:1 (horizontal to vertical) final cover slope installation and shall be retested whenever interface shear testing of the materials to be used has not been conducted during the previous 48 months. Interface shear test methods and criteria shall conform with those provided in Specifications Section 02650-Geomembranes.

Prior to each phase of geomembrane installation, the Owner (or the Owner's designee) shall submit representative sample(s) of each type of geomembrane (i.e. smooth and textured) to a qualified laboratory independent of the geomembrane Manufacturer for the following manufacturing quality assurance (MQA) tests:

- ❑ Thickness,
- ❑ Density,
- ❑ Tensile Properties,
- ❑ Puncture Resistance,
- ❑ Tear Resistance, and
- ❑ Carbon Content.

At least one MQA test shall be performed for each 50,000 square feet (or portion thereof) of geomembrane to be supplied. Test methods shall conform with those provided in Specifications Section 02650-Geomembranes.

Neither interface shear nor MQA testing shall be required for repairs and/or installations totaling less than 1,000 square feet individually, and 10,000 square feet combined over a 12-month period.

CQA Personnel shall conduct the following prior to beginning geomembrane installation:

- ❑ Review all MQC certifications provided by the geomembrane Manufacturer,
- ❑ Review the MQA test results for conformance with the specifications,
- ❑ Review and verify the Installer's inventory of delivered geomembrane rolls,
- ❑ Confirm that the delivered rolls of geomembrane are specifically covered under the Manufacturer's MQC certifications,
- ❑ Confirm that the MQA sample(s) was (were) obtained from roll(s) delivered to the site,
- ❑ Review interface shear test data to confirm that the interface shear strengths conform with the specifications,
- ❑ Review the Installer's Project Superintendent's resume for conformance with Part 1.04 of the Geomembrane Specifications,

- ❑ Review and approve the Installer's panel layout shop drawings,
- ❑ Observe the geomembrane subgrade immediately prior to installation to ensure that the subgrade meets the requirements of Part 3.02 of the Geomembranes Specifications, and
- ❑ Review the Installer's subgrade certification.

Geomembrane Placement and Protection

Specifications for the placement and protection of geomembranes are provided in Parts 3.03 and 3.04 of the Geomembranes Specifications. CQA Personnel shall perform the following during geomembrane placement:

- ❑ Verify that the panels are placed as shown on the approved panel lay-out shop drawing, or as otherwise approved by the CQA Officer,
- ❑ Verify the placement of textured geomembrane where shown on the Drawings,
- ❑ Confirm that the geomembrane protection requirements of the specifications are enforced,
- ❑ Observe geomembrane anchor trenches for conformance with the Drawings and specifications,
- ❑ Verify that the geomembrane trenches are backfilled and compacted as specified,
- ❑ Disapprove geomembrane deployment during inclement weather as described in the specifications, unless specifically approved by the CQA Officer,
- ❑ Observe the geomembrane for defects,
- ❑ Confirm that adjoining panels are overlapped and shingled as specified,
- ❑ Observe for excessive slack or wrinkles in the geomembrane, and
- ❑ Confirm that the in-place geomembrane is adequately ballasted to prevent displacement.

Geomembrane Welds and Defect Repairs

Specifications for welding geomembrane seams and repairing defects are provided in Parts 3.05 and 3.06 of the Geomembranes Specifications. CQA Personnel shall perform the following activities:

- ❑ Verify that the seams being welded are not excessively tensioned or wrinkled,
- ❑ Confirm the use of the specified welding techniques and equipment for each seam,
- ❑ Observe each welder's methods for a sufficient amount of time to confirm that the welding procedures are in accordance with the specifications,

- ❑ Verify that each welding equipment/operator combination are properly pre-qualified in accordance with Part 3.09 of the Geomembranes Specifications,

- ❑ Review the Installer's methods of defect repair for conformance with the specifications, and

- ❑ Observe the completed repairs for workmanship.

Geomembrane Field Quality Control

Specifications for the Installer's field quality control are provided in Part 3.09 of the Geomembranes Specifications. CQA Personnel shall perform the following:

- ❑ Verify that the welding equipment/operator pre-qualification testing is conducted in accordance with the specifications,

- ❑ Confirm that all geomembrane seams are non-destructively tested as specified,

- ❑ Randomly select locations for destructive seam tests, as specified. Random locations shall be selected as described in the Statistical Sampling Program Section of this Plan; sampling frequencies are provided in Part 3.09 of the Geomembranes Specifications,

- ❑ Specify other locations for destructive seam tests where, in the CQA Officer's opinion, the seam quality is questionable (if any),

- ❑ Verify that the destructive sample locations are repaired and tested in accordance with the specifications,

- ❑ Review the laboratory test results for conformance with the specifications, and

- ❑ Confirm that failed seams are repaired as specified.

Documentation

CQA Personnel shall confirm that the Installer maintains the documentation as specified in Part 3.10 of the Geomembranes Specifications.

Geocomposite

Geocomposite, is placed on the final cover geomembrane to drain infiltration water off the final cover. Material specifications for the geocomposite are provided in Part 2.01 of the Geocomposite Specifications (Specifications Section 02646); installation requirements are provided in Parts 3.01 through 3.03 of the Geocomposite Specifications.

The Owner (or the Owner's designee) shall submit a representative sample of the geocomposite and other applicable materials (e.g. geomembrane and protective / vegetative cover soil as appropriate) to be used on the 4:1 (horizontal to vertical) final cover slopes to a qualified laboratory independent of the geocomposite Manufacturer for interface shear testing. Geocomposite-vegetative cover soil interface shear testing shall be conducted prior to each phase of installation of the 4:1 (horizontal to vertical) final cover slopes, but no more frequently

than once during any 12 month period. Geocomposite - geomembrane interface shear testing shall be conducted prior to the first phase of 4:1 (horizontal to vertical) final cover slope installation and shall be retested whenever interface shear testing of the materials to be used has not been conducted during the previous 48 months. Interface shear test methods and criteria shall conform with those provided in Specifications Section 02646-Geocomposite.

Interface shear testing shall not be required for repairs and/or installations totaling less than 1,000 square feet individually, and 10,000 square feet combined over a 12-month period.

Prior to geocomposite installation, CQA Personnel shall:

- ❑ Obtain and review the manufacturer's certification of compliance with the material specifications prior to installation (reference Part 1.04 of the Geocomposite Specifications),
- ❑ Observe and record the labeling on the material rolls to confirm delivery of properly certified products, and
- ❑ Review interface shear test data to confirm that the interface shear strengths conform with the specifications.

During or following installation, CQA Personnel shall:

- ❑ At the CQA Officer's discretion, observe the techniques used by the installer to confirm conformance with Part 3.01 of the Geocomposite Specifications,
- ❑ Inspect representative sections of the material to confirm that the material is free of blisters, undispersed raw materials, contamination from foreign matter, or other defects,
- ❑ Confirm that the geocomposite is terminated at the toe of the final cover slopes as shown on the Drawings,
- ❑ Verify that the installed geocomposite is oriented to provide maximum transmissivity downslope,
- ❑ Confirm that the geocomposite is overlapped and fastened in accordance with Part 3.02 of the Geocomposite Specifications,
- ❑ Observe repairs and penetrations to verify conformance with Part 3.03 of the Geocomposite Specifications, and
- ❑ Confirm that the geocomposite is adequately ballasted to prevent displacement by wind.

Protective / Vegetative Cover

The intent of the Protective / Vegetative Cover is to protect the underlying geomembrane and Final Cover Barrier Soil layers from damage due to freezing, sunlight exposure, equipment, etc. In order to provide this protection, the protective / vegetative cover itself is designed to resist erosion. The establishment of turf and storm water controls consisting of berms, sideslope terraces and letdown pipes will provide erosion protection. Vegetative Cover material specifications are provided in Part 2.07 of the Earthwork Specifications; placement

and compaction specifications are provided in Part 3.06B (final cover components) of the Earthwork Specifications.

CQA activities during Protective / Vegetative Cover placement and compaction are as follows:

- ❑ Observe the Protective / Vegetative Cover materials for compliance with the liquid limit and gradation requirements of Part 2.07 of the Earthwork Specifications. Laboratory testing frequencies for these properties are at the discretion of the CQA Officer,

- ❑ Verify that the first lift of Protective / Vegetative Cover over geosynthetic materials does not contain stones greater than 2-inches diameter, sharp objects, or other materials that could damage the underlying geosynthetic material. This shall be based on continuous observation of the placement of the first lift,

- ❑ Confirm that the first lift of Protective / Vegetative Cover over geosynthetic materials on the final cover sideslopes is placed from the bottom of the slope upwards toward the top of the slope,

- ❑ Measure lift thickness for conformance with the specifications at a nominal frequency of one measurement per acre per lift,

- ❑ Observe compaction methods for conformance with the specifications,

- ❑ Measure the Protective / Vegetative Cover thickness for compliance with the minimum thickness shown on the Drawings. The Protective / Vegetative Cover Thickness shall be verified by measurements taken at a maximum of 100-foot intervals. A grid system, consisting of perpendicular lines spaced no more than 100-feet apart, shall be established. Measurements of Protective / Vegetative Cover Thickness shall be verified by measurements at the intersections of the grid lines. Supplemental thickness measurements shall be made at changes in grades along each grid line, and

- ❑ Verify the construction of berms, letdown pipes, and energy dissipaters as shown on the Drawings.

Turf Establishment

Turf will be established on the final cover to protect the vegetative cover from excessive erosion. Turf Establishment material specifications are provided in Parts 2.01 through 2.03 of the Turf Establishment Specifications (Section 02900 of the Specifications); seedbed preparation, seeding, and mulching specifications are provided in Parts 3.01 through 3.03 of the Turf Establishment Specifications.

CQA Personnel shall perform the following during Turf Establishment:

- ❑ Review the Contractor's planned seed mix, fertilizers, and soil amendment activities for conformance with the specifications, and

- ❑ Verify that the final cover vegetation becomes well established.

Stormwater Control Features

Stormwater around the landfill perimeter will be controlled by ditches, letdown pipes, culverts, and a sedimentation basin. The following sections describe the CQA activities to be performed to ensure that these facilities are constructed in accordance with the Drawings and specifications.

Earth Fill

Random fill is specified for use in temporary and permanent berms, the sedimentation basin dikes, and fill embankments. Material specifications are provided in Part 2.04 of the Earthwork Specifications; placement and compaction specifications are provided in Part 3.08 of the Earthwork Specifications.

Random Fill Material Quality

CQA Personnel shall observe and test Random Fill material for the following:

- ❑ Soil type according to the United Soil Classification System (visual-manual method) at a nominal frequency of one test per 5,000 cubic yards on in-place earth fill,
- ❑ Atterberg limits at the discretion of the CQA Officer,
- ❑ Maximum dry density/moisture content relationship at the discretion of the CQA Officer,
- ❑ Uniformity of gradation, texture, and moisture content,
- ❑ Free of excessive organics, frozen materials, and oversized stone/clods, and
- ❑ Unconfined compressive strength (where placed in embankments greater than 10 feet high with slopes 3 horizontal to 1 vertical or steeper) at the discretion of the CQA Officer.

Random Fill Subgrade Preparation

CQA Personnel shall observe the subgrade prior to placing Random Fill. These CQA activities shall include observing the Contractor proof-roll the subgrade, and verifying the absence of unsuitable materials. The CQA Personnel shall delineate areas of soft, unstable or pumping soil that prevent adequate compaction of the first lift of Random Fill an that require overexcavation. Backfilling such overexcavations shall be subject to the CQA activities defined for Random Fill placement and compaction.

Random Fill Placement and Compaction

CQA Personnel shall observe and test Random Fill material as it is placed and compacted for the following:

- ❑ Maximum lift thickness (prior to compaction and following compaction) at a nominal frequency of one measurement per acre per lift,

- ❑ In-place moisture content and dry density to determine relative compaction,
- ❑ Proper lift bonding,
- ❑ Measures taken to adequately protect the in-place Random Fill from excessive moisture, desiccation, or disturbance, and
- ❑ Proper equipment and methods to protect underlying geosynthetic materials and other in-place installations.

Field density and moisture content tests shall be performed using a properly calibrated nuclear densiometer in accordance with ASTM D-2922 and D-3017, or other generally accepted method approved by the CQA Officer. Field density/moisture content tests should be performed at a nominal frequency of one test per 2,000 cubic yards of in-place random fill. Field density/moisture content test locations shall be judgmentally selected by the CQA Personnel in order to obtain data that is representative of the whole fill, and/or areas of special concern by the CQA Officer.

The CQA Personnel shall record the approximate location of all field density and moisture content tests to a nominal accuracy of 10 feet horizontally and 3 inches vertically referencing the project coordinate and elevation system.

Letdown Pipes, Culverts, Etc.

Letdown pipes are used to drain water off the final cover and into the perimeter ditch at the toe of the landfill. Fabricated energy dissipaters will be installed at the letdown pipe outlets where necessary to prevent erosion at the point of discharge. Culverts will be installed at road crossings. A filtered dewatering device, constructed of corrugated metal pipe (CMP), will be used to drain the sedimentation basin.

CQA Personnel shall verify that the piping used in these applications is as shown on the Drawings. CQA Personnel shall also observe the energy dissipaters and sedimentation basin dewatering device for conformance with the Drawings.

Erosion Control Armor

Erosion control armor includes turf reinforcement material (TRM), riprap, and fabric-formed concrete. The locations and type of erosion control armor are shown on the Drawings. Riprap material specifications are provided in Part 2.08 of the Earthwork Specifications; placement and compaction specifications are provided in Part 3.13 of the Earthwork Specifications. Fabric-formed concrete and TRM shall be installed in accordance with the manufacturers' recommendations.
CQA Personnel shall conduct the following during Riprap installation:

- ❑ Verify the Riprap supplier's certification that the Riprap meets the specified material criteria,
- ❑ Confirm the preparation of the Riprap subgrade, including the placement of Sand Bedding and geotextile if applicable,
- ❑ Observe Riprap placement methods for conformance with the specifications, and

- ❑ Verify the thickness of the in-place Riprap.

CQA Personnel shall observe the following during TRM installation:

- ❑ The installed TRM is as specified on the Drawings,
- ❑ The subgrade is prepared in accordance with the Manufacturer's recommendations,
- ❑ The TRM is anchored as specified by the Manufacturer,
- ❑ Confirm that the seed and soil amendments (if used) conform with Parts 2.01 and 2.02 of the Turf Establishment Specifications, and
- ❑ Verify that check slots or other previously seeded areas that are disturbed during TRM placement are reseeded.

CQA Personnel shall observe the following during fabric-formed concrete installation:

- ❑ The installed fabric-formed concrete will achieve the nominal thickness shown on the Drawings,
- ❑ The fabric form subgrade is prepared in accordance with the Manufacturer's recommendations,
- ❑ The fabric form is anchored as specified by the Manufacturer,
- ❑ The supplied concrete meets the fabric form Manufacturer's recommendations. This determination can be based on review of the concrete supplier's certification and field observations at the CQA Officer's discretion. Field or laboratory testing requirements are at the CQA Officer's discretion, and
- ❑ Concrete is pumped into and evenly distributed throughout the fabric form.

Lines and Grades

CQA Personnel shall check the lines and grades of the ditches, culverts and sedimentation berms for compliance with the Drawings within the tolerances provided for in Part 1.06 of the Earthwork Specifications. The frequency of the measurements shall be at the discretion of the CQA Officer.

STATISTICAL SAMPLING PROGRAM

General

Certain tests and samples will be conducted/collected at randomly selected locations. This section describes the methods that will be used in order to ensure that selected locations are statistically random.

The following tests and samples are subject to this statistical sampling program:

- ❑ Earth Liner field density and field moisture content tests,
- ❑ Earth Liner field and laboratory hydraulic conductivity samples,
- ❑ Final Cover Barrier Soil laboratory conductivity samples, and
- ❑ Geomembrane seam destructive samples.

Earth Liner Field Density and Field Moisture Content Tests

CQA Personnel shall establish the limits of the Earth Liner that will be constructed at the start of each phase of Earth Liner construction. The CQA Personnel shall then grid the Earth Liner construction area into cells that are approximately 20 feet by 20 feet in plan (the grid lines need not be perpendicular). Nonuniform cells, such as those along the edges of the construction area, may be necessary in which case the cells will be sized to be approximately 400 square feet in area.

Once the testing cells are established and numbered, CQA Personnel shall randomly select field density and moisture content test locations in the following manner, or other manner approved by the CQA Officer:

- ❑ Using a random number algorithm or table, randomly select the cell to be tested, and
- ❑ Randomly select another number between 1 and the total number of lifts in which the Earth Liner will be constructed using a random number algorithm or table.

The first randomly selected number is the cell number to be tested, the second randomly selected number is the lift number to be tested in that cell. Repeat the process until all locations of the minimum required number of field density/moisture content tests are selected. Record the cells and lifts to be tested.

During construction, CQA Personnel shall perform field density/moisture content tests at the randomly selected locations (i.e. anywhere within the randomly selected cell). CQA Personnel shall supplement the random testing with "judgmental" testing. Judgmental test locations shall be selected by the CQA Personnel in the field to check areas that the CQA Personnel believe have the lowest likelihood of achieving the specified degree of compaction and/or moisture content. Judgmental testing can also be performed to ensure that no substantial gaps in time (or volume of Earth Liner placed) occur. In general, judgmental testing should comprise at least 10 percent of the total number of tests conducted during any phase of construction.

Areas with failing field density and or field moisture content shall be retested following reworking by the Contractor. Retests shall be within 30 feet horizontally and within the same lift as the previously failing test. Failing tests shall not be counted towards the minimum required number of field density/moisture content tests.

Field and Laboratory Hydraulic Conductivity Tests

Field hydraulic conductivity test locations, and laboratory hydraulic conductivity sample locations shall be randomly selected using the same procedures used to randomly select the field density/moisture content test locations. Furthermore, the depths at which the laboratory hydraulic conductivity samples are to be collected shall be determined using the same methodology as that used to randomly select the lift to be subjected to field density/moisture content testing at each location.

Geomembrane Seam Destructive Tests

CQA Personnel shall assign a unique seam location identifier by length (i.e. in feet) for each seam welded during a specific day. Destructive test sample locations shall then be selected as follows:

- Obtain a random number (with at least as many significant figures as that of the footage of seam welded during the day in question) between 0 and 1 using a random number generator (or table), and

- Multiply the random number by the total length of seam (in feet) welded on the day in question, round the resulting number to the nearest whole number (round exactly one-half upwards to the nearest whole number).

The resulting number is the previously determined unique seam location identifier from which the destructive sample is to be collected. Repeat the above process until there are enough random sample locations to provide a sampling frequency no less than that provided in Part 3.09 of the Geomembranes Specifications.

At the CQA Officer's discretion, the collection of destructive samples can be waived for days during which less than 200 feet of seams are welded. As another alternative at the CQA Officer's discretion, the seam lengths welded on days during which less than 150 feet of geomembrane is seamed can be added to the seam lengths welded on the next day that seaming occurs for random sample location selection. As part of this decision, the CQA Officer shall consider the stress that the seams will be subjected to during the geomembrane service life, the previous destructive sample test results, and the Contractor's pre-qualification test weld results.

DOCUMENTATION AND REPORTS

Field Documentation

CQA Personnel shall maintain detailed documentation of the field conditions, construction activities, and construction materials. The following sections describe the minimum documentation that is required.

Daily Report

CQA Personnel shall prepare a narrative Daily Report for each day that they are onsite. The narrative Daily Report shall at a minimum include the following information:

- ❑ Date, project name, and site location,
- ❑ Weather conditions,
- ❑ Description of work conducted during the day, including work locations, equipment used, and names of Contractor supervisory personnel,
- ❑ Description of any meetings held, attendees, and the meeting results, including required action items,
- ❑ Names, affiliations, and activities of site visitors whom had contact with the CQA Personnel,
- ❑ Description of the earthwork materials used, including soil type and, in the case of Earth Liner construction, the geologic unit(s) from which the earth material was derived,
- ❑ Documentation of the observations and measurements required by this Plan (e.g. subgrade proof-rolling, number of compaction equipment passes, Earth Liner thickness measurements, etc.),
- ❑ Description of imported earth and/or manufactured materials received onsite, including material specifications compliance verification and/or documentation,
- ❑ Calibration, or recalibration of test equipment, including actions taken as a result of recalibration;
- ❑ Decisions made regarding approval of material or of work blocks, and/or corrective actions already taken or to be taken in instances of substandard quality;
- ❑ List of Test Data Sheets, survey notes, field sketches, Photographic Logs, and other field documents generated, and
- ❑ Signature of the originating CQA Personnel, and signature of the CQA Officer (documenting his/her review).

Test Data Sheets

CQA Personnel shall record all test data and results on appropriate Test Data Sheets. Test Data Sheets shall be attached to the corresponding Daily Report. The Test Data Sheets shall, at a minimum, include the following information:

- ❑ Identifying sheet number for cross-referencing and document control,
- ❑ Description or title of the testing/observation activity,
- ❑ Personnel involved in the testing/sampling activity,
- ❑ Date of testing,
- ❑ Location of the monitoring activity or location from which the sample was obtained,
- ❑ Type of testing/monitoring activity and procedure used (reference to standard method when appropriate),
- ❑ Identification of testing equipment by manufacturer, model number and any other appropriate identifier,
- ❑ Recorded observation and test data, with all necessary calculations,
- ❑ Results of the testing/monitoring activity; comparison with specification requirements (i.e. pass or fail), and
- ❑ Signature of the appropriate CQA Personnel.

Any errors found in data sheets shall be corrected by striking a line through the incorrect value and writing in the correct value adjacent to it. Corrections shall be initialed and dated by the CQA Personnel.

Photographs and Photographic Logs

CQA Personnel shall take photographs documenting the construction activities, methods and materials used. Each photograph shall be dated by a film imprint, embedded digital code, or other appropriate means.

CQA Personnel shall also maintain a Photographic Log, which shall be attached to the corresponding Daily Report. Each Photographic Log shall include the following:

- ❑ The date of the photograph,
- ❑ The subject or location of the photograph,
- ❑ Name of the photographer, and
- ❑ Signature of the photographer.

Acceptance Reports

Upon completion of the construction of each major phase (or subphase) as directed by the Owner, the CQA Officer will submit a written Acceptance Report to the IEPA. The Acceptance Reports will be submitted as a permit modification requesting operating authorization from the IEPA. The Acceptance Reports shall, at a minimum, include the following:

- ❑ A certification by the CQA Officer that the work described in the report was completed in accordance with the intent of the drawings, specifications, and approved permit,
- ❑ Description of the work approved by the CQA Officer,
- ❑ Description of any significant deviations from the drawings or specifications, and justification for such deviations,
- ❑ Copies of all earth and manufactured material laboratory test reports,
- ❑ Copies of all manufacturers' or suppliers' material specifications compliance certifications,
- ❑ All Daily Reports and attachments, including test data sheets,
- ❑ Selected photographs,
- ❑ As-built drawings (as appropriate) showing coordinates and elevations of liners and final cover, and thickness measurements of Earth Liner, Sand Drainage Layer, and Final Vegetative Cover, and
- ❑ The CQA Officer's signature and Professional Engineer's stamp.

Document Control

The CQA Officer shall be responsible for maintaining the CQA documentation. The CQA Officer shall provide copies of the Field Daily Reports and attachments to the Owner on a timely basis. The Owner shall also maintain these copies at their offices or the site.