

ATTACHMENT II-9
CONSTRUCTION QA/QC MANUAL

Table of Contents

INTRODUCTION 2

1.0 ORGANIZATION, RESPONSIBILITY AND AUTHORITY 2

2.0 EQUIPMENT CALIBRATION 6

3.0 CHANGE CONTROL PROCEDURES 6

4.0 DOCUMENTATION 8

TABLE 1 - CQA/QC ACTIVITIES

Work Elements:

General Requirements13

Foundation Preparation19

Clay Liner Material Specifications22

Clay Liner Test Pad.....24

Clay Liner Placement29

HDPE Liner37

Granular Fill50

Drainage Net.....52

Geotextile54

Soil Protective Cover56

Appendix 1: Test Methods.....58

Appendix 2: Forms58

Appendix 3: Material Specifications77

INTRODUCTION

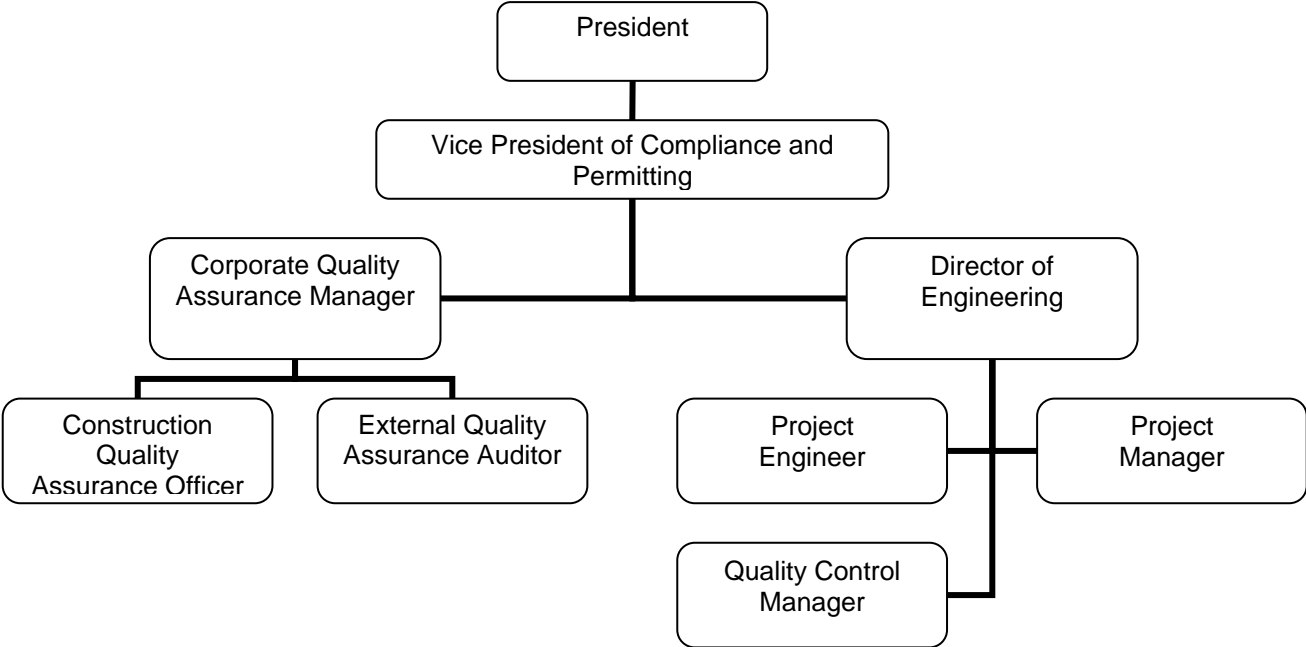
EnergySolutions, LLC (the Permittee) has developed this Construction Quality Assurance/Quality Control (CQA/QC) Manual to ensure that construction activities comply with the applicable state and federal regulations, approved design criteria, engineering plans and specifications, and good engineering practice. The attached table of CQA/QC activities provides the Engineering Specifications, and the Quality Assurance (QA) and Quality Control (QC) inspections, sampling, testing, survey controls, and records required to demonstrate that the Permittee has met these requirements. This CQA/QC Manual is contained in the State-issued Part B Permit as Attachment II-9.

The CQA/QC Manual governs compliance in construction of each new phase of the Mixed Waste Landfill Cell.

1.0 ORGANIZATION, RESPONSIBILITY AND AUTHORITY

1.1 The Permittee is both the owner and operator of its South Clive, Utah Mixed Waste Landfill Cell. Responsibility for the design, construction, operation, and closure of the facility rests with the Permittee alone.

1.2 The Construction QA/QC organization is as follows:



The President or Vice-President of Compliance and Permitting shall designate the Corporate Quality Assurance Manager (CQAM). The CQAM shall designate the Construction Quality Assurance Officer (CQAO) and External Quality Assurance Auditor.

The Vice-President of Compliance and Permitting shall designate the Director of Engineering. The Director of Engineering shall designate the Project Engineer, Project Manager, and the Quality Control Manager.

Construction QA and QC activities are carried out by the QA group and the QC group. The QC group reports to the Director of Engineering via the QC Manager. The QC Manager shall manage the QC group for Mixed Waste landfill construction. Both groups may be staffed by Permittee employees or contractors hired by the Permittee; hereinafter referred to as employees.

1.2.1 President

The President is ultimately responsible for the successful construction and operation of the facilities at South Clive, Utah. He has the authority to select and dismiss organizations or individuals charged with the design, construction, operations, quality assurance, and quality control activities.

1.2.2 Vice-President of Compliance and Permitting

The Vice-President of Compliance and Permitting is responsible to the President for the implementation of the CQA/QC Manual. The Vice President of Compliance and Permitting supervises the Corporate Quality Assurance Manager and the Director of Engineering. He has the authority to select and dismiss organizations or individuals charged with construction and quality assurance activities.

1.2.3 Corporate QA Manager (CQAM)

The CQAM reports to the Vice-President of Compliance and Permitting and supervises the CQAO and Quality Assurance personnel. The CQAM is responsible for ensuring that the quality assurance requirements outlined in this manual are implemented. The reporting relationships allow the CQAM sufficient authority and autonomy to: implement and direct the Quality Assurance Program (QAP); identify quality problems and verify implementation of solutions independent of undue influences and responsibilities, such as costs and schedules. The CQAM shall have direct contact (as needed) with the President for implementing the QAP.

The CQAM coordinates implementation of the CQA/QC Manual with the Director of Engineering. The CQAM has the authority to stop any aspect of the work that is not in compliance with the CQA/QC Manual. After work has been stopped by the CQAM, corrective action(s) shall be determined by the Director of Engineering and approved by the CQAM. Corrective actions must be undertaken to correct any defective work. Specific responsibilities of the CQAM include:

- a. Ensure that the CQA/QC Manual is implemented and a satisfactory level of quality is maintained in construction QC activities;
- b. Train QA staff on QA requirements and procedures;
- c. Schedule, coordinate, and ensure timely completion of QA assessment activities with the construction QC Group;
- d. Verify that construction QC personnel properly complete and document all on-site observations and tests required to ensure compliance with the CQA/QC Manual;
- e. Document any non-conforming and/or suspected non-conforming work, and document resolution of non-conforming work;
 1. Notify the Vice President of Compliance and Permitting and the Executive Secretary of non-conforming work within 7 calendar days of identification.
 2. The notification of non-conforming work shall address liner construction activities in accordance with this Attachment. The notification shall also address waste placement activities in the Mixed Waste Landfill Cell.
- f. Assist in preparing the QA portion of the Construction Certification Report at the completion of the project;
- g. Ensure that any changes in approved drawings and specifications follow the change control procedures described herein and that, when appropriate, approval from the Executive Secretary has been obtained prior to the implementation of the change.

1.2.4 Construction QA Officer (CQAO)

The CQAO reports to the CQAM and has direct contact with the Vice-President of Compliance and Permitting. The CQAO is responsible for compliance with the construction quality assurance requirements outlined in the CQA/QC Manual. The CQAO works closely with the Project Manager and CQAM to ensure that construction specifications are met and documented.

The CQAO shall be a Utah Registered Professional Engineer. The CQAO shall have at least 3 years of experience in synthetic liner installation; or shall supervise quality assurance staff with at least 3 years of synthetic liner installation experience. The Permittee may contract with an independent P.E. to perform CQAO certifications.

1.2.5 External Quality Assurance Auditor

An External Quality Assurance Auditor shall be contracted to audit the construction activities. The individual or group that is to perform this audit shall be independent of the Permittee. The auditor shall: a) audit at least 15% of the Mixed Waste landfill documentation; and b) perform observations of field actions that occur while the auditor is on-site. This audit shall occur during and after landfill construction.

1.2.6 Director of Engineering

The Director of Engineering reports to the Vice-President of Compliance and Permitting and supervises the Project Engineer, Project Manager, and QC Manager. The Director of Engineering is responsible for the management of facility design; including landfill construction, engineering support, site structural engineering, soil mechanics and materials. Reviews and approves, with QA oversight, those designs and specifications. Initiates and provides design solutions to non-conformance or quality problems encountered during construction. The Director of Engineering has the authority to make minor changes in accordance with Section 3.0 below. The Director of Engineering shall be a Utah Registered Professional Engineer.

The Director of Engineering has been assigned the specific responsibility of overseeing the overall construction of the project. The Director of Engineering shall oversee completion of the Construction Certification Report and the As-Built Drawings.

1.2.7 Project Engineer

The Project Engineer reports to the Director of Engineering and is responsible for the following tasks:

- a. Prepare the drawings, specifications and other documents for the construction of embankment liner.
- b. Inspect embankment construction activities to ensure the construction of liner elements is in accordance with the project plans and specifications.
- c. Assist the Director of Engineering in design solutions to non-conformance or quality problems encountered during construction.
- d. Review proposed design, engineering, or construction changes and submit these changes to the Director of Engineering for approval, as appropriate, in accordance with Section 3.0 below.
- e. Prepare, with the assistance of the Project Manager, and certify the Construction Certification Report and As-Built Drawings.

1.2.8 Project Manager

The Project Manager is responsible for overseeing production, scheduling, and coordination activities associated with construction of the waste landfills. The Project Manager reports directly to the Director of Engineering. During construction, the Project

Manager shall regularly inspect the construction site. In the extended absence of the Project Manager, the Director of Engineering shall delegate the duties of the Project Manager. The Project Engineer may perform the duties of the Project Manager.

The Project Manager has the authority to stop any aspect of the work that is not in compliance with the CQA/QC Manual. After work has been stopped by the Project Manager, work can only be resumed with the documented approval of the corrective action by the Director of Engineering and the CQAM.

The Project Manager is responsible for day-to-day project coordination, as needed, with the Executive Secretary's field representative. This coordination includes providing 48 hours notice prior to the preconstruction meetings with the contractor for the overall project and for HDPE work. The Project Manager is also responsible to communicate other key meetings, such as for the implementation of major changes, to the Executive Secretary's field representative.

1.2.9 Quality Control Manager

The Quality Control Manager shall implement and direct the QC portions of this Manual; identify quality control problems; initiate, recommend, or provide quality control solutions. The Quality Control Manager reports to the Director of Engineering.

QC testing of synthetic layers shall be performed by the Synthetics Contractor's personnel.

2.0 EQUIPMENT CALIBRATION

Measuring and testing equipment shall be calibrated at the most frequent of the following:

- Annually, or
- As per the manufacturer's recommended calibration frequency, or
- At the standard frequency practiced in the engineering profession.

Before using measuring and testing equipment on the project, the QC Manager shall provide the CQAO with the calibration documentation. This documentation shall be included in the QA project files.

3.0 CHANGE CONTROL PROCEDURES

3.1 The need may arise for a design, engineering, or construction change to the project. Therefore, change control procedures have been established to ensure the design analysis remains valid upon incorporation of the change. Where a significant design change is necessary because of an incorrect or faulty design, the design process and verification procedures themselves should be reviewed and modified, as necessary.

Phased construction activities, drawings and prints which are approved for a particular construction phase shall be stamped by a Utah Registered Professional Engineer and submitted to the Executive Secretary, prior to construction. Any subsequent changes are considered field changes.

3.2 The general change control procedure is as follows:

- a. A change request may be initiated by, including but not limited to, the contractor, CQAM, CQAO, Project Manager, Project Engineer, Director of Engineering, or representatives of the Executive Secretary.
- b. All proposed design, engineering, or construction changes shall be reviewed for applicability by the Project Engineer. After consultation with the Director of Engineering as well as other personnel (CQAM, contractor, etc.), and if determined to be justified by the Project Engineer, the scope of the change shall be subject to the same design control measures as those applied to the original design.
- c. The Project Engineer shall submit the change for approval to the Director of Engineering. The Director of Engineering, with the concurrence of the Corporate Quality Assurance Manager, determines if the change is a: 1) minor change which does not require formal approval from the Executive Secretary; or, 2) major change which requires formal approval from the Executive Secretary. Minor and major changes are described as follows:
 - 1) Minor changes are defined as all changes that are not major changes. Minor changes may be implemented immediately and shall be documented as outlined in items d, e, and f in this section. The Executive Secretary shall be notified of the change within 24 hours of implementation. The Executive Secretary will determine whether written notification is required.
 - 2) Major changes are defined as changes which conflict with the Permit, this CQA/QC Manual, or the Permit drawings. Major changes shall be reviewed by the Director of Engineering, the CQAM, and the Vice-President of Compliance and Permitting. The Permittee shall receive Executive Secretary approval prior to implementation of major changes. The Executive Secretary shall determine whether verbal or written approval is required.

If verbal approval is granted, the time, date, and agency contact for the approval shall be documented in the "Daily Construction Report." A copy of the documented approval shall be provided to the Executive Secretary and the CQAM as part of the Construction Certification Report. Verbally approved changes can be implemented immediately.

If written verification is required, the Executive Secretary may grant permission to incorporate the changes while the approval letter from the agency is prepared. If permission is granted to proceed, the time, date, and agency contact for granting the permission shall be recorded in the "Daily Construction Report." A copy of the documented permission shall be provided to the Executive Secretary as part of the Construction Certification Report.

- d. Upon approval, the Project Manager shall communicate the change to all affected construction, QC, and QA personnel. The Project Manager may issue an amendment to the applicable documents and submit the amendment to the CQAM (or designee) for distribution to critical personnel (as defined below). The Project Manager may also communicate the change via a Field Directive distributed to critical personnel.
- e. Documentation of all changes shall be included in the Construction Certification Report.
- f. As-built drawings of the project shall reflect all changes made to the Permit Drawings.

4.0 DOCUMENTATION

4.1 Critical personnel shall possess controlled copies of this CQA/QC Manual, the Permit Drawings, and the Construction Drawings. Critical personnel are:

Director of Engineering
Project Engineer
Project Manager
QC Manager
Corporate Quality Assurance Manager
Construction Quality Assurance Officer
General Contractor

Documentation of construction and inspection activities associated with the CQA/QC Manual shall consist of construction QA/QC forms, As-Built Drawings, and a Construction Certification Report. All records shall be indexed, identifiable, retrievable and controlled in an established document control system. All construction and testing documentation produced and received for the project shall become a part of the permanent construction record. This includes, but is not limited to, log books, field notes, transcription records, etc. The original documents shall be retained on-site as part of the Mixed Waste operating record with duplicates retained at corporate headquarters or a retrievable off-site archive.

4.2 Records may be corrected or updated when a change is accomplished or reviewed and approved by the originator or by the department manager or supervisor, as indicated on the organizational chart.

Records are corrected by:

- a. lining out the original entry;
- b. entering the correction immediately adjacent to the original entry;
- c. having the individual making the correction initial and date the line-out; obtaining approval initials and dates from the original signatory for the changes; and
- d. all dates are to be the actual dates of the review action being performed.

Records are updated by:

- a. incorporating the additional data;
- b. having the individual incorporating the data initial and date the data adjacent to entry; and
- c. obtaining approval initials and dates from the original signatory for the changes.

Any changes made to the original document subsequent to QC and/or QA review must be reviewed and approved by the QC and/or QA reviewer. The reviewer shall indicate approval of the changes by documenting the review on the corrected original document.

4.3 "White Out" shall not be used to make corrections. Record entries shall not be made by pencil, erasable ink, or any other means of non-permanent marking. When complete, records on pre-printed forms with unused or blank spaces shall be noted to indicate that no further entries to that form or record are needed.

4.4 Access to original construction records is limited to those Permittee employees, excluding outside auditors and regulators, who have a specific need for information therein or as authorized by the CQAM.

4.5 Construction QA/QC Forms

Documentation requirements associated with CQA/QC activities are described in Table 1. The level of detail provided on each individual form shall be sufficient to demonstrate all work elements were conducted in accordance with the requirements described in Table 1. Any non-conforming or suspected non-conforming work and corrective actions to be taken shall also be documented.

Each form shall be signed and dated by the individual completing the form. The signature date shall be the date on which the form was reviewed and approved. Example forms are included in Appendix 2 to this CQA/QC Manual. These forms identify the minimum documentation required. These forms may be revised if the revision does not adversely affect the overall content of the individual form.

4.5.1 Documentation Review

Construction documentation shall be reviewed for completeness, adequacy and correctness at the frequencies specified in the CQA/QC Manual. The results of testing and observations which are out of specification shall be reviewed for acceptance by the Project Engineer.

During construction, the Project Manager is responsible for maintaining and storing copies of all construction QC documentation. The CQAM is responsible for maintaining and storing copies of all QA documentation.

4.5.2 Documentation Approval

Construction compliance is the responsibility of the Permittee. The Permittee shall observe, inspect, and test each lift or work element during active construction. The active construction process is not complete until the approval of each lift or work element is given by the appropriate Permittee field inspection. With the field approval of each lift or work element, the Permittee is documenting compliance with the CQA/QC Manual requirement. If at any time after initial field approval has been granted, the Permittee self-identifies any non-conforming work the following corrective action will be followed. Corrective action options include: repair, rework, reject, or use-as-is. If the work is repaired, reworked, or rejected then the non-conforming work will be considered to be in active construction once again. If the Permittee exercises the use-as-is option, then a supporting technical justification will be documented.

Deficiencies found and corrected during active construction of a lift or work element, prior to field approval, are not a violation of the CQA/QC Manual requirements.

4.6 Drawings

Three distinct terms are applicable to the drawings that affect mixed waste construction.

4.6.1 Permit Drawings

Permit Drawings provide general design requirements for Mixed Waste Landfill Cell construction. The current approved Permit Drawings are found at Attachment II-11, *Facility Drawings*.

4.6.2 Construction Drawings

Construction Drawings provide detailed design for each specific phase of cell construction. Construction Drawings shall be provided to the Executive Secretary no less than 7 calendar days prior to any final shaping of the rough excavation or significant compaction of the foundation.

The Project Engineer shall maintain a master red-lined set of Construction Drawings to track any major or minor changes implemented on the project.

4.6.3 As-Built Drawings

At the completion of construction, As-Built Drawings shall be prepared from the red-lined Construction Drawings. The As-Built Drawings shall incorporate all changes as outlined in the change control procedures in Section 3.0 of this manual. The As-Built Drawings shall include the key survey data of landfill construction.

As-Built Drawings shall be submitted to the Executive Secretary with the Construction Certification Report.

4.6.4 Surveying

A local coordinate system will be used during each phase of construction. The coordinate system 0,0 point shall be clearly identified on the Construction Drawings and As-Built Drawings for each phase. The local coordinate system shall be tied into the state plane coordinate system for section 32 of T1S R11W, SLB&M. The southwest corner of section 32 is the point of beginning. East shall be the positive x direction and north shall be the positive y direction for local coordinate systems.

Surveying will be done on a 50 foot grid and at all key control points. Key control points are those points in addition to the 50 foot grid that are necessary to ensure compliance with the Permit Drawings.

4.7 Test Pad Report

The test pad report shall include a narrative description of construction activities performed, the equipment used, operating procedures, and results. The test pad report shall clearly define construction procedures to be implemented in clay liner construction.

4.8 Construction Certification Report

At the completion of each construction project, a final joint inspection shall be conducted by the Director of Engineering, Construction Quality Assurance Officer, and Executive Secretary.

Completion of construction is defined as the date of the final inspection.

At the completion of each construction project, a Construction Certification Report shall be prepared under the direction of the Director of Engineering. The construction shall be certified by the Director of Engineering as having been performed in accordance with the approved drawings, plans, and specifications. This report shall be submitted to the Executive Secretary within 90 days of completion of each phase of construction. This report shall include, at a minimum, the following items:

- a. A narrative of the work performed by work element;

- b. A summary of all changes, presented in matrix form, which includes the following:
 - the number of the change;
 - a description of the change;
 - the type of change (e.g. to make things fit, to meet a code, substitution of equivalent materials, or a major change approved by the Executive Secretary); and
 - any comments to clarify or explain the change.
- c. QC sampling and testing schedule;
- d. Copies of QC documentation; and
- e. As-Built Drawings.

4.9 Construction QA Review

At the completion of construction, a construction QA review shall be prepared under the direction of the CQAO. The CQAO shall approve this review. The required CQA/QC testing and inspections shall be certified as having been performed in accordance with this CQA/QC Manual. This review shall be included in the Construction Certification Report. This review shall include, as a minimum, the following items:

- a. A narrative of the QA testing and inspections performed;
- b. A summary of all non-conforming work with the corrective actions taken;
- c. QA sampling and testing schedule; and
- d. Copies of QA documentation.

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - GENERAL REQUIREMENTS

<u>SPECIFICATION</u>	<u>QUALITY CONTROL</u>	<u>QUALITY ASSURANCE</u>
1) RUNOFF BERMS: Runoff berms shall be constructed to a minimum height of 3 feet, measured vertically from the centerline of the ditch immediately adjacent to the berm.	Survey the berms at 100-foot intervals and key points.	
2) Berms shall be a minimum of 3 feet wide across the top.		
3) Berms shall be constructed in lifts with an uncompacted thickness of no greater than 12 inches.		
4) Berms shall be compacted to a minimum of 90 percent of a standard proctor.	Conduct in-place density tests (ASTM D 2922) at a rate of one test per lot and record the results on the "Field Density Test" form. A lot is defined as a maximum of 10,000 square feet of a specified type of material. Test locations shall be chosen on the basis of random numbers. a. Approve lots that meet the specified compaction. b. Rework and retest lots not meeting the specified compaction.	
5) BERM MAINTENANCE: Berms shall be surveyed and improved, as required, by July 31 each year.	Survey the berms at 100-foot intervals and key points. Repair any noted damage and fill low spots to meet the design height.	Review the QC documentation to confirm that the berms are surveyed and improved, as required, each spring.

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - GENERAL REQUIREMENTS

SPECIFICATION

QUALITY CONTROL

QUALITY ASSURANCE

6) **MOVING OR BREACHING A BERM:** When moving or breaching a berm, the work must be authorized in advance by the Project Engineer, or designated alternate. A temporary breach of a berm may be accomplished without a temporary berm, provided the work is completed and the berm replaced the same day.

Review the work to be performed. Document the approval to move or breach a berm on the "Breach of Berm" form.

Review the QC documentation to confirm that the approval to move or breach a berm has been properly documented and that temporary breaches of berms are replaced the same day.

7) **NUCLEAR DENSITY/MOISTURE GAUGE CALIBRATION:** Each nuclear density gauge shall have current (annual) manufacturer calibration prior to use on the project.

Ensure that manufacturer's calibration records are on file.

Document that the calibration records are updated and on file.

8) Probe holes in the clay liner and radon barrier created by the nuclear density gauge shall be filled with dry bentonite or with clay liner material. If clay liner material is used, the probe hole shall be roughly conical in shape and the area shall be compacted by at least one pass of heavy equipment prior to placing clay for the next lift. Use of clay liner material to fill probe holes shall be evaluated in a test pad before utilization in liner construction.

Ensure that probe holes are filled.

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - GENERAL REQUIREMENTS

SPECIFICATION

- 9) **SAMPLING LOCATIONS FOR LOTS:** Each lift shall be divided into testing lots of approximately equal area. The lot sample location shall be chosen by random numbers, with the point of reference located in the northwest corner of the lot.
- 10) Stockpiles shall be sampled as a composite sample from at least two separate locations, representative of the portion of the material being sampled. In the case that a visual inspection determines that more than one type of material is present, a representative sample shall be taken for each material type.
- 11) All QA tests shall be performed in the same location as corresponding QC samples. QA tests shall be performed at a different laboratory than QC tests.
- 12) Any failing QC or QA test shall result in a failing lot and initiate rework for the lot.
- 13) **UNSUITABLE MATERIAL:**
 Unsuitable material is defined as non-

QUALITY CONTROL

Generate random numbers for each lot by using a calculator or computer with a random number generator. Locate the test location within five feet of the location specified by the random numbers. In areas where lot geometry is odd-shaped, if the sample location is outside the lot, generate two new random numbers.

Perform the required stockpile sampling.

Record sampling locations.

QUALITY ASSURANCE

Review the QC documentation to confirm that the test locations are being chosen by random number.

Review the QC documentation to confirm that sampling is being done in accordance with specification.

Review correlation between each QA sample and the corresponding QC sample.

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - GENERAL REQUIREMENTS

<u>SPECIFICATION</u>	<u>QUALITY CONTROL</u>	<u>QUALITY ASSURANCE</u>
<p>soil material, contaminated soil (i.e., fuel spills) or soil which cannot be reworked to meet the compaction criteria.</p> <p>14) TEST METHODS: All tests shall be performed in accordance with the standards specified in Appendix 1 to this CQA/QC Manual.</p> <p>15) FORMS: Appendix 2 to this CQA/QC Manual provides examples of forms to be used to document required testing and inspections. Actual documentation may be revised from the example forms, so long as the minimum information is provided.</p> <p>16) ANCHOR TRENCHES: The inside face (the face closest to the centerline of the landfill) of the anchor trench shall be rounded.</p> <p>17) Synthetic materials shall extend at a minimum to the intersection of the base of the anchor trench and the outside face of the anchor trench.</p> <p>18) Seaming of synthetic layers shall</p>	<p>Inspect the completed anchor trenches prior to placement of synthetic materials. Document the condition of the anchor trench on the Daily Construction Report.</p> <p>Inspect synthetic material placement in the anchor trenches prior to backfilling. Document the condition of the anchor trench on the Daily Construction Report. Inform the Project Manager and the Construction QA Officer of any deviations.</p>	<p>Inspect synthetic material placement in the anchor trenches prior to backfilling.</p>

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - GENERAL REQUIREMENTS

<u>SPECIFICATION</u>	<u>QUALITY CONTROL</u>	<u>QUALITY ASSURANCE</u>
<p>extend at a minimum to the intersection of the inside face of the anchor trench and the base of the anchor trench.</p> <p>19) The first lift of the anchor trench shall be backfilled in a 12-inch lift. Subsequent lifts shall be backfilled in six inch lifts. All lifts shall be compacted to a minimum of 90.0% of a standard proctor.</p>	<p>Conduct in-place density tests (ASTM D 2922) at a rate of one test per lift per anchor trench and record the results on the "Field Density Test" form. Test locations shall be chosen on the basis of random numbers.</p> <p style="margin-left: 20px;">a. Approve lots that meet the specified compaction.</p> <p style="margin-left: 20px;">b. Rework and retest lots not meeting the specified compaction.</p>	<p>Verify that the density tests are performed at the correct frequency and that the documentation has been completed correctly.</p>
<p>20) TEMPORARY ANCHOR TRENCHES: Temporary anchor trenches are those between the current phase of construction and projected future cell phases. Temporary anchor trenches shall meet specifications 16, 17, 18 and 19. Temporary anchor trenches shall be backfilled in two-foot lifts. Backfill shall be compacted; however, there is no testing requirement for compaction. Backfill shall be placed at least 5 feet thick above synthetic materials in the base of the temporary anchor trench.</p>	<p>Observe that backfill is compacted. Ensure that the minimum backfill thickness is attained. Document temporary anchor trench construction on the Daily Construction Report.</p>	

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - GENERAL REQUIREMENTS

SPECIFICATION

QUALITY CONTROL

QUALITY ASSURANCE

21) **ARCHIVE SAMPLES:** Archive samples from testing of synthetic materials shall be retained for no less than 3 years from the date of project completion. After this time, archive samples may be discarded.

22) **REQUIRED SUBMITTALS:** Provide the Executive Secretary with the following documentation prior to startup for each phase of liner construction: (1) current GRI or IAGI recommendations for cold and hot weather HDPE liner welding (see specification 78); and (2) manufacturer's instructions for storage of HDPE liner, drainage net, and geotextile (see specifications 64, 104, and 109).

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - FOUNDATION PREPARATION

SPECIFICATION

23) **EXCAVATION:** Excavation shall be made to the grades and dimensions prescribed in the Construction Drawings. Any significant over-excavation (greater than one foot below design elevation) shall be backfilled with native soils or clay liner material in maximum 12 inch loose lifts and compacted to a minimum of 95.0% of a standard proctor. Gross excavation may begin prior to Executive Secretary approval to construct.

24) **COMPACTION:** Compact the foundation to a minimum of 95.0% of a standard proctor.

QUALITY CONTROL

Observe cell excavation at least once per week. Record observations and corrective actions taken (where required) on the "Daily Construction Report".

In areas of over excavation, conduct in-place density tests (ASTM D 2922) for backfill lifts at a rate of one test per lot per area of significant over-excavation and record the results on the "Field Density Test" form. A lot is defined as a maximum of 10,000 square feet of a specified type of material. Test locations shall be chosen on the basis of random numbers.

- a. Approve lots that meet the specified compaction.
- b. Rework and retest lots not meeting the specified compaction.

Conduct in-place density tests (ASTM D 2922) at a rate of one test per lot and record the results on the "Field Density Test" form. A lot is defined as a maximum of 10,000 square feet of a specified type of material. Test locations shall be chosen on the basis of random numbers.

- a. Approve lots that meet the specified compaction.
- b. Rework and retest lots not meeting

QUALITY ASSURANCE

The Quality Assurance review for foundation preparation shall cover each specification in this work element. Review a minimum of 50% of QC documentation and verify that the tests were performed at the correct frequency.

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - FOUNDATION PREPARATION

<u>SPECIFICATION</u>	<u>QUALITY CONTROL</u>	<u>QUALITY ASSURANCE</u>
	the specified compaction.	
	Proctors (ASTM D 698) shall be performed at a rate of one test per 115,000 square feet (or less) for each material type. At least one proctor shall be performed for each material type. Record the location of the sample on the "Sampling Log."	
25) UNSUITABLE MATERIAL: Remove unsuitable material, if any is encountered.	Define areas of unsuitable material and direct its removal. Observe the areas once the unsuitable material has been removed. Report corrective action on the "Daily Construction Report." Notify the Project Manager and QA of any unsuitable material.	Visually inspect the area to confirm unsuitable material has been removed.
26) FINAL GRADING: The foundation surface shall be smooth-drum rolled and moist prior to clay liner placement. The foundation shall be free from surface debris, soft (wet) spots greater than 3 inches deep, and loose soil areas with a loose surface greater than 3 inches deep. Foundation shall be at or below grade.	Survey the foundation on a 50 ft grid and cell centerline and at key points in the sump and pipe trench. Key points are defined as: the north-south centerline of each sump, measured every 50 feet; 6 points per sump leachate removal point; and 3 points per leachate pipe trench. Final survey measurements shall be documented and provided to the Project Manager and Construction QA Officer. <ul style="list-style-type: none"> a. Approve foundation that meets the design specifications. b. Rework and resurvey areas not 	Review the final survey data. Verify the frequency of the survey points.

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - FOUNDATION PREPARATION

<u>SPECIFICATION</u>	<u>QUALITY CONTROL</u>	<u>QUALITY ASSURANCE</u>
	meeting the specified grade.	
27) FOUNDATION APPROVAL: The foundation shall be approved by the Construction QA Officer. Provide a copy of the “Notice of Acceptance” to the Executive Secretary.	Obtain the “Notice of Acceptance” from the Construction QA Officer before construction of the clay liner begins.	Provide a “Notice of Acceptance” to the Project Manager. Verify that a copy of the “Notice of Acceptance” has been provided to the Executive Secretary.

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - CLAY LINER MATERIAL SPECIFICATIONS

SPECIFICATION

28) CLEARING AND GRUBBING:

Remove vegetation, debris, organic, or unsuitable material from areas to be used for borrow. Grubbing depth shall depend on the type of vegetation, debris, organic, or unsuitable material on the site. If the area is free of these materials then no clearing and grubbing is necessary.

29) MATERIAL: Satisfactory material shall be defined as CL, ML, or CL-ML soils based on the Unified Soil Classification with a plasticity index (PI) between 10 and 25 and a liquid limit (LL) between 30 and 50. The clay shall also have a dry clod size less than 1 inch.

30) PROCESSING: The following procedure may be used to provide

QUALITY CONTROL

Inspect and photograph the area once clearing and grubbing has been completed. Record observation and corrective actions on the "Daily Construction Report." Attach a copy of the photo to the Daily Construction Report. Keep original photographs in the appropriate QC file.

Perform laboratory classification tests (ASTM D 2487) and a standard proctor (ASTM D 698) at a rate of 1 test per lot prior to approving the material for the clay liner. If deflocculant is added in accordance with specification 29, proctor testing shall be conducted after processing. A lot is defined as 3,000 cubic yards (minimum 2 per sump) of specified material. Record the location of the proctor and classification sample on the "Sampling Log."

- a. Approve lots that meet the specified classification.
- b. Lots not meeting the specified classification shall be reworked and retested or removed.

QUALITY ASSURANCE

The Quality Assurance review for clay liner material specifications shall cover each specification in this work element. Review a minimum of 50% of the QC documentation and verify that the tests were performed at the correct frequency.

Perform a minimum of one QA classification test.

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - CLAY LINER MATERIAL SPECIFICATIONS

<u>SPECIFICATION</u>	<u>QUALITY CONTROL</u>	<u>QUALITY ASSURANCE</u>
<p>suitable material for construction of clay liner, as determined by a successful test pad.</p>		
<p>31) 1. Apply deflocculant at a minimum rate of 3.5 pounds per 50 cubic feet.</p>	<p>Measure the mixing areas and verify the deflocculant application rate. Record the size of the mixing areas and the amount of deflocculant applied on the "Daily Construction Report."</p>	
<p>32) 2. Mix the deflocculant thoroughly into the soils by tilling or similar action.</p>	<p>Observe the mixed clay and advise the contractor of areas which are adequately mixed.</p>	
<p>33) 3. Remove clumps or clods in excess of 1" in diameter.</p>	<p>Inspect the mixed clay following the mixing process.</p>	
<p>34) DEFLOCCULANT: If used, deflocculant shall be sodium tripolyphosphate or equivalent.</p>		

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - CLAY LINER TEST PAD

<u>SPECIFICATION</u>	<u>QUALITY CONTROL</u>	<u>QUALITY ASSURANCE</u>
<p>35) NOTICE OF TEST PAD CONSTRUCTION: The test pad plan shall be provided to the Executive Secretary at least 10 working days before test pad construction. The Executive Secretary shall be notified 24-hours in advance of the start-up of test pad construction.</p>		<p>Verify that the Executive Secretary has been notified of the start-up of test pad construction.</p>
<p>36) TEST PAD: An approximately 60 foot by 75 foot large test pad shall be constructed using the procedure, materials, and equipment proposed for construction of the clay liner. Prior to use of manually operated compaction equipment, an approximately 5 foot by 5 foot (or other size appropriate to the small equipment used) small test pad shall be constructed using the procedure, materials and equipment proposed for construction. If manually operated compaction equipment is not used on the project, the small test pad is not required.</p>	<p>Daily, observe the construction of test pads. Measure test pads to ensure that they are constructed to the size indicated and in accordance with the Test Pad Plan. Record the test pad sizes and compliance observations on the "Daily Construction Report."</p>	<p>Daily, observe the construction of the test pads. The Quality Assurance review for clay liner test pad specifications shall cover each specification in this work element. Review a minimum of 50% of the QC documentation and verify that the tests were performed according to the plan requirements.</p>
<p>37) A new test pad shall be constructed each time there is a major change (as defined in Section 3.0 of this CQA Plan) in specifications, construction</p>	<p>The large test pad shall be divided into three lots per lift.</p> <p>Each lift of the small test pad shall equal</p>	

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - CLAY LINER TEST PAD

<u>SPECIFICATION</u>	<u>QUALITY CONTROL</u>	<u>QUALITY ASSURANCE</u>
<p>procedures, types of equipment, unified soil classification, or more than one year has passed since construction of the last test pad.</p>	<p>a lot.</p>	
<p>38) Test pads are to be constructed and tested as follows:</p> <ol style="list-style-type: none"> 1. Place the clay in at least three lifts with a loose material thickness not exceeding twelve inches for the first lift and nine inches for each subsequent lift. A fourth lift shall be constructed if deflocculant is tilled into the clay on the test pad. A fourth lift is not required if deflocculant is tilled into the clay in separate stockpiles. Thickness for the lift shall be established by installing grade poles on the four corners and in the center of the test pad. The grade poles shall not be installed deeper than 1 inch into the underlying clay liner. After the lift thickness has been approved by QC, the grade poles shall be removed. Grade poles shall be numbered and accounted for after removal to ensure that all grade poles have been removed. 	<p>Verify that the required lift thickness is achieved as follows:</p> <ol style="list-style-type: none"> a. Ensure that the required frequency for placement of grade poles has been met. b. Compare soil level with the marked level on the grade poles. c. Use a string line where necessary between poles to check for high spots. d. Define out of specification areas and direct the contractor to rework those areas. e. Review areas reworked and approve areas meeting criteria. f. Continue "b" through "d" above until all areas meet criteria. g. Indicate areas meeting criteria in the "Daily Construction Reports." 	<p>Perform a minimum of 1 visual inspection per test pad.</p>
OR	OR	
<p>Survey to determine lift thickness.</p>	<ol style="list-style-type: none"> a. Verify equipment calibration, b. Verify correct set-up and operation 	

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - CLAY LINER TEST PAD

<u>SPECIFICATION</u>	<u>QUALITY CONTROL</u> of equipment.	<u>QUALITY ASSURANCE</u>
39)2. The clay shall be compacted by equipment proposed for use during construction of the clay liner. There shall be a minimum of 4 passes by an appropriate compactor.	Record type of equipment used, and number of passes on the "Daily Construction Report."	Perform a minimum of 1 visual inspection per test pad.
40)3. A minimum of one pass shall be made with a sheepsfoot or other surface scarification equipment prior to placement of the subsequent lift.	Document equipment used and number of passes on the "Daily Construction Report."	
41)4. The clay shall be compacted to at least 95.0% of a Standard Proctor with a moisture content of optimum to 5 percentage points above optimum.	Conduct in-place density (ASTM D 2922) and dryback moisture content (ASTM D 4643 or D 4959) tests at a rate of three tests per lot. The test location shall be chosen on the basis of random numbers within each lot. Record test results on the "Field Density Test" form. <ul style="list-style-type: none"> a. Approve lots that meet the specified moisture and compaction. b. Rework and retest lots not meeting the specified moisture or compaction. c. Any additional work under b. shall be included in the Test Pad construction method. 	Perform a minimum of 1 QA correlation test.
42)5. Clay liner shall have in-place permeability of no more than 1.0 x	Conduct in-place permeability tests (Appendix 1) at a rate of one test per lot	Perform a minimum of 1 QA correlation test.

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - CLAY LINER TEST PAD

SPECIFICATION

10^{-7} cm/sec. Permeability testing on the bottom lift will be performed at the lift surface. Permeability testing on the second lift will be performed $\geq 2''$ below the lift surface. Permeability testing on the third lift will be performed $\geq 4''$ below the lift surface.

43) 6. At the completion of each lift of the test pad, a thin-walled tube sample shall be taken in close proximity to one field permeability test per lift for laboratory permeability testing (ASTM D 5084). If the test pad is otherwise approved by the Director of Engineering, clay liner placement may begin prior to receipt of laboratory permeability test results.

44) 6. The procedures used to construct

QUALITY CONTROL

per lift. The permeability test shall be run in close proximity to the moisture-density test for each lot. Record the test result on the "Field Permeability Test" form.

- a. Approve each lift if all lots meet the required permeability.
- b. Rework and retest lots not meeting the specified moisture or compaction.
- c. Any additional work under b. shall be included in the Test Pad construction method. If different construction techniques or levels of compactive effort are required to meet this specification, the test pad report shall require the most rigorous construction method for clay liner placement.

The Project Engineer shall review laboratory permeability results against field test results. If any laboratory permeability test results indicate clay liner may not have met specification 41, the Project Engineer shall evaluate potential causes and document this evaluation.

Provide the Director of Engineering with

QUALITY ASSURANCE

Verify that approval has been obtained

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - CLAY LINER TEST PAD

SPECIFICATION

successful test pads shall be reviewed and approved by the Director of Engineering, with concurrence by the CQAO.

45) 7. The approved test pad report shall be submitted to the Executive Secretary prior to construction using the test pad method.

QUALITY CONTROL

copies of the test pad documentation for review and approval.

QUALITY ASSURANCE

for the test pad from the Director of Engineering. Review and approve the test pad report. Verify that the necessary construction procedure documents are on the job site for use during clay liner construction.

Verify that the test pad report has been submitted to the Executive Secretary.

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – CLAY LINER PLACEMENT

<u>SPECIFICATION</u>	<u>QUALITY CONTROL</u>	<u>QUALITY ASSURANCE</u>
46) LIFT IDENTIFICATION: Each lot and lift shall be given a discrete designation for testing purposes.	Assign a lift identification number to each lift. Use the lift identification number to identify all paper work for that lift.	
47) PLACEMENT: The clay liner shall be compacted using the same type of equipment and compacting procedures that were approved in the test pad(s).	Daily, observe the clay liner placement. Record the equipment used to place the clay liner, along with any corrective actions taken (where required) on the "Daily Construction Report."	
48) LIFT BONDING: Clay lifts shall be constructed in accordance with the approved test pad report(s), to assure roughened surfaces for lift bonding.	Verify that the surface of the previously compacted clay liner lift has been roughened as required. Record observations on the "Daily Construction Report."	The Quality Assurance review for clay liner specifications shall be applied to each specification in this work element. Review a minimum of 50% of the QC documentation and verify that the tests were performed at the correct frequency.
49) LIFT THICKNESS: The first lift of uncompacted material shall be no greater than 12 inches. For the remaining lifts, the loose lift thickness shall not exceed the lesser of the minimum lift thickness used to construct the test pad or nine inches. Thickness for the lift shall be established by installing grade poles on at least a 50-foot grid, center line of the sump, and at all key control points. The grade poles shall not be installed deeper than 1 inch into the	Verify that the required lift thickness is achieved as follows: a. Ensure that the required frequency for placement of grade poles has been met. b. Compare soil level with the marked level on the grade poles. c. Use a string line where necessary between poles to check for high spots. d. Define out of specification areas and advise the contractor to rework those areas. e. Review areas reworked and approve	Perform a minimum of 1 visual inspection per lift per sump.

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – CLAY LINER PLACEMENT

<u>SPECIFICATION</u>	<u>QUALITY CONTROL</u>	<u>QUALITY ASSURANCE</u>
<p>underlying clay liner. After the lift thickness has been approved by QC, the grade poles shall be removed. Grade poles shall be numbered and accounted for after removal to ensure that all grade poles have been removed.</p> <p style="text-align: center;">OR</p> <p>Survey to determine lift thickness.</p>	<p>areas meeting criteria.</p> <p>f. Continue "b" through "d" above until all areas meet criteria.</p> <p>g. Indicate areas meeting criteria in the "Daily Construction Reports."</p> <p style="text-align: center;">OR</p> <p>a. Verify equipment calibration, b. Verify correct set-up and operation of equipment.</p>	
<p>50) COMPACTION: Clay liner material shall be compacted to at least 95.0% of a standard Proctor with moisture content between optimum and 5.0 percentage points over optimum.</p>	<p>Conduct in-place density (ASTM D 2922) and dryback moisture content (ASTM D 4643 or D 4959) tests at a rate of one test per lot and record the results on the "Field Density Test" form. A lot is defined as 200 cubic yards (compacted) of a single lift. The test location shall be chosen on the basis of random numbers within each lot.</p> <p>a. Approve lots that meet the specified moisture and compaction. b. Rework and retest lots not meeting the specified moisture or compaction until the lot is approved.</p>	<p>Perform a minimum of 1 QA correlation test per lift per sump.</p>
<p>51) PERMEABILITY: Clay liner shall have in-place permeability of no more than 1.0×10^{-7} cm/sec.</p>	<p>Conduct in-place permeability tests (Appendix 1) at a rate of one test per lot and record the results on the "Field Permeability Test" form. A lot is defined</p>	<p>Visually observe 1 in-place permeability test per sump.</p>

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – CLAY LINER PLACEMENT

<u>SPECIFICATION</u>	<u>QUALITY CONTROL</u>	<u>QUALITY ASSURANCE</u>
	<p>as 1,000 cubic yards of compacted clay liner. The permeability test shall be performed adjacent to one of the density tests in the permeability lot.</p> <p>a. Approve lots that meet the specified permeability.</p> <p>b. Rework and retest lots not meeting the specified permeability until the lot is approved. If rework involves adding compactive effort only, density tests do not need to be repeated. If rework involves ripping and recompacting, new density tests shall be performed.</p>	
<p>52) LINER DRYING PREVENTION: To prevent the clay liner from drying, water shall be applied to the clay surface on an as needed basis or the liner shall be covered.</p>	<p>Regularly observe the liner surface for drying. Advise contractor of deficiencies. Record corrective actions taken (where required) on the "Daily Construction Report."</p>	
<p>53) FROZEN MATERIAL: Clay liner shall not be placed above frozen material. In addition, no frozen material shall be processed or placed. If the air temperature has dropped below 32°F since clay liner was last worked, one of the following scenarios apply: (1) The last lift of clay liner shall be covered overnight (no longer than 24 hours) with at least 9 inches of loose clay, and this loose</p>	<p>As needed, observe the area where clay liner is to be placed. If frozen material is observed, cease placement of clay liner. Record the stopping of placement in the "Daily Construction Report." Monitor liner/foundation temperature each day when ambient temperatures have fallen below 32°F. Temperature shall be taken between 6:00 am and 8:00 am. Temperature measurements shall include a location that is most likely to be coldest;</p>	

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – CLAY LINER PLACEMENT

SPECIFICATION

clay shall have compactive effort applied the next day; or (2) Monitor the liner/foundation temperature approximately 1 inch beneath the surface. If the temperature 1 inch beneath the surface is greater than 27°F, re-roll the surface with one pass of the same type of construction equipment (i.e., a compactor for intermediate lifts or a smooth drum roller for the final surface) and continue with liner construction. If the temperature 1 inch beneath the surface is less than or equal to 27°F, re-work and re-test the affected area. If neither scenario (1) nor (2) above is completed, perform spring start-up testing in accordance with specification 54.

54) **SPRING START-UP:** When clay liner is not covered with at least 2 layers of HDPE liner and the clay temperature is not monitored in accordance with specification 53, spring start-up testing is required. If clay liner is covered with at least 2 layers of HDPE liner for more than 30 days, the ambient temperature has dropped below 13°F, and the clay temperature is not monitored in

QUALITY CONTROL

i.e., if there is a portion of the liner that is shaded or at a low point. Temperature monitoring frequency shall be at least one point per sump.

If the initial temperature measurement is less than or equal to 27°F, the affected sump may be resampled before 8:30 am the same day as follows:

- a. Measure the liner/foundation temperature at a frequency of one measurement per lot. Lots shall be as defined for project permeability measurements in accordance with specification 51.
- b. Lots where the temperature is greater than 27°F do not require rework; except that the lot where the initial temperature less than or equal to 27°F was measured shall be reworked regardless of resampling results.

Perform density and permeability testing in accordance with specifications 50 and 51. Moisture testing is not required for spring start-up.

- a. Approve lots that meet specification. The protective cover lift may be worked in place and tested.
- b. For lots that do not meet specification,

QUALITY ASSURANCE

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – CLAY LINER PLACEMENT

SPECIFICATION

accordance with specification 53, spring start-up testing is required. If clay liner is covered with at least 2 layers of HDPE liner for more than 30 days and the clay temperature is monitored to remain greater than 27°F, neither re-rolling the lift surface nor spring start-up testing is required. If the clay liner is covered with at least one layer of 60 mil HDPE liner for up to 15 days and the clay temperature is monitored to remain greater than 27°F, neither re-rolling the clay surface nor spring start-up testing is required. If clay liner is covered with at least 2 layers of HDPE liner for more than 30 days and the clay temperature is monitored to be less than or equal to 27°F, spring start-up testing is required. For spring start-up testing, the surface lift is assumed to be protective cover. Excavate to the last approved lift surface and re-test for density and permeability. Excavation for testing purposes may consist of removal of the protective cover lift; or may be performed by ‘potholing’ only at the testing locations. Areas that have been ‘potholed’ for permeability testing shall be repaired by applying the same

QUALITY CONTROL

remove the protective cover lift; test the surface of successively lower lifts until a passing lift is found; re-work all failing lots; and re-test.

Document that repairs are completed to the same level of effort as required by the approved test pad for clay liner construction.

QUALITY ASSURANCE

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – CLAY LINER PLACEMENT

<u>SPECIFICATION</u>	<u>QUALITY CONTROL</u>	<u>QUALITY ASSURANCE</u>
level of effort as prescribed by the approved test pad for liner construction.		
55) UNSUITABLE MATERIAL: Remove unsuitable material, if any is encountered.	Define areas of unsuitable material and direct its removal. Observe the areas once the unsuitable material has been removed. Report corrective action on the "Daily Construction Report." Notify the Project Manager and QA of any unsuitable material.	Visually inspect the area to confirm unsuitable material has been removed.
56) FINAL GRADING: Final grading shall be from grade to 0.2 feet above grade.	Survey the clay liner surface on a 50 ft grid, at the sump centerline, and at key control points. Final survey measurements shall be documented and provided to the Project Manager and Construction QA Officer. a. Indicate where the clay liner meets design lines and grades. b. Rework and resurvey areas not meeting the specified grade until the area is approved.	Review the final survey data. Verify the elevations and frequency of the survey points.
57) EXECUTIVE SECRETARY INSPECTION: Prior to the Executive Secretary inspection, all applicable records must be complete and available to the Executive Secretary's Inspector. The Executive Secretary shall inspect completed clay	Notify the Project Manager and QA that the clay liner is prepared and ready for inspection. Obtain written authorization from the Executive Secretary indicating that the clay liner has been inspected; or, if applicable, that the inspection has been waived.	Inspect and approve the clay liner surface. Document approval on the "Liner Inspection Form." Accompany the Executive Secretary inspection.

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – CLAY LINER PLACEMENT

<u>SPECIFICATION</u>	<u>QUALITY CONTROL</u>	<u>QUALITY ASSURANCE</u>
<p>liner prior to covering. The Executive Secretary shall be notified at least 24 hours prior to deployment of HDPE liner. The Executive Secretary may, at their discretion, waive the liner inspection.</p>		
<p>58) CLAY LINER KEYING-IN: Segments of clay liner constructed at times more than 30 days apart from each other shall be keyed-in to each other at vertical steps no greater than nine inches and at least two feet wide. The vertical steps shall not be on a 90-degree angle. The lifts of clay shall be bonded by providing a roughened surface of the previously constructed clay liner lift to promote good bonding between the new and old lifts. The surface does not require scarification if the surface is already rough at the end of compaction of a lift. When scarification is necessary, the surface should be roughened to a depth of approximately one (1) inch.</p>	<p>Verify that the new liner has been properly keyed-in to the existing liner. Record deficiencies on the "Daily Construction Report."</p>	<p>Verify that the keying-in of the liner has been documented. Visually observe at least one key-in.</p>

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - HDPE LINER

SPECIFICATION

59) **LINER**

SURFACE

PREPARATION: Final grading and finishing efforts on the surface of the clay liner shall leave the surface free of sharp objects and unsuitable material. The surface of the completed clay liner shall be generally regular (i.e. \leq a one inch vertical drop). The surface shall be smooth drum rolled. Rocks or other hard objects on the surface that are greater than 1/2 inch shall be removed. In addition, any angular rocks that can be seen protruding from the surface shall be removed. Voids greater than 1/2" deep from the removal of rocks or unsuitable material shall be filled with clay liner material. The liner shall be free from soft (wet) spots greater than 3 inches deep, and loose soil areas with a loose surface greater than 3 inches deep. Desiccation cracks larger than one-fourth inch wide and one inch deep shall be filled with clay liner material or dry powdered bentonite. If clay liner material is used to fill desiccation cracks, the crack shall be dug out to be at least as wide as it is deep, filled, and compacted with at least one pass of heavy equipment.

QUALITY CONTROL

The QC personnel of the Synthetics Contractor shall observe and approve, in writing, the surfaces which form the subgrade for the HDPE liners.

QUALITY ASSURANCE

Verify that an approval, in writing, has been obtained from the Synthetics Contractor.

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - HDPE LINER

<u>SPECIFICATION</u>	<u>QUALITY CONTROL</u>	<u>QUALITY ASSURANCE</u>
60) Photograph the clay liner surface immediately prior to deployment of the HDPE liner material.	Photograph the clay liner surface.	Verify that a photographic record has been obtained prior to deployment of the HDPE liner material.
61) CERTIFICATION REQUIREMENTS: Prior to HDPE liner installation, QA and QC personnel shall review and approve:		
62) 1. <u>Quality Control Certificates:</u> Each roll of liner shall have a unique identification number. QC certificates shall be provided for the properties and frequencies specified in Appendix 3 to this CQA/QC Manual. Liner whose certificates indicate material which does not meet specification shall be marked conspicuously and removed from the construction area.	Review liner certificates. Forward acceptable liner certificates to QA for approval.	Review QC certificates prior to allowing liner to be deployed. Document approval of each roll of HDPE liner on the "HDPE Liner Roll Approval Form." Document approval of polymer raw material on the "Polymer Raw Material Approval Form." Provide copies of these forms to QC personnel.
63) 2. <u>Welding Rod Certification:</u> The welding rod manufacturer shall provide certification that the rod is of the same polymer as the sheet.	Review welding rod certificates. Forward acceptable welding rod certificates to QA for approval.	Document approval of the welding rod on the "Welding Rod Approval Form." Provide copies to QC personnel.
64) MANAGEMENT OF HDPE LINER AND WELDING ROD: HDPE liner and welding rod shall be stored in accordance with the manufacturer's instructions for	Ensure that nonconforming liner materials or welding rod are not used on the project: a. Together with QA personnel, observe the condition of each roll of HDPE liner	Ensure that nonconforming liner materials or welding rod are not used on the project: a. Together with QC personnel, observe the condition of the HDPE liner and

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - HDPE LINER

SPECIFICATION

protection from temperature extremes, weather, and other potential damaging conditions. Provide copies of the manufacturer's instructions to QC and QA personnel.

QUALITY CONTROL

- and welding rod.
- b. Ensure the mil thickness is marked conspicuously on each roll of liner.
 - c. Mark conspicuously any rolls of liner or welding rod that based on observation or measurement do not conform to the specifications and/or appear to be damaged, and remove them from the construction area.
 - d. Ensure that each roll of liner has been accepted by QA prior to allowing it to be deployed by comparing the "HDPE Liner Roll Approval Form" with the rolls of liners.
 - e. Document deployment of the accepted rolls on the "Panel Inspection Form."
 - f. Ensure that each roll or package of welding rod has been accepted by QA prior to allowing it to be used by comparing the "Welding Rod Approval Form" with the rolls or packages of welding rod as they are opened or prepared for use.

QUALITY ASSURANCE

- welding rod.
- b. Observe that the mil thickness is marked conspicuously on each roll of liner.
 - c. Compare the rolls of liners deployed with the rolls designated for acceptance.

65) LINER PLACEMENT: Prior to installation, the Synthetics Contractor shall provide a panel layout plan. The plan shall minimize the number of seams that run parallel to the toe of the side slopes within a distance of

Provide a copy of the approved panel layout plan to the Executive Secretary.

Review and approve the panel layout plan.

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - HDPE LINER

<u>SPECIFICATION</u>	<u>QUALITY CONTROL</u>	<u>QUALITY ASSURANCE</u>
<p>five feet from the toe and minimize the number and length of seams in high stress areas of the sump. The HDPE panels shall be placed such that the up-slope panel overlaps the down-slope panel. The panel layout plan shall be reviewed and approved by the Construction Quality Assurance Officer.</p>		
<p>66) To minimize the risk of damage by wind uplift during liner placement, HDPE liner panels shall be secured using sand bags, or other means which will not damage the liner.</p>	<p>Observe that the liner is adequately loaded to prevent wind uplift.</p>	<p>Verify that QC personnel have inspected the liner panels to ensure adequate loading to prevent wind uplift.</p>
<p>67) Liner material shall not be placed when wind speeds exceed 20 mph; or as provided in accordance with the manufacturer's recommendations, whichever is more restrictive.</p>	<p>Ensure liner material is not placed during high winds.</p>	
<p>68) The liner is to be placed as closely as practical to the panel layout plan. The Project Engineer shall approve all changes to the panel layout plan. Copies of the approved changes to the panel layout plan shall be forwarded to the Executive Secretary. The as-built drawing shall reflect modifications to the panel layout</p>	<p>Observe that the liner is placed in accordance with the approved panel layout plan.</p>	<p>Verify that the liner is placed in accordance with the approved panel layout plan. Verify that the Project Engineer has approved changes to the panel layout plan.</p>

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - HDPE LINER

<u>SPECIFICATION</u>	<u>QUALITY CONTROL</u>	<u>QUALITY ASSURANCE</u>
plan.		
69) Rolls are to be inspected as they are unwound for holes, blisters, thin spots, undispersed raw materials, or any signs of contamination by foreign material. All defects shall be repaired in accordance with specification 86.	Observe the liner, as the rolls are unwound. Mark the roll number conspicuously on the panel and then more closely inspect the panel for defects. Mark defective areas found for repair or removal. Record results of inspection on the "Panel Inspection Form." Record that defective areas were repaired on the same form. Review results with the Construction QA Officer.	Observe the rolls as they are unwound.
70) WELDING: Field welding is to be accomplished by either the fusion method or the extrusion welding method.	Provide certification that the testing equipment has been calibrated within the past year.	
71) Prior to any welding (with either method) at the beginning of the shift and after lunch or dinner breaks, a pre-weld test shall be run for each technician/equipment combination.	Perform pre-weld testing and record results on "Welding Machine Operation Log" form. Ensure problems are corrected and actions taken to correct problems are recorded on the above indicated form. Record the starting and stopping times associated with the operation of each welding machine on the above indicated form. Ensure that the welding machines remain energized (on) with power available throughout the period of welding. If	Observe pre-weld testing. Review results recorded on the "Welding Machine Operation Log" form for accuracy and completeness. Ensure problems are corrected and actions taken to correct problems are recorded. Report deficiencies (if any) to QC personnel and the Construction QA Officer.

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - HDPE LINER

SPECIFICATION

QUALITY CONTROL

QUALITY ASSURANCE

power becomes unavailable or the machine is turned off or otherwise is allowed to cool, another pre-weld certification test must be run.

72) In the case of extrusion welding, 6 coupons shall be taken after cooling. 3 coupons shall be tested for shear, and 3 for peel.

73) In the case of the fusion method, 6 coupons shall be taken after cooling. 3 coupons shall be tested for shear. The inner and outer seams of the remaining 3 coupons shall each be tested for peel. The inner seam is the seam which cannot be seen from the top surface of the liner.

74) In addition, at the discretion of the Construction QA Officer, a pre-weld test may be required prior to welding key seams.

75) If any pre-weld test fails, then an additional pre-weld sample shall be made and tested. After any second pre-weld test failure, two consecutive pre-weld samples must be made, tested and have passing results before that particular technician/equipment

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - HDPE LINER

<u>SPECIFICATION</u>	<u>QUALITY CONTROL</u>	<u>QUALITY ASSURANCE</u>
is put into production welding.		
76) If an extrudate welding unit has not been used for more than 15 minutes, the unit shall be run until overheated extrudate is removed prior to seaming.		
77) Seams shall be clean, dry, and have adequate overlap (minimum 3 inches for extrusion welding; 4 inches for fusion welding) prior to welding.	Observe all seams immediately prior to welding to ensure compliance with the specifications. Verify that corrective action has been taken (where required) and record observations on the "Seam Inspection Form".	Randomly, observe seams prior to welding to ensure compliance with the specifications. Review QC documentation of welding. Report deficiencies (if any) to QC personnel and the Construction QA Officer. Review results with Construction QA Officer.
78) <u>Welding under temperature extremes:</u> At liner temperatures below 32° F or above 106° F, current Geosynthetic Research Institute (GRI) or International Association of Geosynthetic Installers (IAGI) recommendations for cold weather or hot weather welding, respectively, shall be followed.	Record liner temperature at the beginning and end of seaming activities for each shift. Advise welding personnel of applicable GRI or IAGI recommendations. Document implementation of applicable recommendations on the "Seam Inspection Form."	Observe field implementation of applicable GRI or IAGI recommendations.
79) <u>Grinding:</u> Care shall be exercised such that excessive grinding of the liner does not occur as part of the extrusion welding technique. Excessive grinding is defined as one	Observe the full length of each seam welded by the extrusion welding technique for excessive grinding. Ensure that corrective actions (where required) are accomplished and record observations	Observe the full length of each extrusion welded seam for excessive grinding. Report deficiencies (if any) to QC personnel and the Construction QA Officer. Verify that corrective action has

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - HDPE LINER

SPECIFICATION

fourth inch (1/4) or more of grind marks showing after the weld is in place, or in the opinion of QA personnel any exposed grind marks that are sufficiently deep to be 10% or greater of the liner nominal thickness. In the event that excessive grinding takes place, then the seam in that area shall be considered defective, and a cap bead shall be placed over the entire seam where the excessive grinding is observed. A cap bead is defined as one additional welding bead parallel to the seam weld, as long as the additional welding bead covers the area of excess grinding. If the additional welding bead does not cover the area of excessive grinding, then a liner cap shall be placed over that portion of the seam where the welding bead does not cover the area of excessive grinding.

80) Non-Destructive Seam Testing:
 Where practicable, production welding using the fusion method shall be tested using the "Seam Air Pressure Test." All fusion seams not tested by the "Seam Air Pressure Test" (ASTM D 5820) and all seams

QUALITY CONTROL

on the "Seam Inspection Form."

Perform the non-destructive testing and document the results of the non-destructive seam testing on the "Seam Inspection Form."

Should a seam fail the seam air pressure test, the seam may be inspected for leaks,

QUALITY ASSURANCE

been taken (where required).

Observe the test. Verify that failing seams are repaired in accordance with specification 86. Review daily the "Seam Inspection Form".

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - HDPE LINER

SPECIFICATION

welded by the extrusion method shall be tested by the "Vacuum Test" (ASTM D 5641). The seam also may be divided into sections and each section tested separately.

81) Destructive Seam Testing: The installed liner shall be destructively tested. One sample for destructive testing shall be cut from seams at a rate of one test for every 500 feet. QA personnel shall determine the location of the samples. As near as practical, samples shall be located near the start or end of seams. Samples shall be approximately 36 inches long by 12 inches wide, with the seam roughly centered in the 12 inch dimension, and numbered to allow traceability. Sample locations and numbers shall be included on the as-built drawings.

82) The pass/fail criteria for destructive testing shall follow the guidelines below:

83) Test Criterion for Production Seams and HDPE Liner Tie-Ins: Film Tear Bond (FTB) and meet the minimum specified values in the Required HDPE Liner Seam Properties table

QUALITY CONTROL

by soaping and pressurizing the seam and checking for bubbles. Any leaks found may be sealed by extrusion welding and the seam retested.

Obtain samples for destructive testing (ASTM D 6392 or ASTM D 4437) at the intervals indicated. Number and then remove each destructive test sampled. Record sampling locations on the "Seam Inspection Form". Document the test results on the "Destructive Testing" form. Divide the sample into three approximately 12 inch x 12 inch samples, one of which is to be tested by QC personnel on-site using a calibrated tensiometer. The remaining 2 samples shall be provided to QA. Provide sample locations and numbers to the Project Engineer for inclusion on the as-built drawings.

Perform field peel and shear testing (ASTM D 6392) on coupons taken from the destructive samples noted above. Record the results of the field testing on the "Destructive Testing" form. When the laboratory test results are received, attach the results of the laboratory testing to the same form. If either a field or laboratory sample fails the destructive

QUALITY ASSURANCE

Notify QC of destructive sampling locations. Review daily the "Seam Inspection" and "Destructive Testing" forms prepared by QC personnel. Resolve any discrepancies with QC personnel. Send one sample to an approved laboratory for peel and shear testing. Archive one sample as directed by the Construction QA Officer.

Observe the field peel and shear testing conducted by QC personnel. Determine based on the pass/fail criteria whether or not the field peel and shear tests have passed or failed. Review the "Destructive Testing" form to ensure that the results are immediately and accurately recorded.

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - HDPE LINER

SPECIFICATION

found in Appendix 3 to this CQA/QC Manual. Yield in the sheet material or breaks at the seam edges are considered FTB.

84) The criterion for field testing of peel and shear is FTB. Partial peel failures of $\leq 10\%$ are acceptable if the primary mode of failure is FTB.

85) Should tie-in testing between new HDPE liner and HDPE placed in previous phases of construction fail to meet the test criteria, 3 samples of the old sheet shall be sent to an off-site laboratory to determine the key sheet strength properties of the old HDPE liner. The average values of the key sheet strength properties for the old HDPE liner shall then be used to establish acceptance criteria for HDPE liner seam properties. Shear strength shall be at least 90 percent of the tensile strength at yield. Peel strength shall be at least 60 percent of the tensile strength at yield.

86) LINER REPAIRS:

87) Definitions: A “cap” is a liner repair that crosses 2 or more panels. A “patch” is a liner repair within a

QUALITY CONTROL

testing then the entire length of the seam from which the destructive sample has been taken shall be repaired in accordance with specification 86. Alternatively, the area of the defective seam may be isolated by the following procedure:

a. Two destructive test samples shall be taken from the same seam at least 10 feet from each side of the original sample. These coupons shall be field tested for peel and shear.

b. If any one of those coupons fail to meet the passing criteria, then the entire seam must be capped in accordance with specification 86.

Perform vacuum tests (ASTM D 5641) on the seams of all patches, caps, and beads. Where defective results are obtained; require, verify, and record that

QUALITY ASSURANCE

Ensure that the destructive testing is completed in accordance with specification. Accompany QC personnel and designate required repairs or additional sampling locations. Review daily the "Destructive Testing" form prepared by QC personnel. Resolve any discrepancies with QC personnel.

Compare laboratory testing results with the acceptance criteria to ensure that the welds met the criteria. Review the above indicated forms to ensure that laboratory results have been recorded. Ensure that areas with failing test results are repaired in accordance with the specifications.

Inspect caps and patches prior to welding. Observe seams for excessive grinding. Observe the vacuum testing performed by QC personnel. Where

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - HDPE LINER

SPECIFICATION

- single panel.
- 88) 1. Holes: Any penetration of the HDPE membrane shall be repaired by capping or patching the area with a HDPE liner cap or patch. The cap or patch shall be vacuum tested. Note: scrapes/scratches that do not penetrate liner may be repaired with an extrusion weld bead that completely covers the defect.
- 89) 2. Failed Extrusion Welded Seams: Extrusion welded seams which fail non-destructive or destructive field or laboratory testing shall be repaired by capping the seam. Seam caps shall be circular or oval in shape, be of the same HDPE material as the liner, and extend a minimum of six inches over the edge of the area to be capped. The corners of the patches shall have a radius of not less than three inches. Caps shall be extrusion welded and the welds shall be vacuum tested.
- 90) 3. Failed Fusion Seams: Fusion seams which fail non-destructive or destructive field or laboratory testing must be repaired by a) welding the edge of the top liner to the bottom liner using the extrusion method provided the overlap is at least one inch, or b) the seam may be capped as

QUALITY CONTROL

seams are repaired and retested. Record results on the liner sheet adjacent to the cap or patch. Record and document observations on the "Seam Inspection Form."

QUALITY ASSURANCE

defective results are obtained, require and verify that seams are repaired and retested. Review results with the Construction QA Officer.

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - HDPE LINER

<u>SPECIFICATION</u>	<u>QUALITY CONTROL</u>	<u>QUALITY ASSURANCE</u>
<p>specified under "Failed Extrusion Welded Seams" of this section.</p> <p>91)4. Destructive Samples: For sample holes in fusion welded seams, the air space shall be sealed at both ends of the sample hole. A cap or patch shall be welded over any sample holes specified under "Failed Extrusion Welded Seam." A single cap or patch may be used to cover holes created by a destructive sample and a failed seam.</p> <p>92)5. Procedure for Seaming Wrinkles: "Fish-mouths" or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle back into the panel to effect a flat overlap as directed by the Project Engineer. They shall then be capped with an oval or round HDPE cap extending a minimum of six inches beyond the cut in all directions.</p> <p>93) HDPE LINER TIE-IN (WELD DEMONSTRATION TESTING): A demonstration test is performed for new HDPE liner tie-in to HDPE liner placed in previous phases of construction by:</p> <p>94) a. Obtain liner samples from at least</p>	<p>Daily, during performance of weld</p>	<p>Notify QC of sampling locations.</p>

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - HDPE LINER

SPECIFICATION

three locations, or at least one sample every 500 feet (whichever is greater) along the exposed edge of the previously placed liner adjacent to where liner tie-in shall occur, as determined by QA personnel. Multiple samples shall be taken at each location to evaluate both the fusion and extrusion welding techniques proposed for use during tie-in construction. Each sample shall be at least 5 feet long. Sample locations and numbers shall be included on the as-built drawings.

95) b. Perform weld demonstration trial seams using both the fusion and extrusion methods by seaming the samples obtained from the previously placed liner with the new liner material. Seams shall be clean, dry, and have adequate overlap (minimum 3 inches for extrusion welding; minimum 4 inches for fusion welding) prior to weld demonstration trial seam welding.

96) c. After cooling, ten test coupons shall be obtained by QC personnel.

QUALITY CONTROL

demonstration testing, perform a calibration check of the testing equipment and record the results on the "Welding Machine Operating Log" form. Correct any deviations prior to performing testing. Provide sample locations and numbers to the Project Engineer for inclusion on the as-built drawings.

Ensure that the welding machines remain energized (on) with power available throughout the period of welding. If power becomes unavailable or the machine is turned off or otherwise is allowed to cool, another weld demonstration trial seam must be run.

Observe all seams immediately prior to welding to ensure compliance with the specifications. Verify that corrective action has been taken (where required) and record observations on the "Seam Inspection Form."

Record results of tie-in demonstration testing on the "Field Destructive Test" forms.

Obtain samples for peel and shear testing. Number each sample obtained. Record

QUALITY ASSURANCE

Observe the performance of the calibration check of the testing equipment and that the results are properly recorded. Ensure any deviations are corrected prior to performing the weld demonstration testing.

Observe all seams prior to welding to ensure compliance with the specifications. Report deficiencies (if any) to QC personnel and the Construction QA Officer. Verify that corrective action has been taken (where required) and properly recorded. Observe the weld demonstration testing. Review the results recorded on the "Welding Machine Operation Log" form for accuracy and completeness.

Accompany QC personnel and designate required repairs and sampling locations.

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - HDPE LINER

SPECIFICATION

Five each of the test coupons shall be tested for shear and peel strength. For the dual fusion method, both the inner and outer seam shall be tested for peel.

QUALITY CONTROL

sampling locations on "Seam Inspection Form." Divide the sample into three approximately 12 inch by 12 inch samples, one sample to be tested by QC personnel on-site using a calibrated tensiometer. The remaining 2 samples shall be provided to QA. Provide sample locations and numbers to the Project Engineer for inclusion on the as-built drawings.

QUALITY ASSURANCE

Resolve any discrepancies with QC personnel.

Send one sample to an approved laboratory for peel and shear testing (ASTM D 638). Archive one sample as directed by the Construction QA Officer.

97) d. The pass/fail criteria for testing of the trial seams shall be the same as that noted above for destructive testing of HDPE liner production and repair seams.

Perform trial seam testing (ASTM D 6392 or ASTM D 4437) and record results on the "Welding Machine Operating Log" form. Ensure problems are corrected and that any corrective actions taken are recorded.

Determine whether or not the weld demonstration trial seam tests have passed or failed.

98) Weld demonstration trial seams shall be performed until passing tests are achieved at each sample location for each type of welding technique (fusion and extrusion). Production welding for tie-in shall not begin until successful weld demonstration trial seams are completed.

When the laboratory test results are received, record the results of the laboratory testing. If either a field or laboratory sample fails any of the testing then additional weld demonstration trial seams shall be performed. Ensure the technique used during the weld demonstration testing (e.g. welding speed, wedge temperature, nip roller force, etc.) is replicated as much as possible during production or repair welding of the liner tie-in.

Compare laboratory testing results with the acceptance-rejection criteria to ensure that the welds met the criteria. Ensure that laboratory results are recorded.

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - GRANULAR FILL

SPECIFICATION

99) **GRANULAR FILL:** Granular fill shall be clean, rounded to subrounded rock with 100% passing a 2.5 inch U.S. sieve. Clean rock shall be defined as material having no more than 10.0% passing the number 40 sieve, and free from all other material not of the same mineralogical nature.

100) **RUB SHEET:** The sump rub sheet shall be installed throughout the SLRP prior to granular fill placement.

101) **PERMEABILITY:** Granular fill shall have permeability of greater than or equal to 1×10^{-2} cm/sec.

102) **THICKNESS:** The thickness of granular fill shall be a minimum of one foot. Thickness shall be established by installing grade poles. The grade poles shall be marked at

QUALITY CONTROL

Obtain one laboratory gradation test (ASTM D 422) on every sump or 200 cubic yards of material, whichever is more frequent. Record compliance, deficiencies and corrective action on the "Daily Construction Report" form. Ensure that corrective actions required by QA personnel are accomplished.

Verify that the sump rub sheet has been installed.

Perform a permeability test (Appendix 1) on approved granular fill at a rate of one test per 2 sumps and record results on the "Field Permeability Test" form. Permeability testing may be performed on a representative sample of approved granular fill outside of the sump.

Verify the required thickness is achieved as follows:
a. Ensure that the required frequency for placement of grade poles has been met.

QUALITY ASSURANCE

Review 10% of all QC documentation. Verify frequency of laboratory tests and compliance of test results. Report deficiencies (if any) to the Project Engineer and QC personnel. Verify that corrective action has been taken (where required) and recorded on the "Daily Construction Report" form. Record findings of observations, reviews, and corrective actions taken (where required) on the "Daily Quality Assurance Report". Make an observation during the placement of one SLRP per sump.

Verify that the measurements are being performed at the correct frequency.

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - GRANULAR FILL

SPECIFICATION

the appropriate depth to establish the thickness. After the thickness has been checked and approved by QC personnel, the grade poles shall be removed. Grade poles shall be numbered and accounted for after removal to ensure that all grade poles have been removed.

OR

Survey to determine thickness.

QUALITY CONTROL

- b. Compare granular fill levels with the marked level on the grade poles.
- c. Use a string line where necessary between the poles to check for high or low spots.
- d. Define out of specification areas and advise the contractor to rework those areas.
- e. Review areas reworked and approved areas meeting criteria.
- f. Continue “b” through “d” above until all areas meet criteria.

OR

- a. Verify equipment calibration,
- b. Verify correct set-up and operation of equipment.

QUALITY ASSURANCE

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - DRAINAGE NET

SPECIFICATION

103) CERTIFICATION

REQUIREMENTS: Prior to installation, the manufacturer shall provide quality control certificates (roll and polymer raw materials) pertaining to the drainage net. The material properties and frequencies of testing are specified in Appendix 3 to this CQA/QC Manual. Each roll must have a unique manufacturing identification number that shall be recorded.

104) MANAGEMENT OF DRAINAGE NET: Drainage net shall not be used on the project until it has been accepted by the Construction QA Officer. Acceptance of the material shall be based on receipt and approval of the required certificates as discussed in specification 103 and visual observation of the condition of each roll of drainage net. The drainage net shall be stored in accordance with the manufacturer's instructions for protection from temperature extremes, weather, and other potential damaging conditions. Provide copies of the manufacturer's instructions to QC and QA personnel.

QUALITY CONTROL

Review QC certificates. Forward acceptable QC certificates to QA for approval. Mark conspicuously rolls not meeting specification and require that they be removed from the construction area.

Observe and document the condition of each roll of drainage net

Ensure that each roll of drainage net has been accepted by QA personnel prior to allowing it to be deployed by comparing the "Drainage Net Approval Form" with the rolls of drainage net.

QUALITY ASSURANCE

Review QC certificates prior to allowing liner to be deployed.

Document approval of each roll of drainage net on the "Drainage Net Approval Form." Provide copies of this form to QC personnel.

a. Together with QC personnel, observe the condition of each roll of drainage net.

b. Document acceptance of each roll of drainage net on the "Drainage Net Approval Form."

c. Provide QC personnel with copies of the forms indicating acceptance of the drainage net rolls.

d. Ensure that any rolls of drainage net not meeting specifications are marked conspicuously and removed from the construction area.

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - DRAINAGE NET

<u>SPECIFICATION</u>	<u>QUALITY CONTROL</u>	<u>QUALITY ASSURANCE</u>
<p>105) DRAINAGE NET: Prior to covering the HDPE liner with drainage net, the individual seams and panels must be approved by the Construction QA Officer. Prior to deployment of the drainage net, the underlying HDPE liner is to be clear of soil or unsuitable material. Following deployment, the drainage net shall be covered in a timely manner.</p>	<p>Verify that each panel and seam to be covered has been approved by QA. Observe and photograph the HDPE liner prior to drainage net placement. Observe drainage net placement.</p>	<p>Observe areas daily for compliance with the specifications. Report deficiencies (if any) to QC personnel and the Construction QA Officer. Verify that corrective action has been taken (where required) and recorded on the "Daily Quality Assurance Report."</p>
<p>106) The drainage net shall be installed by hand. Adjacent rolls shall be joined by overlapping the edges by a minimum of four inches. Adjacent rolls shall be connected by tying. The tying material shall be a polymer braid or polymer cable ties of a different colored material than the drainage net. Ties shall be secured so as to not damage the underlying or overlying HDPE liner.</p>	<p>Observe placement and joining of adjacent panels of drainage net for compliance with the specifications. Require deficiencies to be corrected prior to covering the net. Document on the "Daily Construction Report."</p>	<p>Observe areas daily for compliance with the specifications. Report deficiencies (if any) to QC personnel and the Project Engineer. Record findings of observations, review, and corrective actions taken (where required) in the "Daily Quality Assurance Report." Document approval of each placed drainage net layer on the "Daily Quality Assurance Report."</p>
<p>107) A geocomposite (a geotextile laminated to a geonet) may be used in place of distinct geotextile and geonet layers. If used, geocomposite shall meet or exceed the material properties contained in Appendix 3.</p>		

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - GEOTEXTILE

SPECIFICATION

108) CERTIFICATION

REQUIREMENTS: Prior to installation, the manufacturer shall provide quality control certificates (roll number, unit mass, and strength) pertaining to the geotextile. The material properties and frequencies of testing are specified in Appendix 3 to this CQA/QC Manual. Each roll must have a unique manufacturing identification number that shall be recorded.

109) GEOTEXTILE STORAGE: All geotextile shall be stored in accordance with the manufacturer's instructions for protection from temperature extremes, weather, and other potential damaging conditions. Provide copies of the manufacturer's instructions to QC and QA personnel.

110) GEOTEXTILE

QUALITY CONTROL

Review QC certificates. Forward acceptable QC certificates to QA for approval. Mark conspicuously rolls not meeting specification and require that they be removed from the construction area.

a. Together with QA personnel, observe the condition of each roll of geotextile and observe that the tag or printing on each roll indicates that the roll is the type that has been specified.

b. Rolls of geotextile not meeting specifications shall be marked conspicuously and removed from the construction area.

Periodically inspect to ensure that the stored geotextiles are covered in accordance with the manufacturer's instructions. Record observations and corrective actions taken (where required) on the "Daily Construction Report."

Observe geotextile placement. Observe

QUALITY ASSURANCE

Receive, review and approve required QC certificates prior to allowing geotextile to be deployed. Review the results of the required submittals with the QC personnel. Document roll numbers and quality control certificates received on the "Geotextile Approval Form." Mark conspicuously rolls of geotextile not meeting the specifications and require that they be removed from the construction area. In the comments column on the above-indicated form note any rolls not meeting specifications and document that those rolls have been removed from the construction area.

a. Together with QC personnel, observe the condition of each roll of geotextile and observe that the tag or printing on each roll indicates that the roll is the type that has been specified.

b. Ensure that any rolls of geotextile not meeting specifications are marked conspicuously. Designate a location for non-conforming rolls of geotextile to be placed sufficiently removed from the construction location so as to ensure the non-conforming roll of geotextile is not inadvertently used.

Observe geotextile placement. Record

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - GEOTEXTILE

SPECIFICATION

INSTALLATION: The geotextile shall be installed by hand. The geotextile shall be loaded to prevent wind uplift until the placement of the overlying layer. Adjacent rolls shall be joined by overlapping the edges by a minimum of three inches. Adjacent rolls shall be connected by sewing or fusion welding.

QUALITY CONTROL

placement and joining of adjacent rolls of fabric for compliance with the specifications. Advise the Synthetics Contractor of any deficiencies. Require deficiencies to be corrected prior to covering the fabric with the soil cover. Perform a final inspection and photograph or video the geotextile prior to placement of the soil cover. Record observations and corrective actions taken (where required) on the "Daily Construction Report."

QUALITY ASSURANCE

observations and corrective actions taken (where required) on the "Daily Quality Assurance Report."

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – SOIL PROTECTIVE COVER

SPECIFICATION

111) **MATERIAL:** Soil protective cover shall be native soil screened through a 3” or smaller screen and free of unsuitable material. Unsuitable material for soil protective cover shall be defined as metal, concrete, hard plastic, or any other material that may potentially damage the underlying or overlying synthetic layers. Soil protective cover material shall have a gradation of 100% passing the 3” screen and at least 85% passing the 1” screen. With notification to the Executive Secretary, waste free of unsuitable material is approved for use in the upper soil protective cover layer.

112) **SOIL PROTECTIVE COVER:** Equipment used in placing the soil protective cover shall be restricted so as to ensure that the equipment ground pressure does not exceed 3000 psf at the HDPE surface. A minimum of one foot of soil protective cover shall be placed prior to any heavy equipment travel on the geofabric surface. Additional thickness of soil protective cover may be placed to reduce ground pressure at the HDPE surface.

QUALITY CONTROL

Perform gradation tests (ASTM C 136) at a rate of 1 test per lot prior to approving the material for soil protective cover. A lot is defined as 5,000 cubic yards.

- a. Approve lots that meet the specification.
- b. Re-screen or reject lots that do not meet the specification.

Provide the Project Engineer with a list of equipment to be operated on top of soil protective cover. The Project Engineer shall calculate ground pressure exerted by the listed equipment and determine minimum soil protective cover thickness beneath each type of equipment. Observe that minimum thickness of soil protective cover required by the Project Engineer per equipment type is maintained. Advise the contractor of any deficiencies. Require all deficiencies to be corrected. Record observations and corrective

QUALITY ASSURANCE

Perform a minimum of one QA gradation test.

Observe the sump construction areas at least once for compliance with the specifications. Review 10% of QC documentation. Report deficiencies (if any) to QC personnel and the Project Engineer. Record findings of observations, review, and corrective actions taken (where required) on the "Daily Quality Assurance Report".

CQA/QC MANUAL FOR MIXED WASTE EMBANKMENT
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – SOIL PROTECTIVE COVER

<u>SPECIFICATION</u>	<u>QUALITY CONTROL</u>	<u>QUALITY ASSURANCE</u>
	actions taken (where required) on the "Daily Construction Report."	
113) No compaction or moisture requirements are specified for the soil cover.		
114) FINAL GRADING: Grade for the soil protective cover shall be established by installing plastic grade poles on at least a 50-foot grid and at all key control points. Grade poles shall be conspicuously marked at the appropriate compliance depth to establish the thickness. Grade poles shall be numbered and accounted for after removal to ensure that all grade poles have been removed. OR Survey to determine thickness.	Verify that the required soil cover thickness is achieved as follows: a. Ensure that the required frequency for placement of grade poles has been met. Record the number of grade poles placed. b. Compare soil level with the marked level on the grade poles. c. Use a string line where necessary between poles to check for high or low spots. d. Define out of specification areas and advise the contractor to rework those areas. e. Review areas reworked and approve areas meeting criteria. f. Continue "b" through "d" above until all areas meet criteria. OR a. Verify equipment calibration, b. Verify correct set-up and operation of equipment.	

APPENDIX 1: TEST METHODS

ASTM C 117	Standard Test Method for Materials Finer than 75- μm (No. 200) Sieve in Mineral Aggregate by Washing
ASTM C 136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 702	Standard Practice for Reducing Field Samples of Aggregate to Testing Size
ASTM D 75	Standard Practice for Sampling Aggregates
ASTM D 413	Standard Test Methods for Rubber Property – Adhesion to Flexible Substrate
ASTM D 422	Standard Test Method for Particle-Size Analysis of Soils
ASTM D 618	Standard Practice for Conditioning Plastics for Testing
ASTM D 638	Standard Test Method for Tensile Properties of Plastics
ASTM D 698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³ (600 kN-m/m ³))
ASTM D 1140	Standard Test Method for Amount of Material in Soils Finer than the No. 200 (74- μm)
ASTM D 1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 2216	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 2487	Standard Practice for Standard Classification of Soils for Engineering Purposes (Unified Soils Classification System)
ASTM D 2922	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4437	Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes

- ASTM D 4643 Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method
- ASTM D 4718 Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles
- ASTM D 4959 Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating
- ASTM D 5084 Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
- ASTM D 5641 Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber
- ASTM D 5820 Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes
- ASTM D 6392 Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods

PROCEDURE FOR SEALED SINGLE RING INFILTRMETER
FIELD PERMEABILITY TEST

The sealed single ring infiltrometer testing procedure for field permeability testing is as follows:

1. Equipment
 - a. Metal Ring – With a minimum area of 1294 cm². The bottom of the ring is beveled for a cutting edge. A flange welded to the top of the metal ring is provided to allow connection of a lid.
 - b. Lid – Cover for the metal ring. Provided with a gasket to seal the cover to the ring flange. Also provided with a nipple to connect a water supply hose and vent valve.
 - c. Water Reservoir – Supplies water for the saturation portion of the test. Connects to the lid and the readout tube.
 - d. Readout Tube – Approximately .32 cm diameter to measure the flow of water into the system.
 - e. Stand – Method to support the water reservoir and the readout tube.
 - f. Static Weight Penetrometer – The probe construction will be a stainless steel rod with a quarter (1/4) inch nominal diameter and a flat tip. The probe will have a weight such that the minimum tip pressure is one hundred pounds per square inch (100 psi).

2. Testing Procedures
 - a. Metal rings with a minimum radius of 20.3 cm will be utilized for permeability testing during test pad construction.
 - b. Prepare the area to be tested by smoothing the ground surface and removing any loose or disturbed soil.
 - c. Place the metal ring on the area prepared. Push the metal ring at least 15.2 cm into the soil.
 - d. Remove any soil disturbed from inside the metal ring by the insertion process.
 - e. Seal the inside of the metal ring by compacting the soil immediately adjacent to the ring.
 - f. Place a small plate on the soil surface and pour water over the plate into the ring, filling the ring with water to within approximately 1.3 cm of the top of the ring.
 - g. Place the lid on the ring and seal with clamps or other devices.
 - h. Connect the water reservoir and readout tube to the lid and set on support stand.
 - i. Fill the system with water, filling the ring, reservoir and all hoses.
 - j. Secure the reservoir at least 91.4 cm above the ring.
 - k. Allow the water to permeate into the soil for a minimum of 4 hours (for test pads only: Minimum 0.76 cm wet from depth for each wet front depth test. The average wet front depth for all 9 SSRI tests performed for each test pad must be at least 0.86 cm).
 - l. Fill the readout tube with water and secure the readout tube so that the water level in the tube is approximately 152.4 cm above the ring. Allow the readings to stabilize prior to starting the test. The water level shall be greater

- than or equal to 121.9 cm when the test starts. Record the initial height of the water above the soil surface inside the ring.
- m. Record the water level in the readout tube every 20 seconds for 8 minutes. Plot the water drop over time.
 - n. Dismantle the system and measure the temperature at the soil-water interface (inside the ring, measured in °C). The appropriate Temperature Correction Factor shall be identified from Figure 1 of the Field Permeability Test Form EC-1906, or from Table 1 of ASTM D 5084. Then measure the depth that the water penetrated into the soil, using the static weight penetrometer. The average of at least three wet front depth tests shall be used for calculating the water penetration depth.
 - o. Calculate the Change in Head during the test based on a linear regression analysis of the plotted results.
 - p. Calculate the permeability. Report permeability to two significant digits.
3. Documentation

Record the following items. (Record all length measurements in cm.)

- a. Date and time soil saturation began and when permeability test readings were taken.
- b. Test location and elevation.
- c. Timed water drop readings.
- d. Height of water at beginning of readings.
- e. Size of ring and readout tube (if required).
- f. Soil-water interface temperature.
- g. Average depth of wet front.
- h. Plot of water level drop with time.
- i. Plot the calculated regression line of water level drop with time.
- j. Calculated permeability.

Appendix 2: Forms

EnergySolutions, LLC

DAILY CONSTRUCTION REPORT

(EC-1902)

PROJECT: LARW MW 11e.(2) CLASS A OTHER _____

DATE: _____

WEATHER: Fair: Cloudy: Warm: Rain: Snow: Wind: Other:

CONSTRUCTION OPERATIONS: Waste Placement Cell Excavation Clay Liner
Radon Barrier Rock Placement Other

PERSONNEL ON SITE: Broken Arrow Others

EQUIPMENT USED:

Rock trucks Trackhoes Loaders Dozers
Locomotives Forklifts Graders Backhoes
Sheepsfoot Scrapers Tillers Rollers
CAT 815 Water trucks Others

DAILY PROGRESS MEETING: Yes No

LIFTS TESTED: _____

LIFTS APPROVED: _____

EXPLANATIONS: _____

INSPECTOR APPROVAL

DATE

QC OFFICER APPROVAL

DATE

EnergySolutions, LLC

SAMPLING LOG

(EC-1903)

PROJECT: LARW MW 11e.(2) CLASS A OTHER _____

DATE: _____

SAMPLE NUMBER: _____ MATERIAL TYPE: SOIL _____ ROCK _____

LOCATION: _____

TEST(S) TO BE PERFORMED: _____ SAMPLED BY: _____

PROCTOR: _____ CLASSIFICATION: _____ LABORATORY PERMEABILITY: _____

NA SOUNDNESS: _____ LA ABRASION: _____ ABSORPTION: _____

SPECIFIC GRAVITY: _____ GRADATION: _____

COMMENTS: _____

SAMPLE NUMBER: _____ MATERIAL TYPE: SOIL _____ ROCK _____

LOCATION: _____

TEST(S) TO BE PERFORMED: _____ SAMPLED BY: _____

PROCTOR: _____ CLASSIFICATION: _____ LABORATORY PERMEABILITY: _____

NA SOUNDNESS: _____ LA ABRASION: _____ ABSORPTION: _____

SPECIFIC GRAVITY: _____ GRADATION: _____

COMMENTS: _____

SAMPLE NUMBER: _____ MATERIAL TYPE: SOIL _____ ROCK _____

LOCATION: _____

TEST(S) TO BE PERFORMED: _____ SAMPLED BY: _____

PROCTOR: _____ CLASSIFICATION: _____ LABORATORY PERMEABILITY: _____

NA SOUNDNESS: _____ LA ABRASION: _____ ABSORPTION: _____

SPECIFIC GRAVITY: _____ GRADATION: _____

COMMENTS: _____

QC OFFICER APPROVAL _____ DATE _____

EnergySolutions, LLC

LIFT APPROVAL FORM

(EC-1904)

PROJECT: _____ LARW _____ MW _____ 11e.(2) _____ CLASS A _____ OTHER _____

NW CORNER _____ DATE: _____ PAGE 1 of _____

	P_1 _____	
	EW: _____ X _____ = _____	
	NS: _____ X _____ = _____	
	P_2 _____	
	EW: _____ X _____ = _____	
	NS: _____ X _____ = _____	
	P_3 _____	
	EW: _____ X _____ = _____	
	NS: _____ X _____ = _____	
	P_4 _____	
	EW: _____ X _____ = _____	
	NS: _____ X _____ = _____	
	P_5 _____	
	EW: _____ X _____ = _____	
	NS: _____ X _____ = _____	
	Page 2 attached: Y N	

IDENTIFY LOTS ABOVE

LIFT ID: _____ NW CORNER: _____ INTERFACE RANDOM #: _____

WASTE GENERATOR ID NUMBER(S): _____

THICKNESS: UNC: _____ COM: _____ ELEV: _____ Debris Insp. By: _____ Date: _____

Time: _____

DEBRIS CALCULATIONS: _____

KEYING IN NOTES: N E S W _____ DENSITY TESTS ID # (S): _____

COMMENTS: _____

LIFT APPROVED BY: _____ DATE: _____ TIME: _____

QC OFFICER APPROVAL

DATE

EnergySolutions, LLC

Random Number Test ID Form

(EC-1904 Continuation Sheet)

Date: _____

Page _____ of _____

Lift ID: _____

NW

Corner: _____

P_6 _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____	P_{14} _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____	P_{22} _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____
P_7 _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____	P_{15} _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____	P_{23} _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____
P_8 _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____	P_{16} _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____	P_{24} _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____
P_9 _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____	P_{17} _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____	P_{25} _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____
P_{10} _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____	P_{18} _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____	P_{26} _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____
P_{11} _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____	P_{19} _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____	P_{27} _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____
P_{12} _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____	P_{20} _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____	P_{28} _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____
P_{13} _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____	P_{21} _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____	P_{29} _____ EW: _____ x _____ = _____ NS: _____ x _____ = _____

COMMENTS: _____

EnergySolutions, LLC

FIELD DENSITY TEST (EC-1905)

PROJECT: LARW MW 11e.(2) CLASS A **OTHER**
LIFT IDENTIFICATION: _____ **DATE:** _____
WASTE OR TEST ID NUMBER(S): _____
TEST LOCATION: _____ **TEST METHOD:** D1556 D2922

<p style="text-align: center;">D2922 DENSITY DETERMINATION (NUCLEAR DENSITY GAUGE) GAUGE ID NO.</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;">On-Cell Standard: Density Counts _____ Moisture Counts _____ Depth Setting (inches) _____ Moisture Counts _____ Wet Density (PCF) _____ Moisture Density (PCF) _____</td> <td style="width: 50%; border: none;">Off-Cell Standard: Density Counts _____ Moisture Counts _____ Count Time (minutes) _____ Density Counts _____ Dry Density (PCF) _____ Moisture Fraction (%) _____</td> </tr> </table>	On-Cell Standard: Density Counts _____ Moisture Counts _____ Depth Setting (inches) _____ Moisture Counts _____ Wet Density (PCF) _____ Moisture Density (PCF) _____	Off-Cell Standard: Density Counts _____ Moisture Counts _____ Count Time (minutes) _____ Density Counts _____ Dry Density (PCF) _____ Moisture Fraction (%) _____	<p style="text-align: center;">D1556 DENSITY DETERMINATION (SAND CONE)</p> <p>Bulk Density of sand (PCF) _____ Mass of Sand to Fill Cone & Plate (g) _____</p> <p>Mass of bottle & cone before filling cone, plate, & hole (g) _____</p> <p>Mass of bottle & cone, after filling cone, plate, & hole (g) _____</p> <p>Mass of sand to fill cone, plate, & hole (g) _____</p> <p>Mass of sand to fill cone & plate (g) _____</p> <p>Mass of sand to fill hole (g) _____</p> <p>Mass of wet soil & container (g) _____</p> <p>Mass of container (g) _____</p> <p>Mass of wet soil (g) _____</p>
On-Cell Standard: Density Counts _____ Moisture Counts _____ Depth Setting (inches) _____ Moisture Counts _____ Wet Density (PCF) _____ Moisture Density (PCF) _____	Off-Cell Standard: Density Counts _____ Moisture Counts _____ Count Time (minutes) _____ Density Counts _____ Dry Density (PCF) _____ Moisture Fraction (%) _____		

MOISTURE DETERMINATION

Container ID _____	
Mass of wet soil & container (g)	
Mass of dry soil & container (g)	
Mass of water (g)	
Mass of dry soil & container (g)	
Mass of container (g)	
Mass of dry soil (g)	
Moisture content (%)	

Dry Density = $\frac{\text{Wet Density (PCF)} \times 100.0}{\text{Moisture content (\%)} + 100.0}$

Dry Density = $\frac{\text{ } \times 100.0}{+ 100.0}$ _____ pcf

Percent Compaction = $\frac{\text{Dry Density} \times 100.0}{\text{Proctor Density}}$

Percent Compaction = $\frac{\text{ } \times 100.0}{\text{ }}$ = _____ %

Wet Bulk density = $\frac{\text{Mass of wet soil (g)}}{\text{Mass of sand filling hole (g)}} \times \text{Bulk density of sand (PCF)}$ Density (PCF) = _____	<table border="1" style="width: 100%; height: 100%; border-collapse: collapse;"> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> <tr><td style="height: 20px;"></td></tr> </table>										

SOIL DATA: _____ **PROCTOR #** _____

Proctor
Dry Density (PCF) _____
 Proctor
Optimum Moisture(%) _____
 Required
Moisture(%): _____ to _____
 Required
Compaction(%): _____

TEST RESULTS:
 ___ Pass
 ___ Failed Moisture
 ___ Failed Compaction
 BY: _____ TIME: _____

INSPECTOR APPROVAL _____ DATE _____ QC OFFICER APPROVAL _____ DATE _____

EnergySolutions, LLC
Breach of Berm
(EC-1911)

PROJECT: _____ LARW: _____ MW: _____ 11e.(2) _____ OTHER (specify) _____

LOCATION OF BERM: _____



Sketch location (if needed)

TYPE OF BREACH:

_____ Permanent removal of berm, or

_____ Temporary removal of berm

ACTION:

_____ New and / or temporary berms have been inspected and permission is granted to breach the berm.

_____ The breach and repair of the berm will be accomplished during one shift; therefore, no temporary berms are required. Permission is granted to breach the berm for one shift on _____.
Date

_____ Permission to breach the berm is denied because _____

QC OFFICER APPROVAL

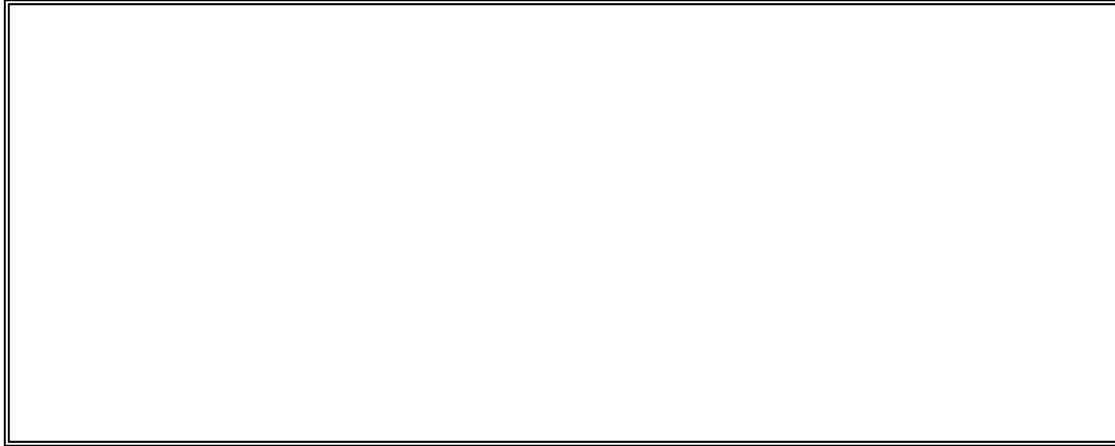
Date

EnergySolutions, LLC

LINER / RADON BARRIER INSPECTION FORM (EC-1912)

PROJECT: LLRW _____ CLASS A _____ MW _____ 11e(2) _____

LOCATION OF LINER / RADON BARRIER: _____



sketch location (if needed)

COMMENTS: _____

EnergySolutions _____ Date _____

COMMENTS: _____

DRC _____ Date _____

--

Appendix 3: Material Specifications

REQUIRED HDPE LINER INDEX PARAMETERS			
Property	Test Method	60 mil HDPE	80 mil HDPE
Thickness (min. ave.) • Lowest individual of 10 values	ASTM D5199	60 mil • -10%	80 mil • -10%
Density mg/l (min.)	ASTM D1505 or ASTM D792	0.940 g/cm ³	0.940 g/cm ³
Elongation @ Yield (1)	ASTM D6693 Type IV	12%	12%
Elongation @ Break (1)	ASTM D6693 Type IV	700%	700%
Tensile Strength @ Yield (1)	ASTM D6693 Type IV	126 lb/in	168 lb/in
Tensile Strength @ Break (1)	ASTM D6693 Type IV	228 lb/in	304 lb/in
Carbon Black Content	ASTM D1603 (3)	2.0% to 3.0%	2.0% to 3.0%
Carbon Black Dispersion	ASTM D5596	Note (4)	Note (4)
Stress Crack Resistance (2)	ASTM D5397	300 hr.	300 hr
Tear Resistance	ASTM D1004	42 lb	56 lb
Puncture Resistance	ASTM D 4833	108 lb	144 lb
<p>Note:</p> <p>(1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction. Yield elongation is calculated using a gage length of 1.3 inches. Break elongation is calculated using a gage length of 2.0 in.</p> <p>(2) The yield stress used to calculate the applied load for the SP-NCTL test should be manufacturer's mean value via MQC testing.</p> <p>(3) Other methods such as D4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D1603 (tube furnace) can be established.</p> <p>(4) Carbon black dispersion (only near spherical agglomerates) for 10 different views: 9 in categories 1 or 2 and 1 in category 3.</p>			

REQUIRED HDPE LINER SEAM PROPERTIES⁽¹⁾			
ASTM D4437		60 Mil HDPE	80 Mil HDPE
Shear	Fusion	113 lbs/in	151 lbs/in
	Extrusion	113 lbs/in	151 lbs/in
Peel	Fusion	76 lbs/in	101 lbs/in
	Extrusion	76 lbs/in	101 lbs/in
Note: (1) Specified properties are minimums.			

REQUIRED DRAINAGE NET PROPERTIES			
PROPERTIES	UNITS	SPECIFIED VALUES⁽¹⁾	TEST METHOD
Polymer composition	%	95 polyethylene by weight	
Polymer Density	g/cm ³	0.920	ASTM D1505
Polymer melt index	g/10 min.	≤1.0	ASTM D1238
Carbon black content	%	2-3	ASTM D1603, modified
Nominal thickness	in	0.160	ASTM D374C, D1777, or D5199
Transmissivity	m ² /s	5 x 10 ⁻⁴	ASTM D4716-00
NOTES:			
(1) Values represent minimum average roll values (i.e., any roll in a lot should meet or exceed the values in this table). Where ranges of values are specified, the average roll values must be within the specified range.			

REQUIRED GEOTEXTILE PROPERTIES			
Properties	Units	Specified Values ⁽¹⁾	Test Method
Polymer composition	%	95 [polypropylene, polyester, or polyethylene by weight]	
Mass per unit area	oz/yd ²	8.0	ASTM D3776 or ASTM D5261
Apparent opening size	mm	0 ₉₅ < 0.212 mm	ASTM D4751
Tensile strength	lb	200	ASTM D4632 ⁽²⁾
Mullen Burst strength	psi	350	ASTM D3786
Notes:			
(1) Values represent minimum average roll values (i.e., any roll in a lot should meet or exceed the values in this table). The specified apparent opening size is a maximum average roll value.			
(2) Minimum value measured in machine and cross machine direction on a constant-rate-of-extension (CRE) machine.			