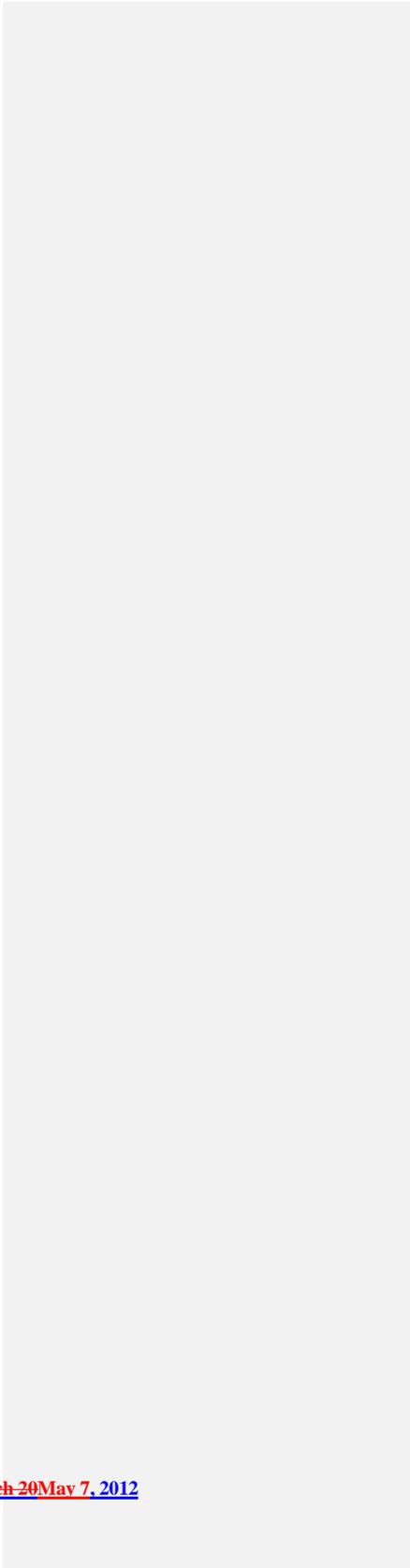


**LLRW and 11e.(2) Construction Quality Assurance/Quality Control (CQA/QC) Manual**



**LLRW and 11e.(2) CQA/QC Manual**

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**LLRW and 11e.(2) CQA/QC MANUAL  
TABLE 1 - QA/QC ACTIVITIES  
WORK ELEMENT - DOCUMENT CONTROL**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>SCOPE:</b> This work element applies to all construction activities in the <del>Class A, Class A North, Class A West</del> and 11e.(2) embankments.</p> <p><b>QC DOCUMENTATION APPROVAL:</b> QC documentation shall be approved/rejected by the QC Officer and submitted to the Construction QA Officer. The Construction QA Officer shall approve/reject the documentation.</p> <p><b>QC DOCUMENTATION FILES:</b> Original QC documents shall be maintained at the site. A copy shall be saved into the electronic database.</p> <p><b>QA DOCUMENTATION FILES:</b> Original QA documents shall be maintained at the site. A copy shall be saved into the electronic database.</p>	<p>Sign the reports indicating documentation is adequate, correct, and has been accepted by QC. Provide QA with copies of the documentation and obtain their signature on the documentation indicating QA acceptance. Ensure that corrective actions required by QA personnel are accomplished.</p> <p>After the QC documentation has been accepted by QA, a copy of the original shall be saved into the electronic database. Originals of all QC documentation shall be maintained in the site engineering file.</p> <p>None</p>	<p>Review the documentation generated by QC. Report deficiencies to the QC officer and the Construction QA Officer. Verify that corrective action has been taken (where required) and recorded on the QC documentation. Countersign reports indicating documentation is adequate, correct, and has been accepted by QA. Record findings on the "Daily Quality Assurance Report".</p> <p>Periodically review the site engineering files to ensure the correct documentation is being retained by QC personnel.</p> <p>A copy of the original shall be saved into the electronic database and originals maintained in the site QA file.</p>

**LLRW and 11e.(2) CQA/QC MANUAL**  
**TABLE 1 - QA/QC ACTIVITIES**  
**WORK ELEMENT - GENERAL REQUIREMENTS**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>SCOPE:</b> This work element applies to the <u>Class A West, Class A, Class A North,</u> and 11e.(2) embankments.</p> <p><b>RUNON CONTROL DURING PROJECT:</b> The perimeter berms shall be constructed to a minimum of 3 feet above the ground elevations (GL) shown in the engineering drawings. The first lift of material shall have an uncompacted thickness of no greater than 12 inches. Elevations for the berms between the specified ground elevations shall be linearly interpreted between the shown elevations. The berms shall be a minimum of 10 feet at the top and shall be compacted to 90 percent of a standard Proctor.</p> <p><b>RUNOFF CONTROL DURING PROJECT:</b> Berms shall be constructed around the outside edge of the clay liner to a height of 3 feet. This height is measured as the elevation above the design elevation of the clay liner; or as the elevation above the design elevation of the liner protective cover, whichever is higher. Berms shall be a minimum of 3 feet wide at the top. The first lift of material shall have an uncompacted thickness of no greater than 12 inches. The berm will be constructed on top of the clay liner such that the berm is not in contact with native ground. A distance of 10 feet shall be maintained between the toe of the berm and the toe of the waste. The berms shall be compacted to 90 percent of a standard Proctor.</p> <p>Contact water shall be controlled inside the runoff control berm system. Contact water is defined as any storm water that falls within the runoff berm system in the active, unfinished portions of the embankment. Access ramps that cross runoff berms shall be constructed to prevent such runoff from leaving the lined portion of the embankment.</p>	<p>Verify that the required berms have been constructed to the specified dimension. Record any findings on the "Daily Construction Report". Spot check the density of the first lift and subsequent lifts of the berm to ensure that it meets specifications. Record density tests on the "Field Density Test" form.</p> <p>Verify that the required berms have been constructed to the specified dimension. Record any findings on the "Daily Construction Report". Spot check the density of the first lift and subsequent lifts of the berm to ensure that it meets specifications. Record density tests on the "Field Density Test" form.</p> <p>Inspect the access ramps that cross runoff berms on a weekly basis for the presence of runoff control channels and document the inspection on the "Daily Construction Report".</p>	<p>Verify that berms have been inspected by QC personnel.</p> <p>Verify that the berms have been inspected by QC personnel.</p> <p>Verify that the weekly access ramp inspections have been performed and documented.</p>

**LLRW and 11e.(2) CQA/QC MANUAL**  
**TABLE 1 - QA/QC ACTIVITIES**  
**WORK ELEMENT - GENERAL REQUIREMENTS**

<b>SPECIFICATION</b>	<b>QUALITY CONTROL</b>	<b>QUALITY ASSURANCE</b>
<p>Fences or other barriers will be installed at the active cell boundary, (the run-off berm and near the radon barrier/waste interface) The barriers will be "chicken-wire", snow-fence, chain-link fence, or herculite (or other materials similar to herculite) secured to "T" posts.</p> <p>Storm runoff for up to a 10-year, 24-hour event that runs off from those portions of the embankment that have been completed to final cover design shall be managed and controlled to prevent such runoff from contacting contaminated waste material in the active unfinished portions of the embankment.</p> <p>After the first lift of radon barrier material for an entire side slope area (i.e., from the toe of waste to the side slope breakover) has been constructed, verified, and approved, the adjacent runoff berm for that side slope area may be removed. During placement of this first lift of radon barrier, there is no minimum offset to the runoff berm.</p> <p><b>MONTHLY BERM INSPECTION:</b> The berms and fences are to be inspected monthly. Inspect for obvious damage to berms and fences. Ensure berm height where roads cross berms.</p> <p><b>BERM MAINTENANCE:</b> The runon and runoff berms shall be surveyed and improved, as required, by July 1 of each year.</p>	<p>Verify fences are installed around the active cell boundary and near the radon barrier/waste interface and document the inspection on the "Daily Construction Report".</p> <p>Inspect the berm on a monthly basis and document the inspection and any corrective actions taken (if required) on the "Daily Construction Report". Marker posts indicating the required berm height should be placed at both side of a road at the point where the road crosses the berm. This is to aid in identifying damage to the berm due to road traffic. Repair any noted damage of berm or wind dispersal fences and fill low spots to meet the design height.</p> <p>Survey the berms at 100 foot intervals and key points. Repair any noted damage and fill low spots to meet the design height.</p>	<p>Verify that fences are in place and have been inspected by QC personnel.</p> <p>Verify that the monthly berm inspections have been performed and properly documented. Verify proper installation of marker posts and wind dispersal fences or other barriers.</p> <p>Verify that the berms are surveyed and improved, as required.</p>

**LLRW and 11e.(2) CQA/QC MANUAL**  
**TABLE 1 - QA/QC ACTIVITIES**  
**WORK ELEMENT - GENERAL REQUIREMENTS**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>MOVING OR BREACHING A BERM:</b> When moving or breaching a berm, the work must be authorized by the QC officer prior to commencing work. A temporary breach of a berm may be accomplished without a temporary berm, provided the work may be completed and the berm replaced the same day. A temporary berm will have the same specifications as a permanent berm.</p>	<p>Review the work to be performed. Document the approval to move or breach a berm on the "Breach of Berm" Form.</p>	<p>Verify that the approval to move or breach a berm has been properly documented.</p>
<p><b>NUCLEAR DENSITY/MOISTURE GAUGE CALIBRATION:</b> To ensure proper calibration, a sand-cone density test shall be performed jointly with five percent of the nuclear density test. The frequency of sand-cone tests shall be reduced to two percent of the nuclear density tests for the clay liner or radon barrier to minimize the damage to these low permeability layers from the sand-cone test. Holes in the clay liner and radon barrier created by the nuclear density gauge shall be filled with dry bentonite. To ensure proper calibration, an oven-drying test shall be performed jointly with five percent of the nuclear moisture tests.</p>	<p>Perform sand-cone density tests and oven-drying tests to calibrate the nuclear moisture/density gauge. Review the results with the Construction QA Officer.</p> <p>When performing the sand-cone density test or the oven-drying test to calibrate the nuclear moisture/density gauge, the data obtained from the sand-cone density test or the oven-drying test takes precedence over the data obtained from the nuclear moisture/density gauge.</p>	<p>Review the results with the QC officer. Verify that the data obtained from the sand-cone density tests and oven-drying tests (when performed) are used in the calculations for ultimate acceptance of the tested media.</p>
<p><b>SAMPLING LOCATIONS FOR LOTS:</b> For sample location chosen by random numbers, two random numbers shall be employed. The first number (X) shall be between 0 and the largest east-west distance of the lot. The second number (Y) shall be between 0 and the largest north-south distance of the lot. The test location will be located at X feet east and Y feet south of the north-west corner of the lot. For a linear lot (e.g. the intersection of lifts), a single random number shall be generated.</p> <p>For borrow sources which consist of multiple lots which will be sampled by a single test pit, the test pit shall be located by two random numbers as outlined</p>	<p>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. If the sample location is outside the lot, generate two new random numbers.</p>	<p>Verify that the test methods are being chosen by random number.</p>

**LLRW and 11e.(2) CQA/QC MANUAL  
TABLE 1 - QA/QC ACTIVITIES  
WORK ELEMENT - GENERAL REQUIREMENTS**

<b>SPECIFICATION</b>	<b>QUALITY CONTROL</b>	<b>QUALITY ASSURANCE</b>
above and will be the same for all lots.		
<b>TEST METHODS:</b> All tests shall be performed in accordance with the test methods specified in Appendix B.	Use the test methods in Appendix B to perform the require testing.	Verify that the test methods being use to conduct the tests are the methods specified in Appendix B.
<b>QA AUDITING:</b> EnergySolutions shall contract with an independent firm to perform an annual audit of the CQA/QC. The auditor shall: a) audit at least 15% of the CQA\QC documentation; and b) observe QC procedures for field density/moisture tests, classification tests, Proctors, permeability tests, and surveying. A copy of the auditors report shall be submitted to the DRC.	Schedule times with the QA auditor to observe the specified testing. Cooperate with QA auditor in the review of QC documentation.	Cooperate with QA auditor in the review of QC documentation.
<b>WEEKLY CONSTRUCTION SCHEDULE:</b> During clay liner and embankment cover construction projects, including test pads, a weekly construction schedule will be provided to DRC. This specification also applies to permitted facilities under construction within Section 32. The schedule does not constitute a binding commitment; but is a reasonable estimate of when listed construction activities will occur. No submittal is required if there are no clay liner, cover, or other permitted facilities under construction.	Support the Director of Engineering in preparing the schedule for submittal.	
<b>TEST FAILURE PROTOCAL:</b> Unless otherwise specified in this Manual, any failing test shall be addressed as follows: <ol style="list-style-type: none"> <li>1. Document the failing test result in applicable QC records.</li> <li>2. Notify construction personnel of the failing test result and re-work as needed.</li> <li>3. After re-work is complete, re-test and document results.</li> <li>4. If the re-test results pass, approve the work.</li> <li>5. If the re-test results fail, direct further re-work</li> </ol>		

**LLRW and 11e.(2) CQA/QC MANUAL**  
**TABLE 1 - QA/QC ACTIVITIES**  
**WORK ELEMENT - GENERAL REQUIREMENTS**

<b>SPECIFICATION</b>	<b>QUALITY CONTROL</b>	<b>QUALITY ASSURANCE</b>
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- until passing results are achieved.
- Any circumstance where re-work is not desired or possible shall be documented on a Condition Report. The Director of Engineering or designee shall be responsible for determining and originating a Condition Report. Any circumstance addressed via Condition Report requires DRC notification and written approval prior to proceeding.

**LLRW and 11e.(2) CQA/QC MANUAL**  
**TABLE 1 - QA/QC ACTIVITIES**  
**WORK ELEMENT - FOUNDATION PREPARATION**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>SCOPE:</b> This work element applies to the <u>Class A West, Class A, Class A North,</u> and 11e.(2) embankments.</p> <p><b>CLEARING AND GRUBBING:</b> Remove vegetation, debris, organic, or deleterious material from areas to be excavated for construction of cells. Grubbing depth will depend on the type of vegetation, debris, organic, or deleterious material on the site. If the area is free of these materials then no clearing and grubbing will be necessary.</p> <p><b>EXCAVATION:</b> Excavation shall be made to the lines, grades, and dimensions prescribed in the approved plans. Any over excavation shall be backfilled with select materials and compacted to 95 percent of Standard Proctor. The uncompacted lift thickness shall not exceed 9 inches.</p> <p><b>SCARIFICATION AND COMPACTION:</b> The foundation shall consist of either: a. scarifying the in-situ clays to at least six inches and compacting it to at least 95 percent of a standard proctor or; b. inspecting the in-situ sands and if cracking of the surface is</p>	<p>Inspect the area once clearing and grubbing has been completed. Record observations and corrective actions (where required) on the "Daily Construction Report".</p> <p>Observe the cell excavation. Record observations and corrective actions taken (where required) on the "Daily Construction Report".</p> <p>In areas of over excavation, conduct in-place density tests 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 lift of a specified type of material. Test locations shall be chosen on the basis of random numbers.</p> <ol style="list-style-type: none"> <li>a. Approve lots which meet the specified compaction.</li> <li>b. Rework and retest lots not meeting the specified compaction.</li> </ol> <p>Proctors shall be performed at a rate of one test per 100,000 square feet 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".</p> <p>Observe the foundation. Record observations and corrective actions on the "Daily QC Report".</p> <p>Conduct in-place density tests at a rate of one test per lot and record the results on the "Field Density Test"</p>	<p>Verify that the clearing and grubbing has been inspected by QC.</p> <p>Observe, at a minimum, five percent of the tests performed by QC personnel to ensure that the tests and observations are being performed correctly. Verify that the tests are being performed at the correct frequency and that the documentation is being completed.</p> <p>Observe, at a minimum, five percent of the tests performed by the QC personnel to ensure that the tests and observations are being performed correctly. Verify that the tests are being performed at the correct frequency and that the documentation is being</p>

**LLRW and 11e.(2) CQA/QC MANUAL**  
**TABLE 1 - QA/QC ACTIVITIES**  
**WORK ELEMENT - FOUNDATION PREPARATION**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
observed, then scarify the in-situ sands to at least six inches and compact it to at least 95 percent of a standard proctor, or, if no cracking is observed, then compact the in-situ sands to at least 95 percent of a standard proctor without prior scarification.	<p>form. A lot is defined as a maximum of 10,000 square feet of a 6 inch lift of a specified type of material. Test locations shall be chosen on the basis of random numbers.</p> <p>a. Approve lots which meet the specified compaction.  b. Rework and retest lots not meeting the specified compaction.</p> <p>Proctors shall be performed at a rate of one test per 100,000 square feet 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".</p>	completed.
<b>FINAL GRADING:</b> The foundation for the clay liner shall be fairly smooth and free from clods, rocks, soft spots, wet areas, etc. Foundation elevations shall be at grade or below grade.	<p>Survey the foundation on a 50 ft grid and at key points. Final survey measurements will be documented and provided to the QC officer and Construction QA Officer.</p> <p>a. Indicate where the foundation meets design line and grade.  b. Rework and resurvey areas not meeting the specified grade.</p>	Review the final survey data. Verify the frequency of the survey points.
<b>UNSUITABLE MATERIAL:</b> Remove unsuitable material as required. Unsuitable material is non-soil material or soil which cannot be reworked to meet the compaction criteria.	<p>Define areas of unsuitable material and advise the project manager that such areas must be removed. Observe the areas once the unsuitable material has been removed. Report corrective actions (where required) on the "Daily Construction Report".</p>	Verify that the removal of unsuitable material has been properly documented.
<b>FOUNDATION APPROVAL:</b> Foundation to be approved by Construction QA Officer.	<p>Obtain the "Notice of Acceptance" from the Construction QA Officer before construction of the clay liner begins.</p>	Provide a "Notice of Acceptance" to the QC officer indicating that the foundation meet the required specifications.

**LLRW and 11e.(2) CQA/QC MANUAL**  
**TABLE 1 - QA/QC ACTIVITIES**  
**WORK ELEMENT - CLAY LINER BORROW MATERIAL**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>SCOPE:</b> This work element applies to the <u>Class A West, Class A, Class A North,</u> and 11e.(2) embankments.</p>		
<p><b>CLEARING AND GRUBBING:</b> Remove vegetation, debris, organic, or deleterious material from areas to be used for borrow. Grubbing depth will depend on the type of vegetation, debris, organic, or deleterious material on the site. If the area is free of these materials then no clearing and grubbing will be necessary.</p>	<p>Inspect the area once clearing and grubbing has been completed. Record observations and corrective actions (where required) on the "Daily Construction Report".</p>	<p>Verify that the clearing and grubbing has been inspected by QC.</p>
<p><b>MATERIAL:</b> Satisfactory material shall be defined as CL and ML soils based on the Unified Soil Classification with at least 85 percent passing the No. 200 sieve (silt and clay), 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 or equal to 1 inch.</p>	<p>Perform laboratory classification tests at a rate of 1 test per lot prior to use of material in the clay liner. A lot is defined as a maximum of 3,000 cubic yards (compacted) of specified material type. Record the location of the classification sample on the "Sampling Log".</p> <p>a. Approve lots (which meet the specified classification) for use in the clay liner.</p> <p>b. Lots not meeting the specified classification can not be used.</p>	<p>Verify the frequency of laboratory tests and compliance of test results.</p>
<p><b>PROTECTION:</b> The clay borrow material shall be handled in such a manner as to prevent contamination with radioactive waste material or other deleterious material. The in-place clay may contain up to 5 percent additional rocks and sand above the content found in the classification test.</p>	<p>Visually check clay liner materials for contamination by foreign materials. Remove clays which have been contaminated above the specified requirements. Document corrective actions (where required) on the "Daily Construction Report".</p>	<p>Verify that the clay liner is being inspected for contaminants and that corrective actions (if required) are properly documented.</p>
<p><b>PROCESSING:</b> These procedures may be used to provide suitable material for construction of the clay liner.</p> <ol style="list-style-type: none"> <li>1. Apply deflocculant at a rate determined by the production engineer</li> <li>2. Mix the deflocculant thoroughly into the soils by tilling or similar action.</li> </ol>	<p>Measure the mixing areas and verify that the application rate of the deflocculant is equal to or greater than the rate determined by the production engineer. Record the size of the mixing areas and the amount of deflocculant applied on the "Embankment Construction Lift Approval Form".</p> <p>Observe the mixed clay and advise the project manager of areas which are adequately mixed.</p>	<p>Verify that the size of the mixing areas and the amount of deflocculant applied have been properly documented.</p> <p>Verify that the clay is being inspected by QC.</p>

**LLRW and 11e.(2) CQA/QC MANUAL  
TABLE 1 - QA/QC ACTIVITIES  
WORK ELEMENT - CLAY LINER TEST PAD**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>SCOPE:</b> This work element applies to the <u>Class A West, Class A, Class A North,</u> and 11e.(2) embankments.</p> <p><b>NOTICE OF TEST PAD CONSTRUCTION:</b> The test pad plan shall be approved by the DRC prior to the test pad construction. The DRC shall be notified 48 hours in advance of the start-up of test pad construction.</p> <p><b>TEST PAD:</b> An approximately 60 feet by 75 feet large test pad will be constructed using the procedure proposed for construction of the clay liner.</p> <p>A small test pad with minimum dimensions of 5 feet by 5 feet will be constructed. The purpose of this small test pad is to establish equipment and procedures for construction of clay liner in locations where large equipment is not practical (e.g. repairs).</p> <p>A new test pad shall be constructed each time there is a change in specifications, construction procedures, types of equipment, unified soil classification, or QC testing equipment or procedure.</p> <p>Test pads are to be constructed and tested in accordance with the following specifications:</p> <ol style="list-style-type: none"> <li>Place the clay in at least three lifts with the first lift uncompacted thickness not exceeding twelve inches. Remaining lifts shall have a loose material thickness not exceeding nine inches for each lift. The clay material will be inspected for dry clod size during placement of each lift of clay liner.</li> </ol>	<p>Obtain documentation confirming that the test pad plan has been approved by the DRC. Verify that the DRC has been notified, as required.</p> <p>Observe the construction of test pads. Measure test pads to ensure that they are constructed to the size indicated. Record the test pad size on the "Embankment Construction Lift Approval Form".</p> <p>The large test pad shall be divided into three lots per lift (approximately 1,500 square feet per lot). Each lift of the small test pad shall equal a lot.</p> <p>Measure the lift thickness at a rate of 1 test per lot. Record thicknesses on the "Embankment Construction Lift Approval Form".</p> <p>Inspect the loose clay material during the unloading and spreading process for each uncompacted lift to ensure any dry clods that are present are less than or equal to one (1) inch. Record inspection of the clod size on the "Embankment Construction Lift Approval</p>	<p>Verify that the test pad plan has been approved by the DRC. Verify that the DRC has been notified as required.</p> <p>Observe the construction of the test pads. Verify that the test pad has been measured and is properly documented.</p> <p>Verify that the number of lifts and lift thicknesses have been documented. Verify that the clod size inspection has been performed and documented for each uncompacted lift thickness.</p>

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**TABLE 1 - QA/QC ACTIVITIES**  
**WORK ELEMENT - CLAY LINER TEST PAD**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
	Form”.	
2. The clay is to be placed and compacted by equipment proposed for use during construction of the clay liner.	Verify with the project manager that the same or similar type equipment and compaction efforts will be used in the cell for construction of the clay liner. Record type of equipment used, and number of passes on the “Embankment Construction Lift Approval Form”.	Verify equipment used and the number of passes made in preparing the test pad are those to be used during the construction of the clay liner.
3. The lifts of clay shall be bonded by: a) providing a rough upper surface on the underlying layer of clay liner. The surface should have changes in grade of approximately one inch or more at a rate of two per linear foot; <p style="text-align: center;"><b>- OR -</b></p> b) by compacting with a sheepsfoot with feet approximately two inches longer than the lift thickness.	Verify that there are adequate changes in grade by placing a straight edge at least two feet long on the surface. Count the number of points approximately one inch or more below the straight edge. <p style="text-align: center;"><b>- OR -</b></p> Verify that the feet on the sheepsfoot compactor are approximately two inches longer than the lift thickness.	Verify the frequency of measurements and compliance of test results.
4. The clay is to be compacted to at least 95 percent of a standard Proctor with a moisture content of optimum to 5 percent over optimum. Compaction of the large test pad is to be accomplished by at least four passes of suitable compaction equipment.	Conduct in-place moisture-density tests at a rate of one test per lot. The test location shall be chosen on the basis of random numbers. Record the test result on the “Field Density Test” form. a. Approve lots which 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.	Verify the frequency of tests and compliance of test results.
5. The clay is to be constructed to provide a permeability less than or equal to $1 \times 10^{-6}$ cm/sec. Permeability testing on the bottom lift will be performed at the surface. Permeability on the second lift will be performed $\geq 2$ ” below the surface. Permeability on the third lift will be performed $\geq 4$ ” below the surface.	Conduct in-place permeability tests at a rate of one test per lot per lift. The permeability test shall be run in close proximity to the moisture-density test. Record the test result on the “Field Permeability Test” form. a. Approve lots which meet the specified permeability. b. Rework and retest lots not meeting the specified permeability c. Any additional work under b. shall be included in	Verify the frequency of tests and compliance of test results.

**LLRW and 11e.(2) CQA/QC MANUAL  
TABLE 1 - QA/QC ACTIVITIES  
WORK ELEMENT - CLAY LINER TEST PAD**

<b>SPECIFICATION</b>	<b>QUALITY CONTROL</b>	<b>QUALITY ASSURANCE</b>
	the test pad construction method.	
6. At least one PI, LL, and gradation test shall be conducted for each test pad.	Conduct PI, LL, and gradation tests at a rate of one of each type of test per test pad.	Verify that the PI, LL, and gradation tests have been conducted and documented.
7. The procedures used to construct the test pad shall be reviewed and approved by the certifying engineer. The test must be approved by a Professional Engineer.	Provide the certifying engineer with copies of the documentation for the test pad for review and approval.	Verify that proper approval has been obtained for the test pad and that the necessary construction procedure documents are in place for use during clay liner construction.
8. The procedures used to construct the test pad shall be reviewed and approved by the DRC prior to using the new test pad construction method.	Obtain documentation confirming the DRC approval of the test pad.	Verify that proper approval has been obtained for the test pad and that the necessary construction procedure documents are in place for use during clay liner construction.

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TABLE 1 - QA/QC ACTIVITIES  
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SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>SCOPE:</b> This work element applies to the <u>Class A West, Class A, Class A North,</u> and 11e.(2) embankments.</p>		
<p><b>LIFT IDENTIFICATION:</b> Each lift shall be given a discrete designation for testing and surveying purposes.</p>	<p>Assign a lift identification number to each lift. Use the lift identification number to identify all paper work for that lift.</p>	<p>Verify that a lift identification number has been assigned to each lift. Verify that the lift identification number is used on all paper work for that lift.</p>
<p><b>PLACEMENT:</b> The clay liner will be prepared, placed, and compacted using the same type of equipment and mixing and compacting procedures that were approved in the test pad.</p>	<p>Observe the clay liner placement. Record the equipment used to place the clay liner and any corrective actions (where required) on the "Embankment Construction Lift Approval Form".</p>	<p>Verify the equipment used to construct the clay liner has been documented and that it is the same type of equipment used to construct the test pad.</p>
<p><b>LIFT BONDING:</b> The lifts of clay shall be bonded by:</p> <p>1) providing a rough upper surface on the underlying layer of clay liner. The surface should have changes in grade of approximately one inch or more at a rate of two per linear foot;</p> <p style="text-align: center;"><b>- OR -</b></p> <p>2) by compacting with a sheepsfoot with feet approximately two inches longer than the lift thickness.</p>	<p>Verify that there are adequate changes in grade by placing a straight edge at least two feet long on the surface. Count the number of points approximately one inch or more below the straight edge.</p> <p style="text-align: center;"><b>- OR -</b></p> <p>Verify that the feet on the sheepsfoot compactor are approximately two inches longer than the lift thickness.</p>	<p>Verify the frequency of measurements and compliance of test results.</p>
<p><b>LIFT THICKNESS:</b> The first lift of material shall have an uncompacted thickness of no greater than 12 inches. For the remaining lifts, the loose lift thickness shall not exceed the lesser of the lift thickness used to construct the test pad or nine inches. Thickness for the lift will be established by installing grade poles on at least a 70-foot grid and at all control points. The grade poles must not be installed deeper than 1 inch into the underlying clay liner. The grade poles must be marked at the appropriate depth to establish the grade. After the grade for the lift has been checked and approved by QC personnel, the grade poles shall be removed. The clay material will be inspected for dry clod size during placement of each lift of clay liner.</p>	<p>Verify that the required grading tolerance is achieved as follows:</p> <ol style="list-style-type: none"> <li>a. Ensure that the required frequency for placement of grade poles has been met.</li> <li>b. Compare soil level with the marked level on the grade poles.</li> <li>c. Use a string line where necessary between poles to check for high or low spots.</li> <li>d. Define high out of specification areas and advise the project manager to rework those areas.</li> <li>e. Review areas reworked and approve areas meeting criteria.</li> <li>f. Continue "b" through "d" above until all areas meet criteria.</li> </ol>	<p>Observe, at a minimum, five percent of the measurements performed by the QC personnel to ensure that the measurements are being performed correctly. Verify that the measurements are being performed at the correct frequency and that the documentation is being completed. Verify that the clod size inspection has been performed and documented for each uncompacted lift thickness.</p>

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	<p>g. Indicate areas meeting criteria on the “Embankment Construction Lift Approval Form”.</p> <p style="text-align: center;"><b>- OR -</b></p> <p>Dig a hole and measure the loose lift thickness at a rate of one per lot. A lot is defined as 10,000 square feet of a single lift and record on the "Lift Approval Form". The location of the measurement shall be chosen on the basis of random numbers.</p> <p>a. Approve lots which meet the specified lift thickness.</p> <p>b. If the thickness is greater than the specified thickness, measure the thickness at four points (north, east, south, and west) within ten feet of the first measurement. Average the five measurements together.</p> <p>c. Approve lifts with an average less than or equal to the specified lift thickness.</p> <p>d. Rework and retest lots with an average lift thickness greater than the specified lift thickness.</p> <p>Inspect the loose clay material during the unloading and spreading process for each uncompacted lift to ensure any dry clods that are present are less than or equal to one (1) inch. Record inspection of the clod size on the “Embankment Construction Lift Approval Form”.</p>	
<p><b>KEYING-IN:</b> Segments of cell 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 twice as wide as they are high.</p> <p><b>COMPACTION:</b> Clay liner material will be compacted to at least 95 percent of standard Proctor with a moisture content between optimum and 5 percent over optimum.</p>	<p>Verify that the new liner has been properly keyed-in to the existing liner. Record deficiencies on the “Embankment Construction Lift Approval Form”.</p> <p>Conduct in-place moisture-density 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.</p> <p>a. Approve lots which meet the specified moisture and</p>	<p>Verify that the keying-in of the liner has been documented.</p> <p>Observe, at a minimum, five percent of the tests performed by the QC personnel to ensure that the tests and observations are being performed correctly. Verify that the tests are being performed at the correct frequency and that the documentation is being completed.</p>

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	<p>compaction.</p> <p>b. Rework and retest lots not meeting the specified moisture or compaction.</p> <p>Proctors shall be performed at a rate of one test per borrow lot. A borrow lot is defined as 3,000 cubic yards (compacted) or less of a specific material type. Record the location of the Proctor sample on the "Sampling Log".</p>	
<p><b>PERMEABILITY:</b> Clay liner will have an in-place permeability less than or equal to <math>1 \times 10^{-6}</math> cm/sec.</p>	<p>Conduct in-place permeability tests at a rate of one test per lot and record the results on the "Field Permeability Test" form. A lot is defined as 2,000 cubic yards (compacted) of clay liner. The permeability test shall be run in close proximity to a moisture density test location.</p> <p>a. Approve lots which meet the specified permeability. b. Rework and retest lots not meeting the specified permeability. c. Restore all test areas to assure no leaks.</p>	<p>Observe, at a minimum, five percent of the tests performed by the QC personnel to ensure that the tests and observations are being performed correctly. Verify that the tests are being performed at the correct frequency and that the documentation is being completed.</p>
<p><b>LINER DRYING PREVENTION:</b> To prevent the clay liner from drying, water will be applied to the clay surface on an as needed basis or the liner will be covered with six inches of loose clay or 12 inches of loose waste. Newly constructed liner will be covered with six inches of loose clay or 12 inches of loose waste within 15 days of liner completion. Desiccation cracks larger than one-fourth inch wide and one-inch deep in the clay liner will be reported to the DRC and will be documented as a non-conformance item when discovered.</p>	<p>Observe the liner surface for drying. Advise the project manager of any deficiencies. Record corrective actions taken (where required) on the "Daily Construction Report".</p>	<p>Verify that the liner is being inspected.</p>
<p><b>SNOW REMOVAL:</b> When clay liner material is to be placed and the work area is covered with snow, the snow must be removed.</p>	<p>Observe that snow is removed. Advise the project manager of any deficiencies. Construction may not continue without taking corrective action to remove the snow. Record these corrective actions (where required)</p>	<p>Verify that snow removal is being documented.</p>

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<p><b>COLD WEATHER PLACEMENT OF CLAY LINER:</b> For purposes of this CQA/QC Manual, “frozen” is defined as a soil temperature of less than or equal to 27°F. Clay liner shall not be placed above frozen material. In addition, no frozen material shall be processed or placed.</p> <p>If the air temperature has dropped below 32°F since the last lift of clay liner was approved, one of the following three scenarios apply:</p> <p>(1) If less than 30 days have passed since the date of lift approval and the last lift of clay liner has been covered since the approval date with at least 9 inches of loose clay or 6 inches of compacted clay, then the cover clay may be worked with no additional testing of the lower approved lift.</p> <p>(2) If less than 30 days have passed since the date of lift approval and the last lift of clay liner has not been covered with at least 9 inches of loose clay or 6 inches of compacted clay, then:</p> <p>(a) Perform spring start-up testing as discussed below; or</p> <p>(b) 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 density and permeability of the affected area after the clay temperature has risen above 27°F.</p> <p>(3) If more than 30 days have passed since the date of lift approval, perform spring start-up testing.</p>	<p>in the "Daily Construction Report".</p> <p>As needed, observe the area where clay liner is to be placed. If frozen material is observed, cease placement of clay liner. If frozen material is suspected, measure soil temperature. Record the stopping of placement in the "Daily Construction Report."</p> <p>Review ambient air temperature records as measured at the site meteorological station. Document status of clay liner cover placement on the "Daily Construction Report." Monitor liner/foundation temperature when triggered under 2.(b). Clay temperature shall be measured between 6:00 am and 8:00 am on the day that clay liner will be placed. Temperature measurements shall include a location that is most likely to be coldest; 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 100,000 square feet or one point per contiguous project area, whichever is smaller.</p> <p>If the initial clay temperature measurement is less than or equal to 27°F, the affected area may be resampled before 8:30 am the same day as follows:</p> <p>a. Measure the liner/foundation temperature at a frequency of one measurement per lot (defined as no more than 10,000 square feet).</p> <p>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.</p>	<p>Verify that clay liner is tested during cold weather conditions.</p>

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<p><b>SPRING START-UP:</b> See “Cold Weather Placement of Clay Liner” above for situations that trigger this specification.</p> <p>For spring start-up testing, the surface lift is treated as protective cover, regardless of whether it was an approved lift of clay liner at one time or not. Excavate 9 inches below the clay surface and re-test for density and permeability. Excavation for testing purposes may consist of removing 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 level of effort as prescribed by the approved test pad for liner construction.</p> <p>Spring start-up testing shall be conducted on 11e.(2) embankment lift areas S-11, R-12, L-12, H-12, and D-12 prior to and in the same construction season as initial waste placement for each area.</p> <p><b>CONTAMINATION OF CLAY LINER:</b> The clay liner material shall not become contaminated with radioactive soils or debris during construction. The in-place clay may contain up to 5 percent additional rocks and sand above the content found in the classification test.</p> <p><b>FINAL GRADING:</b> Final grading shall be from grade to above grade. Survey on a 50 ft grid and key points to verify the minimum design liner thickness requirement is met.</p>	<p>Perform density and permeability testing at the frequencies outlined for liner construction above. This testing may be performed outside of the approved lift area so long as the area tested is representative of the clay in the approved lift area (i.e., was constructed at the same time and with the same method). Moisture testing is not required for spring start-up.</p> <p>a. Approve lots that meet specification. The protective cover lift may then be worked in place and tested to become the next lift of clay liner.</p> <p>b. For lots that do not meet specification, test the surface at successively deeper 9 inch increments until a passing lift is found; remove all failing lifts; re-work all failing areas; and re-test.</p> <p>Document that repairs are completed to the same level of effort as required by the approved test pad for clay liner construction.</p> <p>Visually check clay liner for contamination by foreign materials. Remove clays which have been contaminated above the specified requirements.</p> <p>Survey the foundation on a 50 ft grid and at key points. Final survey measurements will be documented and provided to the QC officer and Construction QA Officer.</p> <p>a. Indicate where the clay liner meets design line and grade.</p> <p>b. Rework and resurvey areas not meeting the</p>	<p>Verify that removal of contaminated material has been properly documented.</p> <p>Review the final survey data. Verify the frequency of the survey points.</p>

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	specified grade.	
<b>HEAVY EQUIPMENT ON CLAY LINER:</b> Heavy equipment travel will be minimized on top of the finished clay liner. Heavy equipment will not be operated on saturated clay liner.	Observe work on clay liner. Advise the project manager of problems with equipment on the clay liner. Record corrective actions taken (where required) on the "Daily Construction Report".	Verify that the work is being inspected.
<b>DRC APPROVAL:</b> The DRC shall approve documentation associated with completed clay liner. Documentation shall include all QC and QA records associated with clay liner construction, as well as photographs of the completed liner surface. In addition, 48 hour notification shall be provided to the DRC prior to placement of soil material over the clay liner (waste or soil protective cover). However, DRC approval of clay liner documentation is not required prior to placement of waste material over the clay liner.	Notify the Construction QA Officer that the clay liner is prepared and ready for inspection by the DRC. Obtain written authorization on the "Liner Inspection Form" from the Construction QA Officer that the clay liner has been inspected. Obtain documentation confirming the DRC approval of the clay liner documentation.	Provide written approval of the clay liner prior to the placement of material over clay liner (waste or soil protective cover). Notify the DRC that the clay liner is prepared and ready for inspection at least 48 hours prior to covering with soil material.
<b>LINER PROTECTIVE COVER:</b> At least 1 ft of compacted native soils, free of debris, shall be constructed on top of the clay liner. This layer is termed Liner Protective Cover. Liner Protective Cover shall be placed in accordance with the lift thickness and compaction requirements specified under Work Element – Waste Placement or in accordance with the lift thickness and compaction requirements specified under Work Element – Clay Liner Placement. Contaminated equipment may be used to place Liner Protective Cover.	Verify and test Liner Protective Cover in accordance with the specifications for the relevant Work Element (Clay Liner Placement or Waste Placement).	
<b>QUALITY ASSURANCE SAMPLING:</b> Assurance samples for clay liner materials tests are to be obtained at the following minimum frequency:  1. In-place moisture-density tests (ASTM D6938): 1 per 50,000 cubic yards (compacted).	Coordinate with QA personnel in obtaining the quality assurance samples. Record the samples on the "Sample Log" and moisture-density test on the "Density Testing Log". Promptly report result of QC testing to Construction QA Officer so that a comparison of QA and QC testing results can be made.	Conduct or coordinate quality assurance sampling and testing in accordance with the designated frequencies. Obtain test results of QC samples so that a comparison of QA and QC test results can be made. The Construction QA Officer, in consultation with the QC officer, shall be responsible for determining the adequacy of correlation and documentation of the

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<p>2. Moisture/density relationship testing (ASTM D698): 1 per 50,000 cubic yards (compacted).</p> <p>3. Classification tests (ASTM D2487, D1140, and D4318): 1 per 50,000 cubic yards (compacted).</p> <p>A minimum of one of each of the above tests is required for each year that clay liner is placed.</p>		<p>rationale used to determine adequacy. If the correlation is not adequate, new QC and QA samples shall be taken immediately. The Construction QA Officer, in consultation with the QC officer, shall then evaluate the accuracy of the QC sampling and testing and, if necessary, provide for improved sampling and testing procedures and closer inspection and control. Record findings of the quality assurance sampling in the "Daily QA Report".</p>

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**SCOPE:** This work element applies to the Class A West, Class A, Class A North, and 11e.(2) embankments.

**APPLICABILITY:** This work element is applicable to waste placed with the CAT 826 compactor. With prior DRC approval, this work element may be implemented by equipment demonstrated to perform equivalent to the CAT 826 compactor.

**DEFINITIONS:**

Machine Pass is defined as movement of the compactor across an area of the lift in any direction, which also meets compaction criteria calculated by an algorithm in the compactor's system. For example, movement of the compactor from south to north across the lift, which also meets compaction criteria calculated by an algorithm in the compactor's system, constitutes one machine pass; the return trip from north to south, which also meets compaction criteria calculated by an algorithm in the compactor's system, constitutes a second pass.

Wheel Pass is defined as movement of any of the compactor's drums across an area of the lift, which also meets compaction criteria calculated by an algorithm in the compactor's system. Since there are forward and rear drums on the CAT 826 compactor, each machine pass constitutes two wheel passes. The CAES compaction tracking system reports wheel passes.

**LINER PROTECTION:** The compactor shall not be operated on the surface of finished clay liner or on the surface of the Liner Protective Cover directly over the clay liner. The compactor may not be used to compact the first lift of waste above the Liner Protective Cover.

Document equipment used for compaction on the Lift Approval Form.

When disposal and compaction is being performed on or adjacent to the first lift above the Liner Protective Cover, observe compactor operation for protection of the liner and Liner Protective Cover. Document observations on the Daily Construction Report.

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When operating on a slope that terminates on the surface of the first lift of waste above the Liner Protective Cover, the compactor shall be operated in a manner to prevent impact to the Liner Protective Cover.		
<b>LIFT IDENTIFICATION:</b> Each lift shall be given a discrete designation.	Assign a lift identification number to each lift. Use the lift identification number to identify all paper work for that lift. Summarize all lifts on the lift summary form or master sheet.	Verify that a lift identification number has been assigned to each lift. Verify that the lift identification number is used on all paper work for that lift.
<b>LIFT ACCEPTANCE:</b> At the time of acceptance, the date and time of lift approval shall be recorded.	Record the date and time of lift approval on the lift approval form.	Verify that the date and time of lift approval is recorded on the lift approval form.
No waste material will be disposed on a lift until the prior lift is approved, except for management of in-cell bulk disposal	Verify that the previous waste lift has been approved prior to waste disposal.	
<b>LIFT THICKNESS:</b> The waste material will be placed in lifts with a compacted average thickness not exceeding 24 inches.	<p>Survey the mean elevation of the top of each lift by surveying at least five points and taking the average. Where practical, survey the corners and at least one spot in the middle. Survey measurements will be documented and forwarded to the Construction QA Officer. Lift thickness may also be verified via GPS.</p> <p>a. Approve lifts with an average less than or equal to the specified lift thickness.</p> <p>b. Remove excess material from the thicker areas of the lift if the average lift thickness is greater than 24 inches, and re-compact lift in the areas where wastes are removed.</p> <p style="text-align: center;">OR</p> <p>Download the CAES system report of beginning and ending lift elevations. For lifts that are not sloped, survey data may be used for beginning lift elevation. Lift thickness shall be reported using CAES in accordance with operating procedure CL-QC-PR-038.</p>	<p>Perform a monthly assessment of the survey documentation performed by the QC personnel to ensure that the measurements and observations are being performed correctly. Verify that the surveys are being performed at the correct frequency and that the documentation is being completed.</p> <p>Verify that the survey data has been received from the QC personnel.</p>

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	When calculating the average lift thickness on a side slope, no point shall be more than 2.1'. If CAES is used to document lift thickness on the side slope, there shall be no white pixels shown in the lift.	
<b>LIFT AREA:</b> Identify the dimensions and the location of the northwest corner of the lift. There is no minimum lift area for this work element.	Locate the northwest corner of each lift, and document the location and lift dimensions.	
<b>CLASSIFICATIONS:</b> Soil classification testing is not required for waste placed using this work element.		
<b>TERRACING OF LIFTS:</b> As new lifts are placed next to old lifts, at least one foot, measured horizontally, shall be removed from the outer edge of the old lift (except for CLSM lifts).	Inspect the intersections of old and new lifts. Verify that the outer one foot of the old lifts are being removed (except for CLSM lifts). Record any problems on the "Daily Construction Report".	Verify that the required inspections are being performed.
<b>COMPACTION WITH CAES:</b> When using the CAES system, each lift and lift interface shall be compacted by at least 4 machine passes with the CAT 826 compactor. The lift surface shall be firm and unyielding to the compactor's weight. A minimum of 90% of the grid points reported for the lift by CAES shall exhibit adequate compaction and machine passes. Adequate compaction as well as meeting the minimum number of wheel passes is reported by CAES when the pixel turns green. Furthermore, a maximum of 5 non-green pixels shall be adjacent to each other within the lift area limits. "Adjacent" means that two pixels share a common side; pixels that share only a common corner are not adjacent to each other.	Document the CAES system report of compaction for each lift area. Compactive effort is reported by CAES on a roughly 3.3' x 3.3' grid; with each on-screen pixel representing one square meter. Ensure that the CAES reports a minimum of 4 machine passes (i.e., 8 wheel passes) for at least 90% of the grid points in the lift, as detailed in operating procedure CL-QC-PR-038. Record this information on the Lift Approval Form. Perform a QC inspection of the compacted lift by observing the CAES control screen for evidence of uniform and adequate compaction. This condition is indicated by having a majority of the screen light green, with only isolated pixels in other colors. Evaluate all pixels that are not green to ensure the maximum number of adjacent pixels is not exceeded. Print the screen as a color image and include with the lift approval form. Record QC inspection results on the Lift Approval Form.	Perform a monthly assessment of the compaction documents generated by the QC technician.
a. Additional compaction may be required if, after the minimum number of passes is complete, the minimum percentage of grid points do not exhibit adequate compaction, as reported by the CAES system.		

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<p>b. Evaluate the lift interface when compacting adjacent to previously poured CSLM. Visually inspect for obstructions (e.g., CLSM surface, irregularities in CLSM side slope, etc.) that may affect compaction data. More than 5 non-green adjacent pixels are permitted in this situation if QC visually observes and documents a minimum of 6 machine passes to within 12 inches of the obstruction.</p>	<p>Perform a visual inspection of the CLSM/Soil interface. Identify areas of the CLSM pour that present an obstacle for the 826 compactor. Visually observe the compactor operator make a minimum of 6 machine passes to within 12 inches of the obstruction. Document the observations on the Lift Approval form.</p>	
<p><b>COMPACTION WITHOUT CAES:</b> If the CAES system is not available to be used for compaction under this work element, the following requirements apply.</p> <ol style="list-style-type: none"> <li>1. Verbal notice shall be provided to DRC within 24 hours of beginning to approve lifts without CAES. This notice may be provided via email.</li> <li>2. Written notice shall be provided to DRC no later than 3 calendar days (72 hours) after beginning to approve lifts without CAES. The written notice shall explain why CAES is down; an estimate of when CAES will be back online; a map of the areas being compacted without CAES; and a map of pre-final cover settlement monitoring points over the area being compacted without CAES.</li> <li>3. Compaction without CAES is limited to 10 calendar days per occurrence.</li> </ol> <p>Each lift and lift interface shall be compacted by at least 6 machine passes with the CAT 826 compactor. The lift surface shall be firm and unyielding to the compactor's weight. Additional compaction may be required if, after the minimum number of passes is complete, any of the following are observed:</p> <ol style="list-style-type: none"> <li>a. The lift surface exhibits ruts or compression (excluding depressions caused by the tines of the</li> </ol>	<p>Document that the minimum number of passes is completed for each lift area. Passes shall be counted by the QC technician or by using a GPS unit communicating with the GPS unit on the compactor.</p> <p>Perform a visual inspection of the compacted lift surface. If rutting or other indications of inadequate compaction are present, direct the equipment operator to complete additional passes until the situation is corrected. If additional passes are unable to correct the situation, moisture adjustment or other corrective actions may be needed and the lift shall not be approved until these actions are completed.</p> <p>Survey lift elevation and thickness in accordance with the specification "Lift Thickness" above, with the further requirement that the greater of the following number of points shall be surveyed per lift:</p> <ol style="list-style-type: none"> <li>a. At least 5 points; or</li> <li>b. One point per 2,000 square feet of lift area.</li> </ol> <p>Record number of passes and visual inspection results on the Lift Approval Form.</p>	<p>Perform a monthly assessment of the compaction documents generated by the QC technician.</p>

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<p>compactor wheel) in excess of four inches;</p> <p>b. The waste material exhibits pumping behavior, or has other indications of excess moisture content; or</p> <p>c. The lift does not appear to be uniformly compacted.</p> <p><b>DEBRIS PLACEMENT WITH THE COMPACTOR:</b> For purposes of this work element, debris shall be defined as provided in the work element "Waste Placement", below.</p> <p>Debris placed in accordance with this work element shall be limited to no more than 50% by volume of the compacted volume of the lift. The debris shall be uniformly distributed across the lift.</p> <p>Lifts containing materials susceptible to wind dispersal shall be covered with soil-like waste, fill material, or a commercial fixative so that these materials are secured by the end of the shift the materials were placed into the lift. "Secure" means a visual inspection to confirm that cover material has been applied to all materials susceptible to wind dispersal so that no material is obviously blowing around. Plastic, etc., may be visible at the surface.</p> <p><b>DEBRIS SIZE:</b> All debris placed in accordance with this work element shall be less than 10 inches in at least one dimension and no longer than 12 feet in any dimension. Note: bags of asbestos-containing debris may be larger than 10 inches in all dimensions before compaction.</p>	<p>Determine the volume of debris. Volume determination shall be established by either: a) inspecting the debris on the lift and calculating the quantity of debris, or b) using the manifested waste volume for shipments placed on the lift.</p> <p>Inspect debris once it is spread out on the lift and prior to placement of fill material. Ensure that debris is spread out uniformly across the lift and in a manner to minimize void spaces and does not exceed volume requirements. Document the debris inspection on the Lift Approval Form. Record the debris fill calculations and estimates on the Lift Approval Form.</p> <p>Document cover material used, location, and result of visual inspection to ensure materials are secure on the "Daily Construction Report".</p> <p>Inspect debris placed in soil lifts to ensure that it meets the debris size requirements.</p>	<p>Observe in the field that the debris calculations and estimates are being performed and properly documented. Review documentation to verify that the visual observations of debris shipments are being properly performed by QC personnel or that the manifested volume of waste is used to calculate the volume of fill material required.</p>

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<b>SPECIFICATION</b>	<b>QUALITY CONTROL</b>	<b>QUALITY ASSURANCE</b>
<p><b>SNOW REMOVAL:</b> When waste material is to be placed and the work area is covered with snow and/or ice, the snow and/or ice must be removed so that no more than ¼ inch remains on the surface. Isolated individual clumps of snow and/or ice may be present, but shall be no larger than 2 inches in diameter.</p>	<p>Observe that snow is removed. Advise the project manager of deficiencies. Construction may not continue without corrective action. Record corrective action (where required) in the "Daily Construction Report".</p>	<p>Verify that snow removal is being performed and documented.</p>

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SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>SCOPE:</b> This work element applies to the <u>Class A West, Class A, Class A North,</u> and 11e.(2) embankments.</p>		
<p><b>LIFT IDENTIFICATION:</b> Each lift shall be given a discrete designation for testing and surveying purposes.</p>	<p>Assign a lift identification number to each lift. Use the lift identification number to identify all paper work for that lift.</p>	<p>Verify that a lift identification number has been assigned to each lift. Verify that the lift identification number is used on all paper work for that lift.</p>
<p><b>LIFT ACCEPTANCE:</b> At the time of acceptance, the date and time of lift approval shall be recorded.</p>	<p>The QC technician shall record the date and time of lift approval on the lift approval form.</p>	<p>Verify that the date and time of lift approval is recorded on the lift approval form.</p>
<p>No waste material will be disposed on a lift until the prior lift is approved, except for management of in-cell bulk disposal</p>	<p>Verify that the previous waste lift has been approved prior to waste disposal.</p>	
<p><b>LIFT THICKNESS:</b> The radioactive disposal material will be placed in lifts with a compacted average thickness not exceeding 12 inches (except CLSM lifts).</p>	<p>Survey the mean elevation of the top of each lift by surveying at least five points and taking the average. Where practical, survey the corners and at least one spot in the middle. Survey measurements will be documented and forwarded to the Construction QA Officer.</p> <ol style="list-style-type: none"> <li>a. Approve lifts with an average less than or equal to the specified lift thickness.</li> <li>b. Remove excess material and retest lots with an average lift thickness greater than the specified lift thickness.</li> </ol>	<p>Observe, at a minimum, five percent of the surveys performed by the QC personnel to ensure that the measurements and observations are being performed correctly. Verify that the surveys are being performed at the correct frequency and that the documentation is being completed.</p> <p>Verify that the survey data has been received from the QC personnel.</p>
<p><b>LIFT AREA:</b> The lift area shall be at least 10,000 square feet except CLSM, Containerized Waste Facility, and Mixed Waste lifts. Identify the dimensions and the location of the northwest corner of the lift.</p>	<p>Locate the northwest corner of each active lift, and determine the dimension.</p> <ol style="list-style-type: none"> <li>a. Allow placement to continue on any lift that meets the lift area requirement.</li> <li>b. Stop placement on any lift which does not meet the lift area requirements.</li> <li>c. The Construction QA Officer may grant a waiver, for up to five percent of the lifts, if it is deemed impracticable to place at the specified lift area (e.g. a narrow lift on the outside edge of the cell). Insufficient material from a specific generator does</li> </ol>	<p>Verify that the lift area meets the lift area requirements.</p>

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**SPECIFICATION**

**QUALITY CONTROL**

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**COMPACTION:** Each lift shall be compacted to 90 percent of a standard Proctor, except lifts with greater than ten (10%) compressible debris, which shall be compacted to a minimum of 95 percent of a standard Proctor. The moisture content of all lifts shall be equal to at least 2 percent and no greater than up to 3 percentage points above the optimum moisture (except for CLSM lifts).

not constitute grounds for a waiver.

Except for CLSM lifts, conduct in-place moisture-density tests at a rate of one test per lot and record the results on the "Field Density Test" form. A lot is defined as 1,000 cubic yards (compacted) of a single lift. At least one test will be performed per lift. At least one test will be performed per soil type in the lift. The test location shall be chosen on the basis of random numbers. Approve lots when:

- a. Material is observed to be properly compacted throughout the lot;
- b. Moisture/density tests performed meet moisture and compaction specifications.

Outliers shall be resolved according to the following:

- a. For lot sections where the material is observed to not be properly compacted throughout the entire lot:
  - 1) Identify the section requiring further compaction and rework the material until it is observed to be adequately compacted;
  - 2) Perform moisture/density testing as outlined above.
- b. For lots where the dry density reading from a nuclear gauge moisture/density test is less than or equal to the required percentage of the standard Proctor:
  - 1) Identify the section(s) of the lot (including dimensions) requiring further compaction, and re-work the material. Re-test at the location previously tested. Test one more location in the re-worked lot section. Identify the test location using the lot section dimensions and random numbers.
    - If the test results from both tests meet moisture/density requirements, approve the lot;
    - If either test fails, repeat the above process

Observe, at a minimum, five percent of the tests performed by the QC personnel to ensure that the tests and observations are being performed correctly. Verify that field moisture/density tests are being performed at the correct frequency and that the documentation is being completed.

Ensure that resolution of any outliers is properly accomplished and documented.

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	<p>until all tests at both locations meet moisture and compaction requirements.</p> <p style="text-align: center;"><b>- OR -</b></p> <p>2) If the lot is observed by the QC Technician to be adequately compacted, investigate the reason for the low density reading. If it is determined that the test results were <u>improperly influenced</u> (e.g. debris directly beneath the gauge), take two more density tests within 5 feet of the original test. <b>NOTE: <u>All tests are to be recorded.</u></b></p> <p style="padding-left: 20px;">- If the results from both tests are above the required compaction requirements, record both tests and approve the lot.</p> <p>If either test fails to meet moisture/density specifications – and the test results were not improperly influenced as described above - follow instructions for a.1 above.</p> <p>Proctors shall be performed at a rate of one test per 15,000 cubic yards (compacted) or less of a specific material type.</p>	<p>Observe, at a minimum, five percent of the tests performed by the QC personnel to ensure that the tests and observations are being performed correctly. Verify that proctor tests are being performed at the correct frequency for each specific material type and that the documentation is being completed properly.</p>
<p><b>CLASSIFICATIONS:</b> One soil classification test shall be performed at six month intervals for each large soil waste generator.</p>	<p>Perform a soil classification test (ASTM D2487) every six months for each large soil waste generator. A large soil waste generator is defined as a generator disposing of at least 30,000 cubic yards (compacted) of compactable soil in a given calendar year. Record the location of the classification sample on the "Sampling Log".</p>	<p>Verify the frequency of laboratory tests.</p>
<p><b>TERRACING OF LIFTS:</b> As new lifts are placed next to old lifts, at least three feet, measured horizontally, shall be removed from the outer edge of</p>	<p>Inspect the intersections of old and new lifts. Verify that the outer three feet of the old lifts are being removed (except for CLSM lifts). Record any problems</p>	<p>Verify that the required inspections are being performed.</p>

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<p>the old lift (except for CLSM lifts).</p> <p><b>INTERSECTION OF LIFTS:</b> In addition to the density testing of the lift, an average of one density test per three lifts shall be performed at the old/new-lift interfaces. For lifts intersecting with CLSM lifts, the interface density testing is performed on the non-CLSM lift within 2 feet of the CLSM interface.</p>	<p>on the "Daily Construction Report".</p> <p>Conduct in-place moisture-density tests at an average rate of one test per three lifts and record the results on the "Field Density Test" form. For each lift random numbers between 0 and 1 shall be generated. If the random number is 0.65 or greater, then a moisture-density test is required on the lift interface between the new lift and old lift. On lifts requiring an interface test, the test location shall be chosen on the basis of a random number. For intersections with CLSM, perform a density test on the non-CLSM portions of the intersection within 2 feet of the CLSM interface.</p> <ol style="list-style-type: none"> <li>a. Approve lots which meet the specified compaction.</li> <li>b. Rework and retest lots not meeting the specified compaction.</li> </ol>	<p>Observe, at a minimum, five percent of the tests performed by the QC personnel to ensure that the tests are being performed correctly. Verify that tests are performed at the correct frequency and the documentation has been completed.</p>

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<b>DEBRIS PLACEMENT</b>		
<p><b>DEBRIS DEFINITION:</b> For the purposes of this CQA/QC project plan, debris is defined as any radioactive waste for disposal other than compactable soils. Compactable soil is defined as: (a) having a graded material that will pass through a four inch grizzly; (b) as having a bulk density greater than seventy pounds per cubic foot dry weight in accordance with ASTM D-698; and (c) having soil-like properties (i.e., standard tests in accordance with waste placement procedures can be performed. Additionally, debris shall be classified as either incompressible debris (i.e. concrete, stone, or solid metal) or compressible debris (all other debris types). A large object is defined as any debris that does not have at least one dimension less than 10-inches or that has any dimension in excess of 12-feet. A large component is defined as a large object that weighs more than 100,000 pounds.</p> <p><b>DEBRIS PLACEMENT METHODS:</b> Debris may be placed in the embankment using two different methods: 1) placement of the debris in a lift with compactable soil at a limited ratio of debris to soil, or 2) placement of the debris in a lift and in-filling the debris with Controlled Low Strength Material (CLSM).</p> <p>For placement of large components, the maximum allowable load on the clay liner surface must be less than 3000 psf.</p> <p>When CLSM is required as structural fill in the Large Component Engineering Review in order to meet the load specification, the first 4 feet of CLSM shall be placed around the large component within 30 calendar days of large component disposal.</p>	<p>No action required.</p>	<p>No action required.</p>
	<p>Perform a Large Component Engineering Review. Ensure that the bearing pressure at the clay liner surface meets specification for the load associated with placement of any large component.</p> <p>Document the following on the Lift Approval Form:</p> <ol style="list-style-type: none"> <li>Date of large component disposal and date of CLSM pour.</li> </ol>	

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<p><b>DEBRIS QUANTITY IN SOIL WASTE LIFTS:</b> Debris that is placed in the embankment with compactable soil shall be limited to a portion of the total volume of the waste lot. Furthermore, the debris shall be uniformly distributed across the lot.</p> <p>Lifts containing materials susceptible to wind dispersal shall be covered with soil-like waste, fill material, or a commercial fixative so that materials susceptible to wind dispersal are secured by the end of each working day.</p> <p>A lot is defined as an area for the placement of waste from a single generator. The volume of a lot is limited to one thousand (1000) cubic yards for testing purposes. A lift is defined as one or more lots which are compacted and tested together to meet lift placement requirements. The minimum fill required will be controlled by the volume of uncompacted debris placed in the lift.</p> <p>For compressible debris, the volume of the debris in a lot shall be limited to less than or equal to thirty percent (30%) by volume of the calculated compacted volume of the lot.</p> <p>Incompressible debris (concrete, stone, or solid metal) may be placed in a lot up to twenty-five percent by volume of the calculated compacted volume of the lot. When combining the two types of debris in one lot, the above volume limit applies and the maximum volume of all debris shall be less than or equal to 25 percent. At least one moisture/density test shall be performed per soil type in the lift.</p>	<p>For shipments containing debris material, determine the volume of debris for the shipments. Volume determination shall be established by either a) inspecting the debris in the shipment and calculating the quantity of debris, or b) using the manifested waste volume.</p> <p>Visually inspect lifts containing materials susceptible to wind dispersal are covered with soil-like waste or fill material by the end of each working day.</p> <p>Inspect debris once it is spread out on the lot and prior to placement of fill material. Ensure that debris is spread out uniformly across the lot and in a manner to minimize void spaces and does not exceed volume requirements. Document the debris inspection on the "Lift Approval Form." Record the debris fill calculations and estimates on the "Lift Approval Form".</p>	<p>Observe in the field that the debris calculations and estimates are being performed and properly documented.</p> <p>Review documentation to verify that the visual observations of debris shipments are being properly performed by QC personnel or that the manifested volume of waste is used to calculate the volume of fill material required.</p>

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<p><b>DEBRIS SIZE:</b> All debris placed in soil waste lifts shall be less than ten (10) inches in at least one dimension, and no longer than twelve (12) feet in any dimension. Note: bags of asbestos-containing debris may be larger than 10 inches in all dimensions before compaction.</p> <p><b>RESIN LIFTS:</b> Unless disposed in the Containerized Waste Facility, resins shall be disposed as follows or in accordance with the specification “CLSM Pours with Resin-Filled Containers” below. For resin lifts, resins will be less than one inch thick, at any location on the surface of the lift, prior to tilling.</p> <p>Ion Exchange Resin (IER) must be blended with native clay that meets the CL classification in a minimum ratio of 1:9 (one part IER to nine parts CL clay) on a volumetric basis. This native clay shall be tested by ASTM method D-2487 at a rate of one test every 250 cubic yards.</p> <p>Blending of IER must take place where native soil has been placed and approved by the Construction Quality Control Officer (CQCO) as a marker layer over the previous lift. The CQCO may approve the 6-inch fill cover for the 10% debris lifts as the bottom marker layer provided verification of the following: 10% debris is placed in previous lifts; and cover fill is native soil that is distinguishable from the previous lift and resin clay.</p> <p>Exposed blended resins shall be compacted, tested and approved after placement of at least 2-inches of native soil cover. A minimum of 2-inches of native soil cover must be placed by the end of each workday. The minimum 2-inch native soil cover may be used to blend the resin in the next lift.</p>	<p>Inspect debris placed in soil lifts to ensure that it meets the debris size requirements.</p> <p>For resin lifts, inspect the spread resin prior to tilling to ensure:</p> <ol style="list-style-type: none"> <li>a) resin is less than one inch thick at any location on the surface of the lift;</li> <li>b) resin is spread throughout the resin lift area;</li> <li>c) there are no areas larger than 25 ft<sup>2</sup> without resin;</li> <li>d) there are no depressions or wheel ruts deeper than one inch.</li> <li>e) verify native clay meets CL classification and is blended at a 9 to 1 ratio.</li> <li>f) Verify a minimum of 2-inches of native soil cover must be placed by the end of each workday.</li> </ol> <p>Require additional spreading for any resin lift not meeting these specifications. Record the debris inspection on the Lift Approval Form.</p> <p>Notify DRC during normal working hours of placement of blended materials at least 24 hours prior to covering beyond this 2” clay layer in order to allow inspection and sampling of placed blended materials.</p>	<p>Review documentation associated with debris lifts to verify that debris inspections are being performed.</p> <p>Review documentation associated with resin lifts to verify blending and disposal requirements are being performed.</p>

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<b>CLSM POURS:</b>		
<p><b>CLSM PYRAMID:</b> 1) CLSM lifts shall form a pyramid with a maximum 3H:1V outside edge slope. Thus, with a six foot CLSM lift and six inch (6”) cap, the next CLSM lift must be constructed to minimum of 19.5 feet inside the edge of the lift immediately below it. 2) The pyramid base dimensions and maximum 3H:1V side slope requirements will control the location of all subsequent CLSM lifts throughout the full height of the embankment. 3) Adjacent pyramids shall not be placed above any portion of previous CLSM pyramids.</p>	<p>Determine the location of the northwest corner and the dimensions of each lift and document on the ES-1904 form. Use the lift location and dimensions to ensure compliance with the CLSM pyramid specification. Document the dimensions of the previous CLSM lift on the ES-1904 form diagram. In locating a new pyramid, document on the ES-1904 form:</p> <ul style="list-style-type: none"> <li>a) The pyramid base is placed on the Liner Protective Cover; or,</li> <li>b) The pyramid base has not been placed above a previously placed pyramid</li> </ul>	<p>Verify compliance with the CLSM pyramid specification and proper documentation of the QC requirements.</p>
<p>CLSM Lift Preparation: The average height of each pour shall be limited to six feet. Large objects taller than six feet shall be poured with the subsequent CLSM pours (in layers) until completion.</p>	<p>Perform an inspection of the preparation of debris for placement with CLSM. Ensure that the average formed height of the CLSM lift is less than six feet and that any large objects are localized into specific areas. Also, ensure that debris is placed in a manner to minimize the possible entrapment of air during the CLSM pour and to allow maximum in-filling of the debris. Document the inspection on the CLSM Inspection Form.</p>	<p>Review inspection documentation to ensure that inspections are performed and properly documented.</p>
<p>Debris disposed with CLSM will be placed to minimize the entrapment of air in the CLSM pour.</p>		
<p><b>DRC NOTIFICATION FOR CLSM POURS:</b> The DRC shall be notified at least 48 hours in advance of any CLSM pour. A CLSM pour will be defined as a formed area approved and documented by Engineering for CLSM designated on a waste lift.</p>	<p>Verify that the DRC has been notified at least 48 hours in advance of any CLSM pour. Document DRC notification on the “Daily Construction Report”.</p>	<p>Verify that the DRC has been notified at least 48 hours in advance of any CLSM pour.</p>
<b>PORTLAND CEMENT OR FLY ASH CLSM DESIGN SPECIFICATIONS:</b>		
<p>Notwithstanding the following specifications, Macro Vaults as approved by the Division of Solid and</p>		

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<p>Hazardous Waste in the Mixed Waste Landfill Cell are considered large objects that do not require CLSM. Macro Vaults shall not be proof rolled.</p> <p>CLSM shall have the following characteristics:</p> <p>a) The design mix is approved by the production engineer prior to use in the cell area and meets the material specifications provided in Table 2 or Table 3 of this Attachment II-A.</p> <p>b) The CLSM passes a Slump Test (procedure provided in Appendix B of this manual), Flow Consistency Test (ASTM D6103) or Efflux test (procedure provided in Appendix B of this manual), as applicable. Passing criteria for each test is specified in Table 2 “Material Specifications for Portland Cement CLSM” or Table 3 “Material Specifications for Fly Ash CLSM” of this Attachment II-A.</p> <p>c) The CLSM shall have a wet unit weight in all cases of at least 100 lbs/ft<sup>3</sup> as determined by ASTM D6023 (Unit Weight, Yield, Cement Content, and Air Content (Gravimetric) of CLSM).</p>	<p>Two types of tests will be performed to ensure that the CLSM meets the design specifications: initial screening tests and lot acceptance tests. The results of these tests and corrective actions, if any, shall be documented on the CLSM Testing Form.</p> <p>a. Initial screening tests shall be performed on the first load of CLSM for each day that CLSM is poured. This screening test shall be performed from the “front end” of the load. The initial screening test includes either a Flow Consistency Test (ASTM D6103) or Efflux test (procedure given in Appendix A), as well as a unit weight test (ASTM D6023). The results from this initial screening test shall indicate whether or not any adjustments need to be made at the batch plant to ensure loads meet design specifications.</p> <p>b. If adjustments are made to the load to produce a product that passes the testing requirements, perform initial screening testing on the subsequent two loads to verify that the batch plant adjustments are sufficient</p> <p>c. CLSM pouring shall only be authorized to proceed upon verification that the initial load (and subsequent two loads if the initial load failed) meets mix specifications.</p> <p>d. Acceptance tests shall be performed at a rate of one test per lot, with a minimum of one acceptance test performed for each CLSM pour. A lot is defined as 100 cubic yards of CLSM. Sampling for acceptance tests shall be performed in accordance with ASTM D5971</p>	<p>Observe, at a minimum, five percent of the tests performed by QC personnel on the CLSM to ensure that the tests and observations are being performed correctly. Verify that the required testing has been performed and properly documented.</p>

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	<p>(Sampling Freshly Mixed CLSM). These acceptance tests shall be performed from a composite of two samples from near the middle of the load.</p> <p>a. Accept loads that meet specification.</p> <p>b. For loads with unsatisfactory results, accept the first part of the load and reject the remainder, or modify the load and/or pour techniques and retest.</p>	
d) The CLSM shall have a minimum 28-day strength of 150 pounds per square inch (psi) as determined by ASTM D4832. A minimum of 3 cylinders shall be cast for compressive strength testing.	Cast a minimum of 3 cylinders per 2000 cubic yards of CLSM placed, with at least one set per lift for lifts smaller than 2000 cubic yards. Perform compressive strength testing in accordance with ASTM D4832 at 28 days to ensure the minimum strength requirements are met. If the CLSM cap does not meet specification, evaluate why it failed and implement corrective actions to prevent recurrence.	Ensure compressive strength testing is being performed at the correct frequency.
e) A load ticket shall be furnished for each truck of CLSM to be poured.	Obtain the load ticket for each truck load of CLSM and ensure the load meets the mix specifications provided in Table 2 “Material Specifications for Portland Cement CLSM” or Table 3 “Material Specifications for Fly Ash CLSM” of this Attachment II-A. Reject any loads not meeting the mix specifications. Include the load ticket with the Lift Approval Form for the CLSM lift. During each CLSM pour, a QC Technician shall be present at or near the pour at all times and shall visually observe pour activities.	Verify that the load tickets have been obtained by QC personnel for each truck load of CLSM and that the load ticket has been checked against Table 2 “Material Specifications for Portland Cement CLSM” or Table 3 “Material Specifications for Fly Ash CLSM”.
<b>CLSM PLACEMENT OF UNCONTAINERIZED DEBRIS:</b> Debris shall be placed to minimize the entrapment of air in the CLSM pour. To accomplish this, any plastic caps, wrappings, or other obstructions placed on pipes, valves, and other debris objects shall be cut or removed prior to pouring CLSM. The uncontainerized debris shall be spread horizontally across the lift. Any compressible debris in the lift shall	Visually inspect the debris pour to ensure that the CLSM can flow throughout all uncontainerized debris in the waste matrix. Inspect pipes, valves, and other debris object and ensure that sufficient access exists for CLSM to enter the debris interior and fill voids. Verify that all compressible debris is properly secured. Ensure that wood materials are spread throughout the lift and not stacked or nested together.	Verify the large debris inspections have been performed and documented on the CLSM Inspection and Testing Form.

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be secured to ensure proper disposal and cover with CLSM. Any wood materials shall be spread throughout the lift to prevent localized stacking or concentration of wood materials.

**CLSM POURS WITH DEBRIS-FILLED CONTAINERS:** In-filling of debris inside containers with CLSM shall be maximized. A minimum of two holes shall be punched into the bottom of one of the walls of each box container to allow for flow throughout the container. Containers filled with primarily wood materials shall not be disposed with CLSM, and must be emptied and spread out prior to placement.

Lids shall be removed from all box containers prior to pouring CLSM (unless a specific waste stream or shipments are exempted by UDRC for safety or ALARA considerations). Drum containers do not require removal of the lid. However, a drum container lid shall be pierced with a hole size of at least 2" X 4" to allow flow of CLSM into the container. If any container includes compressible debris, the material shall be secured to remain inside the container. Drum containers that contain compressible debris shall have the lid removed or a six-inch CLSM cap shall be placed over the filled container.

Hot particles are very small, often microscopic discrete radioactive fragments with high specific activity. Their presence or potential presence in a waste stream is documented on the waste profile record. To protect worker health and safety, waste containers up to 115 cubic feet containing asbestos, beryllium or hot particles do not require in-filling of debris inside the containers to be maximized. Box lids and at least one wall shall be punctured with a minimum of two holes

Visually inspect compressible debris inside containers to ensure the debris is secured. Ensure lids are removed from all box containers. If the lid shall remain on the drum container (or other waste container specifically exempted by UDRC), ensure that the lid has been pierced with the proper size and number of holes. Record results on the CLSM Inspection Form.

If the lid remains on the drum container, ensure that the required number and size of holes exist in the lid. A flowability test is not required on containers filled with soil or fine-grained materials.

Ensure that containers with asbestos, beryllium or hot particle waste are marked. Document the location of each such container within the pour. Ensure that the lift is not approved without placement of a six-inch CLSM cap.

Review inspection results to ensure that compressible debris is being properly secured and that adequate holes exist for containers where lids remain on the container.

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<p>at least 2” x 4”. Containers placed in this manner shall be marked as “asbestos”, “beryllium” or “hot particle” waste and shall have a six-inch CLSM cap placed over them.</p> <p><b>CLSM POURS WITH SOIL-FILLED CONTAINERS:</b> Containers that are filled with soil-like materials may be placed with CLSM. The lid may remain on the container. However, holes must be placed in the lid as required for compressible debris-filled containers above.</p> <p><b>CLSM POURS WITH RESIN-FILLED CONTAINERS:</b> Containers that include or are filled with ion-exchange resin materials may be placed with CLSM. Only watertight steel or poly containers are permitted for resin disposal in CLSM. Cardboard, wood, and soft plastic “supersack” containers are expressly prohibited from use as the sole container for resin disposal in CLSM.</p> <p>Each container shall be inspected for headspace void and have any headspace void filled with an inert material. Provide a minimum of 24 hours notice to DRC prior to filling headspace void and sealing containers. CLSM and other concrete products are expressly prohibited for use filling this headspace void. After filling the headspace void, the lid shall be replaced on the container and latched, banded, or otherwise secured. The container shall be watertight to minimized potential CLSM contact with ion-exchange resins. Paint or mark the word “RESIN” on all 4 sides and the lid of each container when void filling and sealing operations are complete.</p> <p>The total waste resin volume shall be limited to no more than 25 percent of the total volume of the CLSM</p>	<p>Verify that ion-exchange resin containers are constructed of steel or poly. Document this inspection on the CLSM Inspection Form.</p> <p>Verify that DRC has been notified at least 24 hours prior to the following activities. Inspect each container of ion-exchange resins for headspace void. Document the material used to fill any headspace voids. Document that the lid has been replaced and secured on the container. Document that the container is inherently watertight (i.e., a drum with the ring secured around the lid) or has been rendered watertight (i.e., a steel box with a flexible gasket in place before the lid is secured or that has been otherwise sealed). Document that the container has been painted or marked as required.</p> <p>Prior to the CLSM pour, calculate the ratio of resins to other material in the pour as follows: (1) Document the container type and volume for each container of resins in the pour; (2) Document the total pour volume based on the formed area x height; (3) Resin volume divided by total volume x 100 = resin percentage. Container</p>	

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<p>pour. Other wastes meeting the criteria for CLSM disposal as outlined in this CQA/QC Plan may be used to make up the remainder of the volume of the pour.</p> <p>Containers of ion-exchange resins shall not be placed directly adjacent to each other within the CLSM pour. Containers of ion-exchange resins shall not be placed directly above containers of ion-exchange resins in previous lifts within the CLSM pyramid.</p> <p>CLSM pours with resin-filled containers are subject to all CLSM pyramid controls under the specification “CLSM Pyramid” above.</p> <p><b>FINAL CLSM POUR SURFACE:</b> The final CLSM surface will be a horizontal plane with no exposed debris that impedes contact with the surface area during proof rolling. (with the exception of large objects that require multiple pours to completely dispose with CLSM).</p> <p><b>PROOF-ROLL TESTING:</b> A proof roll test shall be performed on all CLSM lifts a minimum of 3 calendar days following completion of the CLSM pour and prior to placement of any additional waste lifts on top of the completed pour. The test shall consist of a loaded truck (rock truck, cement truck, or other vehicle of equal or greater surface load) driving across the entire footprint of the completed CLSM pour.</p>	<p>volume may be calculated from the nominal capacity or from manifested volume of resins in the container.</p> <p>Survey and document the location of each resin-filled container on the CLSM Inspection Form. Verify that each resin-filled container is not placed directly above resin-filled containers in previous lifts within the CLSM pyramid.</p> <p>Visually inspect the final CLSM pour surface to ensure the area is acceptable for proof rolling.</p> <p>Inspect the entire cured CLSM pour surface. Following inspection, direct the truck (rock truck, cement truck, or other vehicle of equal or greater surface load) across the entire CLSM pour surface. Inspect the surface during rolling for any cracking or depressions resulting from the proof-rolling. Identify any surface cracks or depressions with a vertical displacement of ½-inch or greater, or cracks greater than ½-inch in depth. Mark these areas for repair or rework. Document observations on the Lift Approval Form. Approve all lift areas not marked for repair or rework. For any areas with surface cracking or depressions with a vertical displacement of ½-inch or greater, or cracks greater than ½-inch in depth, one of the following methods shall be followed to remedy the failed area(s):</p> <ol style="list-style-type: none"> <li>a. The area may be compacted and then</li> </ol>	<p>Review the documentation to ensure proof-roll testing is being performed and properly documented.</p> <p>Review the documentation to ensure rework, if required, has been performed and documented</p>

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SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>SIX-INCH CAP:</b> All containers filled with compressible debris that do not have the lids removed shall have a six inch CLSM cap poured over the top of the containers prior to proof rolling. In addition, any CLSM pours that have areas which did not pass the proof-rolling test may have a CLSM cap placed over</p>	<p>re-poured. Following three days from the re-pour, perform another proof-roll test to evaluate if the repair was adequate; or</p> <p>b. Remove the CLSM and debris from the marked area and replace it with debris and CLSM. Following three days from the re-pour, perform another proof-roll test of the area to evaluate if the repair was adequate. Repeat this process until satisfactory results are achieved; or</p> <p>c. Place a six-inch CLSM cap over the pour lift area after the area in question has been compacted. The six-inch cap shall extend a minimum of three feet (3') past the damaged areas created during proof rolling in each direction. Following a minimum of three calendar days, perform a proof roll test of the six-inch cap area to evaluate if the cap was adequate. This process may also be repeated (i.e., placement of additional cap to a 12-inch cap) until satisfactory results are achieved.</p> <p>Visually inspect the CLSM pour area and identify the highest elevations of debris that requires a six-inch cap. Survey and document these designated elevations on the CLSM Inspection Form. Following completion of the six-inch cap, perform a final survey of the entire lift as required for determining lift thicknesses above. Ensure that the thickness of the cap is six inches above all debris requiring a CLSM cap and that the cap extends three feet in each direction past the edge of the area that requires the cap. Document the inspection</p>	<p>Review the documentation associated with the CLSM cap.</p> <p>Verify that compressive strength testing is performed at a rate of 1 per CLSM lift. Ensure that the compressive strength of the cap is greater than or equal to 500 psi.</p>

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<p>those areas. Areas poured with a CLSM cap shall still require a proof-rolling test (as described above) to verify adequacy of the cap. The six inch cap shall extend a minimum of three feet in each direction past the edge of the container area that requires a cap.</p> <p>The minimum compressive strength of the CLSM cap shall be 500 psi. Table 2 and Table 3 specifications do not apply to the CLSM cap.</p> <p><b>IN-CELL BULK DISPOSAL:</b> For both LLRW and 11e.(2) waste: Any waste material taken to the disposal cell but not spread out (for lifts placed with compactable soil) or set into a CLSM lift area for forming (for debris to be placed using CLSM) shall be considered in-cell bulk disposal. In-cell bulk disposal may be temporarily managed in piles up to twenty-five feet high on the embankment. For 11e.(2) waste: In-cell bulk disposal cannot be placed on slopes steeper than approximately 5H:1V. The volume of in-cell bulk disposal shall not exceed the limits found in RML #UT 2300478, condition 10.8.e. All 11e.(2) in-cell bulk placement material shall be placed to final specifications by August 1 of each year.</p> <p>Open-air storage of PCB/Radioactive waste and Dry Active Waste (DAW) is prohibited. DAW is defined in condition 1.E.10.(d) of the Ground Water Quality Discharge Permit. In-cell bulk disposal of PCB and DAW shall be managed to prevent open-air storage as follows:</p> <ol style="list-style-type: none"> <li>Maintained in a water-tight container; or</li> </ol>	<p>and completion of the CLSM cap on the Lift Approval Form.</p> <p>Perform compressive strength testing of the CLSM used for caps at the rate of 1 test per CLSM lift. Test specimens/samples shall be collected in accordance with ASTM D5971 (Sampling Freshly Mixed CLSM). The samples shall then be tested in accordance with ASTM D4832 (Preparation and Testing of CLSM Test Cylinders). If the CLSM cap does not meet specification, evaluate why it failed and implement corrective actions to prevent recurrence.</p> <p>On a monthly basis, calculate and document the volume of in-cell bulk disposal and waste stored on the LLRW storage pads. Stop waste unloading before the volume of waste stored exceeds the volume specified in the trust agreement.</p> <p>Obtain reports from waste disposal personnel as to the location and status of PCB and DAW in-cell bulk disposal at the beginning of each shift. When material requiring cover has been placed into in-cell bulk disposal during the preceding shift, track placement of the specified cover material. Document completion of cover within the required timeframe on the Daily Construction Report.</p>	<p>Review documentation of in-cell bulk disposal and ensure that volumes do not exceed the trust agreement.</p>

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<p>2. Covered within 24 hours of the end of the shift that the waste was unloaded with a nominal 6” of soil or soil-like waste material that is free of PCB and DAW; or</p> <p>3. Covered within 24 hours of the end of the shift that the waste was unloaded with a commercial fixative to prevent wind dispersal and leachate generation, applied in accordance with the manufacturer’s instructions; or</p> <p>4. The following PCB wastes do not require cover to prevent wind dispersal:</p> <ul style="list-style-type: none"> <li>a. Drained equipment;</li> <li>b. Large objects with inaccessible PCB contamination; or</li> <li>c. PCB bulk product waste (as defined in 40 CFR 761.62(b)(1)(i)) with a bulk density greater than 70 pounds per cubic foot.</li> </ul> <p>When cover is required, maintain documentation of the date and shift that PCB and DAW were placed in in-cell bulk disposal and of the date and shift that cover was applied.</p> <p>The volume of in-cell bulk disposal plus the volume of waste stored at the LLRW container storage pads (e.g. LLRW bulk storage pad, LLRW container storage pad, etc.) shall not exceed the volume allowed in the trust agreement.</p> <p><b>COLD WEATHER PLACEMENT</b></p> <p><b>FROZEN MATERIAL:</b> No frozen material shall be disposed directly on or within 24 inches of the clay liner. Frozen material is defined as material which cannot meet the compaction requirements because of frozen water mixed within the material.</p> <p><b>PLACEMENT OF WASTE DURING COLD</b></p>	<p>During cold weather, inspect material to be disposed directly on the clay liner. Do not allow frozen material to be disposed on the clay liner. Record corrections on the "Daily Construction Report".</p> <p>1. For soil lifts:</p>	<p>Verify that inspections for frozen material are being conducted during cold weather and that any corrective actions (if required) are properly documented.</p> <p>1. For soil lifts:</p>

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<p><b>WEATHER:</b> Waste material shall only be placed when the required moisture and compaction can be met.</p>	<p>a) On November 1, decrease density and moisture lot size to 750 cubic yards (compacted).  b) On December 1, and continuing to March 1, decrease density and moisture lot size to 500 cubic yards (compacted).  c) Stop placement of waste on a lift when two consecutive tests fail compaction requirements due to frozen material. The first "unapproved" lift is classified as in-cell bulk disposal.  d) When temperatures are high enough to place the in-cell bulk disposal material, place the material in accordance with lift thickness and compaction requirements specified for waste lifts above.</p> <p>a) If more than 2 feet of waste was stored as in-cell bulk disposal, excavate to a maximum of 12 inches above the last approved waste lift. Test and approve this in accordance with lift thickness and compaction requirements given above.  b) If less than 2 feet of in-cell bulk waste was disposed over the last approved lift, excavate to the top of the last approved lift and re-test this lift in accordance with lift thickness and compaction requirements specified above.</p>	<p>Verify that the testing frequency is increased at the beginning of November, and December. Verify that work stops on a lift after the failure of two consecutive compaction test and that the lift is surveyed before the placement of in-cell bulk disposal.</p>
<p>For CLSM pours:</p> <p>a) Do not pour CLSM on a frozen soil base.</p>	<p>2. For CLSM pours:</p> <p>a) If the CLSM is to be poured on a soil base, perform a soil density test on adjacent material prior to the pour to determine if the underlying soil is frozen. If the soil is found to be frozen do not allow placement of material.</p>	<p>2. For CLSM pours:</p> <p>a) Review documentation of soil base testing verify that CLSM is not to be poured on a frozen soil base. During freezing conditions, verify that QC personnel have performed initial sampling and testing of the CLSM to ensure flowability ensured that the CLSM</p>

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<p>b) If the ambient air temperature is forecast to drop below 5°F anytime during the CLSM pour, CLSM shall not be poured. When the ambient or expected air temperature will fall below 35°F anytime during the CLSM pour, the CLSM shall be sampled and an initial screening test performed as outlined under CLSM Design Specifications above. This initial sample may be used to prompt an adjustment of the load water content or temperature, modify the pour techniques, motivate rescheduling of the pour event, etc., but should not be considered acceptance sampling and testing. Acceptance sampling and testing should be obtained in accordance with ASTM D5971 (Sampling Freshly Mixed CLSM).</p>	<p>b) When the ambient or expected air temperature will fall below 35°F anytime during the CLSM pour, perform an initial screening test of the CLSM immediately before pouring to ensure that it meets the flowability criteria. This screening test includes either a Flow Consistency Test (ASTM D6103) or Efflux test (procedure given in Appendix A), as well as a unit weight test (ASTM D6023). The result from this initial screening test shall indicate whether or not any adjustments need to be made at the batch plant to ensure loads meet design specifications.</p> <p style="padding-left: 20px;">1) If adjustments are made to the load to produce a product that passes the testing requirements, perform initial screening testing on the subsequent two loads to verify that batch plant adjustments are sufficient.</p> <p style="padding-left: 20px;">2) CLSM pouring shall only be authorized to proceed upon verification that the initial load (and subsequent two loads if the initial load failed) meets mix specifications.</p> <p>Perform acceptance sampling and testing from near the center of the load.</p> <p style="padding-left: 20px;">a. Accept loads which meet specification.</p> <p style="padding-left: 20px;">b. For loads with unsatisfactory results, accept the first part of the load and reject the remainder, or modify the load and/or pour techniques and retest. Record the results on the "CLSM Inspection and Testing" forms.</p>	<p>has been covered with concrete blankets or tented and heated, where required. Verify that QC personnel have periodically checked the temperature of the CLSM and recorded the results on the "CLSM Inspection and Testing Form".</p> <p>b) Review documentation of screening tests to ensure that CLSM met flowability specifications during cold weather.</p>
<p>c. Unless the ambient air temperature is at least 35°F</p>	<p>c) When the ambient air temperature decreases to</p>	<p>c) Review documentation of CLSM temperature</p>

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<p>and rising, measures must be taken to ensure the CLSM temperature does not fall below 40°F. To ensure this occurs and therefore the CLSM can adequately cure prior to exposure to freezing temperatures, the following should occur: Limit the pour to a surface area of no more than 4,800 ft<sup>2</sup>. Heat the CLSM prior to pouring (as possible). Cover, or tent and heat, the CLSM directly following pouring (i.e. - pour one truck load, cover or tent the in-place material, then pour the next truck load). Following completion of the pour, cover the CLSM with concrete blankets, or tent and heat the CLSM. Likewise, if following placement, the ambient air temperature decreases below 35°F, or is anticipated to decrease below 35°F anytime in the 24 hours following placement, the CLSM must be covered with concrete blankets, or tented and heated.</p>	<p>below 35°F, ensure the CLSM temperature does not fall below 40°F. Measure and record the temperature of each CLSM load prior to introduction to the cell. Ensure the freshly poured CLSM is covered or tented and heated in a timely manner. Measure and record the temperature of the in-place CLSM every two hours during pouring, at the end of the work shift and at the beginning of the next work shift. Temperature results of pour temperatures shall be recorded on the "CLSM Inspection and Testing" forms. If, following placement, the ambient air temperature decreases below 35°F, or is anticipated to decrease below 35°F anytime in the 24 hours following placement of the CLSM, verify that concrete blankets or tenting and heating has been employed to ensure the CLSM is maintained greater than 40°F. Record the results of the inspection on the "CLSM Inspection and Testing" forms.</p>	<p>measurements and actions taken for cold weather pouring to verify that CLSM temperatures meet specifications.</p>
<p><b>SNOW REMOVAL:</b> When waste material is to be placed and the work area is covered with snow and/or ice, the snow and/or ice must be removed so that no more than ¼ inch remains on the surface. Isolated individual clumps of snow and/or ice may be present, but shall be no larger than 2 inches in diameter.</p>	<p>Observe that snow is removed. Advise the project manager of deficiencies. Construction may not continue without corrective action. Record corrective action (where required) in the "Daily Construction Report".</p>	<p>Verify that snow removal is being performed and documented.</p>
<p><b>FINAL GRADING BEFORE TEMPORARY COVER PLACEMENT:</b> Top of waste elevations shall be at grade or below grade. Also, special attention shall be taken to emphasize complete and thorough void filling around and within any debris in the final waste lift.</p>	<p>Survey the top lift of waste on a 50 ft grid and at key points. Final survey measurements will be documented and provided to the QC and Construction QA Officers.</p> <ol style="list-style-type: none"> <li>a. Indicate where the waste meets design line and grade.</li> <li>b. Rework and resurvey areas not meeting the specified grade.</li> </ol>	<p>Review the final survey data. Verify the frequency of the survey points.</p>
<p>If the last lift of waste was built to work element – Waste Placement (as opposed to work element – Waste Placement with Compactor), then a proof roll of the top of waste surface shall be performed.</p>	<p>Observe the proof roll and document on the "Daily Construction Report". Advise the project manager of any "soft spots" or other areas of concern.</p>	

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<p>A visual inspection shall be performed of the top of waste surface. Any incompressible debris protruding greater than 0.1 foot above the surface shall be compacted into the lift or removed.</p> <p><b>DRC APPROVAL:</b> The DRC shall approve the final grade before temporary cover placement. 48 hour notification shall be provided to the DRC prior to placement of temporary cover material over the finished final grade surface. EnergySolutions may proceed with temporary cover placement 48 hours after DRC notification if the DRC has not inspected and has not notified the Director of Engineering of its intent to inspect the final grade surface.</p>	<p>Perform the visual inspection. Advise the project manager of any deficiencies. Document inspection results on the "Daily Construction Report".</p> <p>Notify the Construction QA Officer that the final grade surface is ready for DRC inspection. Obtain written authorization from the Construction QA Officer that the final grade surface has been inspected. Obtain documentation confirming the DRC inspection and approval.</p>	<p>Provide written approval of the final grade surface. Notify DRC that the final grade surface is ready for inspection.</p>

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**WORK ELEMENT – CONTAINERIZED WASTE FACILITY WASTE PLACEMENT TEST PAD**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>SCOPE:</b> This work element applies to the <a href="#">Class A West Class-A and Class-A North</a> embankments.</p> <p><b>NOTICE OF TEST PAD CONSTRUCTION:</b> The test pad plan shall be approved by the DRC prior to the test pad construction. The DRC shall be notified 48 hours in advance of the start-up of test pad construction.</p> <p><b>CONTAINERIZED WASTE PLACEMENT TEST PAD:</b> A test pad with a minimum area of 400 ft<sup>2</sup> will be constructed using the procedure (container or large component type, container configuration, backfill material properties, placement and compaction methods) proposed for construction of the waste lifts. The test pad shall be representative of anticipated field placement conditions and of dimensions suitable to the equipment to be used for production. The minimum area of the test pad may be reduced with DRC concurrence with the test pad plan.</p> <p>Prior to implementation, within the Containerized Waste Facility, of a containerized waste configuration that has not been previously approved, a waste placement test pad shall be constructed utilizing the proposed containerized waste configuration.</p> <p>Test pads are to be constructed and tested in accordance with the following specifications:</p> <ol style="list-style-type: none"> <li>Construct the proposed configuration of containerized waste in the test pad area.</li> <li>At least one Proctor (or relative density) and classification test shall be conducted on the backfill material for each test pad.</li> </ol>	<p>Obtain documentation confirming that the test pad plan has been approved by the DRC. Notify the DRC 48-hours in advance of test pad construction.</p> <p>Observe the construction of test pads. Measure test pads to ensure that they are constructed to the size indicated. Record the test pad size on the "Daily Construction Report".</p> <p>Document the constructed configuration of containers in the test pad on the "Daily Construction Report."</p> <p>Conduct the required proctor (or relative density) and classification (PL, LL, and gradation) tests.</p>	<p>Verify that the test pad plan has been approved by the DRC. Verify that the DRC has been notified as required.</p> <p>Daily, observe the construction of the test pads. The Quality Assurance review for test pad specifications shall cover each specification in this work element. Review 100% of the QC documentation to verify that the tests were performed and documented correctly.</p> <p>Perform a minimum of one (1) QA visual inspection of the resulting waste form per test pad.</p>

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<p>3. Backfill shall be placed over and between the waste packages in a manner that encourages flow into void spaces. The backfill is to be placed and compacted by equipment and methods proposed for use during construction of the waste lifts. Other equivalent equipment may be used for placement or compaction of backfill with approval from the Director of Engineering and DRC.</p>	<p>Record type of equipment used, and number of passes on the "Daily Construction Report". Verify DRC approval has been received for equivalent equipment when used.</p>	
<p>4. The backfill surrounding the containers shall achieve an average density of at least 85% standard proctor or 55-percent relative density for drum configurations, or an average density of at least 80-percent standard proctor or 50-percent relative density around B-12 or B-25 boxes, HICs, cask liners, large components, or container overpack configurations. The completed test pad shall have no greater than 1% external void space by volume of the entire test pad.</p>	<p>Conduct direct or indirect in-place moisture-density tests at a rate of at least four tests per test pad. The test location shall be chosen to verify backfill compaction throughout the test pad. Record the test result on the "Field Density Test" form. Inspect the constructed test pad for void spaces surrounding the containers. Observe destructive testing of the test pad and measure external void spaces found in the backfill in accordance with the "Containerized Waste Facility Waste Placement Test Pad Destructive Testing" method in Appendix B.</p> <p>a. Approve test pads which meet the specified compaction, and minimize void space conditions.</p> <p>b. Rework and retest test pads not meeting the specified moisture or compaction or minimize void space conditions. Document all rework that was performed.</p> <p>c. Where rework and retesting is impractical, reject the test pad procedure.</p>	
<p>5. The procedures used to construct the test pad (container type, container configuration/orientation, backfill material properties, placement and compaction methods) shall be reviewed and approved by the Director of Engineering. The test must be approved by a Professional Engineer.</p>	<p>Provide the Director of Engineering with copies of the documentation for the test pad for review and approval.</p>	
<p>6. The procedures used to construct the test pad shall</p>	<p>Obtain documentation confirming DRC approval of the</p>	<p>Verify that proper approval has been obtained for the</p>

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be reviewed and approved by the DRC prior to using the new test pad construction method.	test pad.	test pad and that the necessary construction procedure documents are in place for use during backfill construction.

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**SCOPE:** This work element applies to the [Class A West](#) ~~Class A and Class A North~~ embankments.

**LIFT IDENTIFICATION:** Each lift shall be given a discrete designation for testing and surveying purposes.

Assign a lift identification number to each lift. Use the lift identification number to identify all paperwork for that lift. Summarize all lifts on the lift summary form.

The Quality Assurance review for waste placement specifications shall cover each specification in this work element. Review a minimum of 50.0% of the QC documentation to verify that the tests were performed and documented correctly.

**LIFT ACCEPTANCE:** At the time of acceptance, the date and time of lift approval shall be recorded.

The QC technician shall record the date and time of lift approval on the CWF Lift Approval Form

**DEFINITIONS:** For the purpose of this CQA/QC project plan, the following terms are defined:

No action required.

No action required.

Backfill is defined as poorly graded type SP or well graded type SW sand with a minimum of 95% passing the #4 sieve, a minimum of 35% passing the #30 sieve, and less than 5% passing the #200 sieve. The maximum moisture content for backfill shall be less than or equal to 4.1% at the time of backfill placement. This specification may be modified following successful completion and DRC approval of a test pad.

Backfill cover is defined as a minimum of one foot of soil placed over containerized waste packages after backfilling is complete. In the case of standard liners and large liners, the placement sequence is: (1) backfill between the waste forms; (2) intermediate sand; (3) backfill cover.

Containerized waste is defined as any containers of Certified Containerized Waste in accordance with applicable requirements of the Waste Characterization Plan. Certified Containerized Waste is defined as monolithic units in the form of the following filled containers.

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<ol style="list-style-type: none"> <li>1. Any DOT “Strong, Tight” Containers up to 5 feet tall</li> <li>2. <u>Standard Liners</u> are High Integrity Containers (HICs) or other cylindrical packages up to 6.65 feet tall (up to 215 cubic feet external volume)</li> <li>3. <u>Large Liners</u> are HICs or other packages between 6.65 and 9 feet tall (between 215 and 331 cubic feet external volume)</li> <li>4. Other Large Components and oversized DOT containers (larger than 331 cubic feet)</li> </ol>		

Containerized Waste Facility (CWF) pyramid is limited to a maximum of two lifts of containerized waste. Containers up to 5 feet tall are limited to a single lift at the pyramid base. Containers greater than 5 feet tall are limited to two lifts. The volume of the embankment above and surrounding the pyramid shall be filled with bulk waste lifts placed in accordance with the Bulk Waste Placement Work Element of this plan.

Intermediate sand is defined as a minimum of 2 feet of sand meeting gradation specifications for backfill, placed above the top of caissons used for placement of cylindrical containers greater than 5 feet tall. In the case of containers placed using removable steel forms, intermediate sand shall be placed to an elevation at least 9 feet above the base of the container for standard liners and 11.5 feet above the base of the container for large liners.

Lift is defined as containerized waste packages, backfill between packages, intermediate sand (when applicable), and the backfill cover layer. A containerized waste placement lift may contain one layer of containers or more than one stacked layer of containers, depending on the container type and height.

Removable Steel Form is a circular steel form used to

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<p>ensure the spacing of standard or large liners. Removable steel forms are placed in an approved disposal configuration (hexagonal for example) prior to placement of liners. Removable steel forms can be used in either the first lift or second lift in place of caissons. All removable steel forms shall be pulled after liner placement <u>and</u> before backfill.</p> <p><b>CONTAINERIZED WASTE PLACEMENT:</b> 1) All containers shall be placed in accordance with an approved container placement method. Containers shall be placed in a configuration that has been approved through the successful completion of a waste placement test pad. Figures 7 and 8 illustrate approved waste placement configurations. A minimum 6-inch layer of loose sand shall be placed prior to placement of containers. Containers shall be worked into this loose sand to minimize any voids underneath the containers. Containers shall be placed with a minimum distance as specified by individual container type below. Backfill shall be placed over and between the containers in accordance with the approved container placement method for the type of container being placed. The containerized waste placement backfill soil properties shall be tested once per 2,500 square feet of placement area or once per lift.</p> <p>2) Standard Liners shall be placed as follows. Spacing and backfill of standard liners may be facilitated by the use of concrete caissons or removable steel forms; use of caissons or removable steel forms is not required. Caissons or other forms shall not exceed 7 feet tall. When used, removable steel forms shall be removed prior to backfill. Caissons shall not be removed without prior</p>	<p>1) Verify through observation and document that the appropriate container placement method and spacing is followed for the type of container stacking in each lift.</p> <p>Perform at least one moisture content and classification (PL, LL, and gradation) test per 2,500 square feet of placement area, or change in backfill material type, or change in borrow source.</p> <p>Conduct an inspection of the container placement configuration prior to commencement of backfill placement. This inspection shall document that an approved configuration has been utilized for the container types present.</p> <p>Observe placement and compaction of the backfill to ensure that type of equipment, equipment load (if applicable), and number of passes meet the specifications approved by the containerized waste placement test pad. Record type of equipment used, equipment load (if applicable), and number of passes on the CWF Lift Approval Form.</p> <p>2) Verify through observation and document on the CWF Lift Approval Form that standard liners are placed with the appropriate container placement method and spacing.</p> <p>Conduct in-place density tests at the surface of the intermediate sand layer at a rate of one test per lot and</p>	<p>1) Review the QC documentation to confirm that the appropriate container placement and backfilling method has been used and properly documented.</p>

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SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>DRC notification. Backfill shall be placed to a minimum height of 7 feet above the container base elevation by dropping from the bucket of a front-end loader or equivalent around and above the container (whether in a caisson or not). Backfill shall achieve a minimum density of at least 80% of a standard Proctor, as demonstrated by the approved test pad(s). The backfill layer shall be covered by an intermediate sand layer to a minimum depth of 2 feet above the top of the caisson (9 feet above the container base elevation). Intermediate sand shall achieve a minimum density of 85% of a standard Proctor. The backfill cover layer is then placed above the intermediate sand layer. Caissons shall be placed in a hexagonal or other approved (through a test pad) configuration, such as rectangular, that meets the following criteria. Caissons with an outer diameter of 100 inches shall be placed a minimum of 4 inches apart. If no caisson is used, or if a caisson or other form of smaller outer diameter is used, the container shall be placed as if the 100-inch diameter caisson were there for spacing purposes; i.e., within a minimum area of 108-inch diameter centered around the container, no other caisson or container shall intrude.</p> <p>3) Unusually shaped containers shall be placed and backfilled in a manner that allows void spaces to be filled. In no case shall unusually shaped containers be placed such that a significant amount of external void space cannot be filled. A significant amount of external void space for unusually shaped containers is 5 percent of</p>	<p>record the results on the "Field Density Test" form. A lot is defined as 10,000 square feet of a single lift. At least two tests will be performed per lift. The test location shall be chosen on the basis of random numbers. Approve lots when:</p> <ul style="list-style-type: none"> <li>a. Material is observed to be properly compacted throughout the lot;</li> <li>b. Density tests performed meet compaction specifications.</li> </ul> <p>Verify the mean elevation of the top of each intermediate sand lift by installing grade poles, or other methods approved by the Site Engineer. For each lift larger than 50' x 50', survey the corners and at least one spot in the middle. For lifts less than 50' x 50', a minimum of four grade poles, one in each direction, shall be used. Lifts larger than 50' x 50' may be segmented to areas 50' x 50' or less and elevation verified with the use of grade poles. The use of grade poles to verify the compacted thickness of the intermediate sand material shall be verified as part of the test pad for intermediate sand. Thickness measurements of the compacted intermediate sand will be documented and forwarded to the Construction QC Officer.</p> <ul style="list-style-type: none"> <li>a. Approve lifts with an average compacted intermediate sand thickness greater than or equal to the specified compacted intermediate sand thickness.</li> <li>b. Add intermediate sand and retest lots with an average compacted intermediate sand lift thickness less than the specified compacted intermediate sand lift thickness.</li> </ul> <p>3) Verify through observation and document that the unusual containers are placed such that all significant voids can be filled.</p>	

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**WORK ELEMENT – CONTAINERIZED WASTE FACILITY WASTE PLACEMENT**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>the volume of the unusually shaped containers in the lift, unless otherwise approved by the Division.</p> <p>4) Large components and oversized DOT containers shall be placed and backfilled such that void spaces are filled and the bearing capacity of the embankment is not exceeded.</p> <p>5) Large Liners shall be placed as follows. Spacing and backfill of large liners may be facilitated by the use of concrete caissons or removable steel forms; use of caissons or removable steel forms is not required. Caissons or other forms shall not exceed 9.5 feet tall. When used, removable steel forms shall be removed prior to backfill. Caissons shall not be removed without prior DRC notification. Backfill shall be placed to a minimum height of 9.5 feet above the container base elevation by dropping from the bucket of a front-end loader or equivalent around and above the container (whether in a caisson or not). Backfill shall achieve a minimum density of at least 80% of a standard Proctor, as demonstrated by the approved test pad(s). The backfill layer shall be covered by an intermediate sand layer to a minimum depth of 2 feet above the top of the caisson (11.5 feet above the container base elevation). Intermediate sand shall achieve a minimum density of at least 85% of a standard Proctor. The backfill cover layer is then placed above the intermediate sand layer. Caissons shall be placed in a hexagonal or other approved (through a test pad) configuration, such as rectangular, that meets the following criteria. Caissons with an outer diameter of 114 inches shall be placed a minimum of 5 inches apart and no more than 11 inches apart (at the nearest point between two adjacent caissons). If no caisson is used, or if a caisson or other form of smaller outer diameter is used, the container shall be placed as if the 114-inch diameter caisson were there for spacing purposes; i.e.,</p>	<p>4) Verify through observation and document that the large components and oversized DOT containers are placed in accordance with an approved large component placement method.</p> <p>5) Verify through observation and document that large liners are placed with an approved container placement method and spacing.</p> <p>Conduct in-place density tests at the surface of the intermediate sand layer at a rate of one test per lot and record the results on the "Field Density Test" form. A lot is defined as 10,000 square feet of a single lift. At least two tests will be performed per lift. The test location shall be chosen on the basis of random numbers. Approve lots when:</p> <ul style="list-style-type: none"> <li>a. Material is observed to be properly compacted throughout the lot;</li> <li>b. Density tests performed meet compaction specifications.</li> </ul> <p>Verify the mean elevation of the top of each intermediate sand lift by installing grade poles, or other methods approved by the Site Engineer. For each lift larger than 50' x 50', survey the corners and at least one spot located near the center. For lifts less than 50' x 50', a minimum of four grade poles, one in each direction, shall be used. Lifts larger than 50' x 50' may be segmented to areas 50' x 50' or less and elevation verified with the use of grade poles. The use of grade poles to verify the compacted thickness of the intermediate sand material shall be verified as part of the test pad for intermediate sand. Thickness measurements of the compacted intermediate sand will be documented and forwarded to the</p>	

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within a minimum area of 124-inch diameter centered around the container, no other caisson or container shall intrude and adjacent caissons shall be within a maximum area of 136-inch diameter.	Construction QC Officer. a. Approve lifts with an average compacted intermediate sand thickness greater than or equal to the specified compacted intermediate sand thickness. b. Add intermediate sand and retest lots with an average compacted intermediate sand lift thickness less than the specified compacted intermediate sand lift thickness.	
6) Large Liners shall meet the following void space criteria: void spaces within the waste and between the waste and its packaging shall be reduced to the extent practicable, but in no case shall less than 90 percent of the capacity of the container be filled.	6) For large liners, document that the void space criteria is met.	
7) Drums shall be placed horizontally at least 1 inch apart in a single layer. There shall be no continuous contact between drums. Forklifts may be used for drum placement provided that protective measures are taken to prevent damage to the drums. The forklift tines shall not come into direct contact with the drums. Sand shall be compacted to an average standard proctor density of 85% with a minimum of a single pass of a hoe mounted vibratory compactor or its equivalent, prior to placement of the next layer of drums. For purposes of this specification, the “Standard I-13 Liner” and “NUHIC-55 liners” may be placed as a drum.	7) Document that drums have been placed as required. Document equipment used and number of passes.	
8) When backfilling between standard or large caissons placed in a hexagonal pattern, the following controls apply as demonstrated in the “Test Pad Report for the Containerized Waste Facility Tri-Arc Test Pad Plan, Revised Plan” dated September 18, 2007. The loader or other equipment shall have a bucket of at least 25 cubic foot capacity and the bucket shall be totally filled. Dump the backfill sand from a height of approximately 2 feet above the top of the caisson (measured from the lower lip of the bucket to the top of the caisson).		

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<p>9) If placing ion-exchange resins in containers other than standard liners or large liners, ensure that each 50' x 50' lift area contains no more than 25% resins by volume. Increase spacing of resin containers as needed to maintain this criteria.</p>	<p>8) Document that the bucket used to place backfill sand meets or exceeds the minimum capacity. Observe sand dumping operations for compliance with the specification. Document on the Daily Construction Report.</p>	
	<p>9) Calculate the ratio of resins to other material (soil, non-resin wastes) in the lift based on manifested resin volume and actual lift dimensions. Nominal container capacity may be used instead of manifested volume. Resin volume divided by total volume x 100 = resin percentage. Document on the CWF Lift Approval Form.</p>	
<p><b>PYRAMID CONTROLS:</b> Refer also to Figure 7. Containerized Waste Facility (CWF) Pyramid: 1) Containerized waste lifts shall form a pyramid with a maximum 3H:1V outside edge slope. The slope shall be measured to the top of the backfill cover above containers in the lift. 2) Drums and boxes less than 5 feet tall are limited to a single lift on the lower layer of the CWF pyramid. Standard and large liners are limited to two lifts. 3) The pyramid base dimensions and maximum 3H:1V side slope requirements will control the location of the second lift of containers. 4) Adjacent pyramids shall not be placed above a previous CWF pyramid. 5) CLSM pyramids for bulk waste shall not be placed above a previous CWF pyramid. 6) CLSM may be used for fill within the initial lift of the container pyramid. 7) The first liner placed in a second lift using this method shall be</p>	<p>Determine the location of the northwest corner and the dimensions of each lift and document on the CWF Lift Approval Form. Use the lift location and dimensions to ensure compliance with the containerized waste facility pyramid specification. As each lift of backfill cover is placed, survey and document that the corners of the lift meet the 3H:1V slope. If applicable, document the dimensions of the previous containerized waste facility lift on the CWF Lift Approval Form. In locating a new pyramid, document on the CWF Lift Approval Form:</p> <ul style="list-style-type: none"> <li>a) The pyramid base is placed on the liner protective cover; or</li> <li>b) The pyramid base does not encroach the vertical limits of a previous pyramid.</li> </ul> <p>Prior to positioning the first liner in a second lift,</p>	<p>Verify compliance with the containerized waste facility pyramid specification and proper documentation of the QC requirements.</p>

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<p>offset from liners in the lower lift. 8) Large Liners placed in the upper lift of the Containerized Waste Facility shall be placed at least 75 feet from the outer perimeter of the lower lift.</p> <p><b>CLSM USE AS FILL:</b> CLSM use as fill within the initial lift of the container pyramid shall comply with specifications “DRC Notification for CLSM Pours” and “Portland Cement or Fly Ash CLSM Design Specifications” under Work Element – Waste Placement above. However, CLSM used as fill at the Containerized Waste Facility is not required to meet the compressive strength requirements referenced above.</p> <p>CLSM may be used for fill with up to two, 5-drum pallets stacked inside a standard or large caisson. CLSM may also be used for fill with other waste containers that fit inside a standard or large caisson. The entire caisson height may be filled in a single CLSM pour.</p> <p>CLSM may also be used for fill around drums and boxes less than 5 feet tall around the perimeter of the CWF pyramid, so long as the 3H:1V pyramid slope is maintained. Drums placed in this manner may be oriented vertically.</p> <p><b>BACKFILL COVER:</b> After backfilling of voids between containers is complete and intermediate sand is placed (as needed), each lift of containerized waste shall be covered by at least one foot of compacted backfill cover material.</p>	<p>document the location of containers in the first lift. Ensure that the first liner placed in the second lift is offset so that it is not directly above any single liner in the lower lift. Document that large liners placed in the upper lift meet the setback criteria.</p> <p>Document DRC notification and CLSM mix inspections and approval in accordance with the referenced specifications.</p> <p>1. For containerized waste lifts:  Verify the mean elevation of the top of each backfill cover lift by installing grade poles, or other methods approved by the Site Engineer. For each lift larger than 50’ x 50’, survey the corners and at least one spot in the middle. For lifts less than 50’ x 50’, a minimum of four grade poles, one in each direction, shall be used. Lifts larger than 50’ x 50’ may be segmented to areas 50’ x 50’ or less and elevation verified with the use of grade poles. The use of grade poles to verify the compacted thickness</p>	<p>Review the QC documentation.</p>

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SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>Backfill cover for each lift shall achieve a density of at least 95 percent of a standard Proctor.</p>	<p>of the backfill cover material shall be verified as part of the test pad for backfill cover. Thickness measurements of the compacted backfill cover will be documented and forwarded to the Construction QC Officer.</p> <p>a. Approve lifts with an average compacted backfill cover thickness greater than or equal to the specified compacted backfill cover thickness.</p> <p>b. Add backfill and retest lots with an average compacted backfill cover lift thickness less than the specified compacted backfill cover lift thickness.</p> <p>Conduct in-place density tests at the surface of the backfill cover at a rate of one test per lot and record the results on the "Field Density Test" form. A lot is defined as 10,000 square feet of a single lift. At least two tests will be performed per lift. The test location shall be chosen on the basis of random numbers. Approve lots when:</p> <p>a. Material is observed to be properly compacted throughout the lot;</p> <p>b. Density tests performed meet compaction specifications.</p> <p>Perform a laboratory classification test on the backfill cover material at a rate of one test per 3,000 cubic yards (compacted), or change in backfill cover material type, or change in borrow source. The sample for this test will be taken from the backfill cover stockpile.</p>	
<p><b>SET BACK OF WASTE:</b> Maintain a distance of at least 10 feet between the inside toe of the runoff berm and the outside toe of the waste containers.</p>	<p>Initial waste set back approval shall measure the set back distance around the edge of the runoff berm at 100 foot intervals. Record the inspection of the setback on the "Daily Construction Report".</p> <p>Inspect the waste setback on a monthly basis. Record findings on the "Daily Construction Report".</p> <p>Require removal of any waste necessary to maintain the</p>	<p>Review the QC documentation to confirm that the monthly inspections have been performed and properly documented.</p>

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SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
	required set back.	
<b>SNOW REMOVAL:</b> When waste material is to be placed and the work area is covered with snow, the snow must be removed.	Observe that snow is removed. Advise the project manager of deficiencies. Construction may not continue without corrective action. Record corrective action (where required) in the "Daily Construction Report".	Review the QC documentation to verify that snow removal is being performed and documented.
<b>Cold Weather Placement of Backfill:</b> The following requirements apply to placement of flowable sand backfill when the ambient air temperature is below 32 degrees Fahrenheit: a. Backfill with frozen clods shall not be accepted for placement. b. The backfill stockpile shall be worked using heavy equipment prior to use. c. The minimum average spread diameter for the flowability tests shall be 8.75". d. If backfill is observed to have frozen clods or does not meet the flowability specification, the backfill stockpile may be re-worked. Each inspection and test shall be repeated for re-worked material.	When the ambient air temperature falls below 32 degrees Fahrenheit: a. Inspect the backfill stockpile to be used that day for any visible frozen clods. b. Observe working of the backfill stockpile. c. Perform a flowability test (ASTM D6103) on material from the backfill stockpile: 1) Collect a minimum of three representative samples from the backfill stockpile. 2) Test each sample using ASTM D6103. d. Record these actions and test results on the "Daily Construction Report."	Verify that the backfill stockpile is inspected, worked, and tested during cold weather conditions.
<b>FINAL GRADING:</b> Top of waste elevations shall be at grade or below grade.	Survey the top lift of waste on a 50 ft grid and at key points. Final survey measurements will be documented and provided to the Director of Engineering and Construction QA Officer. a. Indicate where the waste meets design line and grade. b. Rework and resurvey areas not meeting the specified grade.	Review the final survey data. Verify the frequency of the survey points.

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**WORK ELEMENT – INTERIM RAD COVER PLACEMENT AND MONITORING**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
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**SCOPE:** This work element applies to the Class A West Class-A and Class-A North embankments.

**DEFINITION:** Interim rad cover is non-waste soil used to comply with the “uncovered radioactive waste” limit at Radioactive Material License UT 2300249, Condition 11. This material was formerly referred to as “temporary cover” or “interim temporary cover”. Waste in closed containers may be stored on interim rad cover. If bulk waste is placed or stockpiled on interim rad cover, the affected area shall no longer be considered to have interim rad cover on it.

The following areas do not count against the “uncovered radioactive waste” limit at RML Condition 11 and do not require interim rad cover to be placed over them:

1. Containerized Waste Facility
2. Large Component disposal areas
3. CLSM pour areas that have been poured and covered. *Note: Areas where debris has been staged or formed for CLSM, but have not yet been poured and covered, shall be counted against the “uncovered radioactive waste” limit.*

**INTERIM RAD COVER MATERIAL:** Interim rad cover shall be native soil that is free of debris material. ~~This work element shall have an effective date one year following DRC approval of its inclusion in the LLRW and 11e.(2) CQA/QC Manual.~~

Visually inspect interim rad cover soil and document on the Daily Construction Report.

**INTERIM RAD COVER PLACEMENT:** Interim rad cover shall be a minimum of 6 inches thick in order for an area to be removed from the “uncovered radioactive waste” inventory. Thickness shall be evaluated through use of grade poles or survey. Contaminated equipment may be used to place interim rad cover.

Survey at least the perimeter of the area covered and document. Document thickness of cover on the Daily Construction Report.

Periodically observe lift approval documentation.

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SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>A commercial fixative product (i.e., polymer), magnesium chloride, or non-contact water may be applied, in accordance with the manufacturer’s instructions, to the surface of the interim rad cover to aid in dust control and erosion prevention. Erosion control blankets, mats, or fiber mulch may also be used, in accordance with the manufacturer’s instructions, for erosion prevention. DRC shall be notified at least 48 hours prior to deployment of erosion control blankets, mats, or fiber mulch.</p> <p><b>OPERATIONAL CONTROLS:</b> Interim rad cover shall be fenced, roped, or otherwise marked to identify as distinct from active waste placement areas. Traffic across interim rad cover shall be minimized. Haul roads are prohibited on interim rad cover.</p> <p><b>INSPECTIONS:</b> Monthly, inspect interim rad cover for the presence of erosion gullies. If the inspection indicates that waste material is exposed due to erosion, the interim rad cover shall be repaired in that area within 7 calendar days.</p> <p><b>SURVEYS:</b> Quarterly, perform an elevation survey on interim rad cover that is within 2 feet of the design top of debris waste elevation. Surveys shall be performed at the temporary and final settlement monument locations provided in Figures 2-<del>and</del> 6, within an 18-inch radius of the design monument location.</p> <p><b>REMOVAL:</b> Interim rad cover may be removed. Soils used as interim rad cover may be used as fill for debris wastes. If used, erosion control blankets, mats, or fiber mulch may be left in place or removed, but either way must be placed and compacted as waste.</p>	<p>Perform monthly inspections and document on the Daily Construction Report.</p> <p>Perform quarterly surveys and document.</p>	

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**WORK ELEMENT – TEMPORARY COVER PLACEMENT AND MONITORING**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
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**SCOPE:** This work element applies to the Class A West ~~Class A, Class A North,~~ and 11e.(2) embankments. Because there is no open cell time limit for the 11e.(2) embankment, time limits within this specification do not apply there.

**TEMPORARY COVER MATERIAL:** Temporary cover shall be native CL or ML soils that are free of debris material. This material provides an adequate thickness of material free of debris to protect the overlying radon barrier.

Perform laboratory classification tests at a rate of 1 test per lot prior to use of material. A lot is defined as a maximum of 6000 cubic yards (compacted) of specified material type. Record the location of the classification sample on the "Sampling Log".

- a. Approve lots which meet the specified classification for use.
- b. Lots not meeting the specified classification can not be used.

Visually inspect temporary cover soil and verify that it is free of debris. Record results on the Lift Approval Form. Provide DRC notification. Document lift area, location, thickness, and compaction on the Lift Approval Form.

Periodically observe lift approval documentation.

**TEMPORARY COVER PLACEMENT:** Temporary cover shall be placed within 15 years of the date of initial waste placement on each lift area, and within 90 days of any survey that determines top of waste elevations and grades for each lot. Top of waste elevations and grades are defined as those found on the approved engineering design drawings authorized under the license. DRC shall be notified in writing at least 48 hours in advance of the start-up of temporary cover placement.

A side slope exemption is limited to the 90 calendar day requirement for temporary cover placement, which does not apply to side slope areas immediately adjacent to top slope lifts that have not reached the top of waste elevations. Once the adjacent top slope area has reached the top of waste elevation all top slope and adjacent side slope areas shall have temporary cover placed within 90 calendar days.

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<b>SPECIFICATION</b>	<b>QUALITY CONTROL</b>	<b>QUALITY ASSURANCE</b>
<p>Temporary cover shall be a minimum of 1 foot thick. Temporary cover may be over-built in order to achieve this thickness. Temporary cover shall be placed in accordance with the lift thickness and compaction requirements specified under Work Element – Waste Placement, above. Contaminated equipment may be used to place temporary cover.</p> <p>The edge of the temporary cover shall be marked with fencing, rope, snow fence, or equivalent marking to prevent heavy equipment travel on the temporary cover surface. Haul routes may traverse temporary cover, provided that the haul route does not travel over any pre-final cover settlement monuments and that the haul route is marked with fencing, rope, snow fence, or equivalent markings. Temporary cover may encroach up to 5 feet into the offset for the run-off berm.</p> <p>A commercial fixative product, magnesium chloride, or clean water may be applied to the surface of the temporary cover to aid in dust control and erosion prevention. Contaminated water shall not be used for dust suppression on temporary cover. Erosion control blankets, mats, or fiber mulch may also be used, in accordance with the manufacturer's instructions, for erosion prevention. DRC shall be notified at least 48 hours prior to deployment of erosion control blankets, mats, or fiber mulch. If used, such erosion control materials shall be removed prior to radon barrier construction.</p>	<p>Provide DRC notification. Document application and removal of erosion control materials on the Daily Construction Report.</p>	

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SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>PRE-FINAL COVER SETTLEMENT MONUMENTS:</b> Pre-final cover settlement monuments shall consist of approximately 18-inch long #5 or greater rebar that is welded to a metal plate. The metal plate shall be approximately 18 inches square with a thickness of 3/16 inch to 1/4 inch. The metal plate shall be placed on the top of waste surface and then secured by the temporary cover as it is placed. Each monument shall be labeled, flagged, and documented on a reference drawing.</p>	<p>Inspect pre-final cover settlement monuments for compliance with the specification prior to installation.</p>	<p>Perform a surveillance of monument installation activities.</p>
<p><b>PRE-FINAL COVER SETTLEMENT MONUMENT PLACEMENT:</b> Pre-final cover settlement monuments shall be placed as close as practical to the locations of final cover settlement monuments identified in Figures 2, <del>and 4,</del> <del>and 6.</del> In addition, pre-final cover settlement monuments shall be placed at the locations identified as "additional final temporary cover monuments" on Figures <del>2 and 4,</del> <del>and 6.</del></p>	<p>Perform and document a post-construction survey of the pre-final cover settlement monuments.</p>	<p>Verify that surveys have been performed.</p>
<p><b>SURVEY REQUIREMENTS:</b> Surveys shall be performed with GPS or approved equivalent equipment. Tolerance shall be no more than ± 0.1 foot.</p>	<p>Calibrate and operate survey equipment in accordance with the manufacturer's recommendations.</p>	
<p><b>SURVEY INTERVAL:</b> The pre-final cover settlement monuments shall be surveyed within 30 days of temporary cover installation. New monuments shall be surveyed again during the months of January, March, May, July, September, and November. After at least one year of data has been obtained for a monument, it shall be surveyed semi-annually during the months of May and November until final cover construction begins. Weather conditions at the time of the survey and a discussion of the potential for frost to be present shall be documented in the survey report.</p>	<p>Perform and document the required surveys. Provide survey data to the Director of Engineering.</p>	<p>Verify that monument surveys are completed as required.</p>

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<b>SPECIFICATION</b>	<b>QUALITY CONTROL</b>	<b>QUALITY ASSURANCE</b>
<p><b>INSPECTIONS:</b> Monthly, inspect temporary cover for the presence of erosion gullies. If the inspection indicates that waste material is exposed due to erosion, the temporary cover shall be repaired in that area within 7 calendar days.</p>	<p>Perform and document monthly inspections.</p>	
<p>Semi-annually, maintain the temporary cover surface. Maintenance shall consist of filling in any erosion gullies and, if necessary, re-grading to prevent ponding on the temporary cover.</p>	<p>Document semi-annual maintenance activities. Document any areas requiring filling or re-grading.</p>	
<p><b>REPORTING:</b> Survey data for pre-final cover settlement monuments shall be compiled and analyzed to evaluate total and differential settlement. This data and analysis shall be submitted to DRC with the annual as-built report.</p> <p>Review and analysis of settlement monitoring data will include the following:</p> <ul style="list-style-type: none"> <li>• A drawing identifying the location of each point.</li> <li>• Graphical or tabular presentation of the incremental settlement for each point (how much each point has moved since the last set of readings),</li> <li>• Graphical or tabular presentation of the total settlement for each point,</li> <li>• Graphical or tabular presentation of the time rate of settlement for each point (to include both the overall rate from the first data for the point, and the incremental rates for each period),</li> <li>• Graphical or tabular presentation of the differential settlement for each point with respect to the nearest adjacent points, and</li> <li>• A discussion about the general nature of the observed settlement, and any areas of the landfill that are behaving in an anomalous manner.</li> </ul>		
<p><b>TRANSITION TO FINAL COVER:</b> If distortion is less</p>	<p>The Director of Engineering shall evaluate pre-final cover</p>	

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**WORK ELEMENT – TEMPORARY COVER PLACEMENT AND MONITORING**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>than 0.007 foot/foot for all of the grid points in a given area, and each grid point has at least one year’s monitoring data; then final cover construction may proceed. Once an area is approved, final cover construction shall be completed within 3 years of this determination.</p> <p>The Director of Engineering shall perform the analysis of projected future distortions. The analysis shall be submitted no later than the end of the 16<sup>th</sup> year since waste placement began in the oldest lift area subject to analysis.</p> <p>If an area is not approved for final cover construction by the end of the 16<sup>th</sup> year of the 18-year open cell period, an analysis of projected future distortions shall be performed and submitted to DRC. The analysis shall evaluate settlement through the end of year 17 of the open-cell period, at a minimum. If the analysis indicates that the future distortions between any two adjacent points will be more than 0.0074 foot/foot, then surcharging over the area(s) in question will be required to stabilize settlement prior to final cover construction. If surcharging is required, a plan and schedule shall be provided to DRC by the end of the 16<sup>th</sup> year of the open-cell period. The surcharging schedule shall show that surcharging will be complete by the end of the 17<sup>th</sup> year of the open-cell period. Settlement monitoring frequency during surcharging shall be at least equivalent to that required in Year 16.</p> <p>Immediately prior to placement of the first lift of radon barrier, the pre-final cover settlement monuments shall be removed and the temporary cover surface restored.</p> <p>Additional clean debris-free soil material shall be placed; or excess temporary cover material shall be cut, as needed</p>	<p>settlement data for each area of cover construction to determine distortion between all adjacent points in that area. If the criteria are met, a written report shall be prepared and forwarded to DRC at least 7 calendar days prior to removing the pre-final cover settlement monuments.</p> <p>Inspect and document that all pre-final cover settlement monuments have been removed prior to final cover construction.</p> <p>Survey and document the temporary cover surface to confirm that the top of waste design grades and elevations are achieved. Document lift thickness and compaction for any debris-free soil material placed to bring the temporary cover surface to the design top of waste grades and elevations.</p> <p>Provide DRC notification of pending temporary cover removal. Document lift area and location on a Daily Construction Report.</p>	<p>Verify that pre-final cover settlement monuments have been removed and that the temporary cover surface meets design top of waste grades and elevations.</p> <p>Periodically observe paperwork for temporary cover removal.</p>

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**TABLE 1 - QA/QC ACTIVITIES**  
**WORK ELEMENT – TEMPORARY COVER PLACEMENT AND MONITORING**

<b>SPECIFICATION</b>	<b>QUALITY CONTROL</b>	<b>QUALITY ASSURANCE</b>
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to return the area for final cover construction to the original top of waste design grades and elevations. When placing clean debris-free soil material for this purpose, the soil shall be placed in lifts with a compacted average thickness not exceeding 12” and compacted to 90% of a standard Proctor. If an area has settled more than 12”, bulk waste may be placed in accordance with the applicable work elements and specifications of this manual, so long as at least 1 ft of temporary cover is in place prior to radon barrier construction.

DRC shall be notified at least 48 hours in advance of the start-up of temporary cover removal in previously placed areas.

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**TABLE 1 - QA/QC ACTIVITIES**  
**WORK ELEMENT - RADON BARRIER BORROW MATERIAL**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>SCOPE:</b> This work element applies to the <u>Class A West, Class A, Class A North,</u> and 11e.(2) embankments.</p>		
<p><b>CLEARING AND GRUBBING:</b> Remove vegetation, debris, organic, or deleterious material from areas to be used for borrow. Grubbing depth will depend on the type of vegetation, debris, organic, or deleterious material on the site. If the area is free of these materials then no clearing and grubbing will be necessary.</p>	<p>Inspect the area once clearing and grubbing has been completed. Record observations and corrective action (where required) on the "Daily Construction Report".</p>	<p>Verify that the clearing and grubbing has been inspected by QC.</p>
<p><b>MATERIAL--NATURAL CLAY MIXTURE:</b> Satisfactory material shall be defined as CL and ML soils based on the Unified Soil Classification with at least 85 percent passing the No. 200 sieve (silt and clay), 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 or equal to 1 inch.</p>	<p>Perform laboratory classification tests at a rate of 1 test per lot prior to use of material in the radon barrier. A lot is defined as a maximum of 3,000 cubic yards (compacted) of specified material type. Record the location of the classification sample on the "Sampling Log".</p> <p>a. Approve lots (which meet the specified classification) for use in the radon barrier.</p> <p>b. Lots not meeting the specified classification can not be used.</p>	<p>Verify the frequency of laboratory tests and compliance of test results.</p>
<p><b>PROTECTION:</b> The borrow material will be handled in such manner as to prevent contamination with radioactive waste material or other deleterious material. The in-place material may contain up to 5 percent additional rocks and sand above the content found in the classification test.</p>	<p>Visually check radon barrier materials for contamination by foreign materials. Remove clays that have been contaminated above the specified requirements. Document corrective actions (where required) on the "Daily Construction Report".</p>	<p>Verify that the radon barrier is being inspected for contaminants and that corrective actions (if required) are properly documented.</p>
<p><b>PROCESSING:</b> These procedures may be used to provide suitable material for construction of the radon barrier.</p> <p>1. Apply deflocculant at a rate determined by the production engineer.</p>	<p>Measure the mixing areas and verify that the application rate of the deflocculant is equal to or greater than the rate determined by the production engineer. Record the size of the mixing areas and the amount of deflocculant applied on the "Embankment</p>	<p>Verify that the size of the mixing areas and the amount of deflocculant applied have been properly documented.</p>

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**WORK ELEMENT - RADON BARRIER BORROW MATERIAL**

<b>SPECIFICATION</b>	<b>QUALITY CONTROL</b>	<b>QUALITY ASSURANCE</b>
	Construction Lift Approval Form”.	
2. Mix the deflocculant thoroughly into the soils by tilling, or similar action.	Observe the mixed clay and advise the project manager of areas which are adequately mixed.	Verify that the clay is being inspected by QC.

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**TABLE 1 - QA/QC ACTIVITIES**  
**WORK ELEMENT - RADON BARRIER TEST PAD**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>SCOPE:</b> This work element applies to the <u>Class A West, Class A, Class A North,</u> and 11e.(2) embankments.</p> <p><b>NOTICE OF TEST PAD CONSTRUCTION:</b> The test pad plan shall be approved by the DRC prior to test pad construction. The DRC shall be notified 48 hours in advance of the start-up of test pad construction.</p> <p><b>TEST PAD:</b> An approximately 60 feet by 75 feet large test pad will be constructed using the procedure proposed for construction of the radon barrier when using heavy equipment for compaction. An approximately 5 feet by 5 feet small test pad will be constructed using the procedure proposed for construction of the radon barrier when using hand compaction equipment.</p> <p>A new test pad shall be constructed each time there is a significant change in specifications, construction procedures, types of equipment, unified soil classification, QC testing equipment or procedure. A new test pad must be constructed each time there is a change in the grade or source of bentonite.</p> <p>Test pads are to be constructed and tested in accordance with the following specifications:</p> <ol style="list-style-type: none"> <li>Place the clay in at least three lifts with the first lift uncompacted thickness not exceeding twelve inches. Remaining lifts shall have a loose material thickness not exceeding nine inches for each lift. The clay material will be inspected for dry clod size during placement of each lift of radon barrier.</li> </ol>	<p>Obtain documentation confirming that the test pad plan has been approved by the DRC. Verify that the DRC has been notified as required.</p> <p>Observe the construction of test pads. Measure test pads to ensure that they are constructed to the size indicated. Record the test pad size on the "Embankment Construction Lift Approval Form".</p> <p>The large test pad shall be divided into three lots per lift (approximately 1,500 square feet per lift). Each lift of the small test pad shall equal a lot.</p> <p>Measure the lift thickness at a rate of 1 test per lot. Record thickness on the "Embankment Construction Lift Approval Form".</p> <p>Inspect the loose clay material during the unloading and spreading process for each uncompacted lift to ensure any dry clods that are present are less than or equal to one (1) inch. Record inspection of the dry clod size on the "Embankment Construction Lift</p>	<p>Verify that the test pad plan has been approved by the DRC. Verify that the DRC has been notified as required.</p> <p>Observe the construction of the test pads. Verify that the test pad has been measured and is properly documented.</p> <p>Verify that the number of lifts and lift thicknesses have been documented. Verify that the clod size inspection has been performed and documented for each uncompacted lift thickness.</p>

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WORK ELEMENT - RADON BARRIER TEST PAD**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>2. The clay is to be placed and compacted by equipment proposed for use during construction of the radon barrier.</p>	<p>Approval Form". Verify with the project manager that the same or similar type equipment and compaction efforts will be used in the cell for construction of the radon barrier. Record type of equipment used, and number of passes on the "Embankment Construction Lift Approval Form".</p>	<p>Verify equipment used and the number of passes made in preparing the test pad are those to be used during the construction of the radon barrier.</p>
<p>3. The lifts of clay shall be bonded by:</p> <p>a) Providing a rough upper surface on the underlying layer of radon barrier. The surface should have changes in grade of approximately one inch or more at a rate of two per linear foot; - OR -</p> <p>b) By compacting with a sheepsfoot with feet approximately two inches longer than the lift thickness.</p>	<p>Verify that there are adequate changes in grade by placing a straight edge at least two feet long on the surface. Count the number of points approximately one inch or more below the straight edge. - OR -</p> <p>Verify that the feet on the sheepsfoot compactor are approximately two inches longer than the lift thickness.</p>	<p>Verify the frequency of measurements and compliance of test results.</p>
<p>4. The clay is to be compacted to at least 95 percent of a standard Proctor with a moisture content of optimum to 5 percent over optimum. Compaction of the large test pad is to be accomplished by at least four passes of suitable compaction equipment.</p>	<p>Conduct in-place moisture-density tests at a rate of one test per lot per lift. The test location shall be chosen on the basis of random numbers. Record the test result on the "Field Density Test" form.</p> <p>a. Approve lots which 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</p>	<p>Verify the frequency of tests and compliance of test results.</p>
<p>5. The clay is to be constructed to provide a permeability of less than or equal to the specified permeability as shown on the approved engineering drawings. Permeability testing on the bottom lift will be performed at the surface. Permeability on the second lift will be performed <math>\geq 2'</math> below the surface. Permeability on the third lift will be performed <math>\geq 4'</math> below the surface.</p>	<p>Conduct in-place permeability tests at a rate of one test per lot per lift. The permeability test shall be run in close proximity to the moisture-density test. Record the test result on the "Field Permeability Test" form.</p> <p>a. Approve lots that meet the specified permeability. b. Rework and retest lots not meeting the specified permeability c. Any additional work under b. shall be included in</p>	<p>Verify the frequency of tests and compliance of test results.</p>

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**WORK ELEMENT - RADON BARRIER TEST PAD**

<b>SPECIFICATION</b>	<b>QUALITY CONTROL</b>	<b>QUALITY ASSURANCE</b>
	the test pad construction method	
6. At least one PI, LL, and gradation tests shall be conducted for each test pad.	Conduct PI, LL, and gradation tests at a rate of one of each type of test per test pad.	Verify that the PI, LL, and gradation tests have been conducted and documented.
7. The procedures used to construct the test pad shall be reviewed and approved by the certifying engineer. The test must be approved by a Professional Engineer.	Provide the certifying engineer with copies of the documentation for the test pad for review and approval.	Verify that proper approval has been obtained for the test pad and that the necessary construction procedure documents are in place for use during radon barrier construction.
8. The procedures used to construct the test pad shall be reviewed and approved by the DRC prior to using the new test pad construction method.	Obtain documentation confirming the DRC approval of the test pad.	Verify that proper approval has been obtained for the test pad and that the necessary construction procedure documents are in place for use during radon barrier construction.

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**WORK ELEMENT - RADON BARRIER PLACEMENT**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>SCOPE:</b> This work element applies to the <u>Class A West, Class A, Class A North,</u> and 11e.(2) embankments.</p>		
<p><b>NOTICE OF COVER CONSTRUCTION:</b> The DRC shall be notified of the cessation of waste placement and the start-up of cover construction for each phase of the "cut and cover" operation.</p>	<p>Verify that the DRC has been notified of the anticipated cessation of waste placement and the start-up of cover construction, prior to the placement of radon barrier.</p>	<p>Verify that the DRC has been notified of the anticipated cessation of waste placement and the start-up of cover construction, prior to the placement of radon barrier.</p>
<p><b>PROJECT AREA:</b> Radon barrier projects shall have a minimum total area of 300,000 square feet, unless otherwise approved in advance, in writing by DRC. Radon barrier projects may continue over more than one construction season, so long as the specifications for cold weather placement and spring start-up are met. A radon barrier project may consist of any number of lift areas.</p>	<p>Document the radon barrier project area dimensions.</p>	
<p><b>LIFT IDENTIFICATION:</b> Each lift shall be given a discrete designation for testing and surveying purposes.</p>	<p>Assign a lift identification number to each lift. Use the lift identification number to identify all paper work for that lift.</p>	<p>Verify that a lift identification number has been assigned to each lift. Verify that the lift identification number is used on all paper work for that lift.</p>
<p><b>PLACEMENT:</b> The radon barrier will be prepared, placed and compacted using the same type of equipment and mixing and compacting procedures that were approved in the test pad.</p>	<p>Observe the radon barrier placement. Record the equipment used to place the radon barrier, along with any corrective actions (where required) on the "Daily Construction Report".</p>	<p>Verify the equipment used to construct the radon barrier has been documented and that it is the same type of equipment used to construct the test pad.</p>
<p><b>LIFT BONDING:</b> The lifts of clay shall be bonded by:</p> <ol style="list-style-type: none"> <li>1) Providing a rough upper surface on the underlying layer of radon barrier. The surface should have changes in grade of approximately one inch or more at a rate of two per linear foot;</li> </ol> <p style="text-align: center;">- OR -</p> <ol style="list-style-type: none"> <li>2) By compacting with a sheepsfoot with feet approximately two inches longer than the lift thickness.</li> </ol>	<p>Verify that there are adequate changes in grade by placing a straight edge at least two feet long on the surface. Count the number of points approximately one inch or more below the straight edge.</p> <p style="text-align: center;">- OR -</p> <p>Verify that the feet on the sheepsfoot compactor are approximately two inches longer than the lift thickness.</p>	<p>Verify the frequency of measurements and compliance of test results.</p>

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**WORK ELEMENT - RADON BARRIER PLACEMENT**

<b>SPECIFICATION</b>	<b>QUALITY CONTROL</b>	<b>QUALITY ASSURANCE</b>
<p><b>LIFT THICKNESS:</b> The first lift of material shall have an uncompacted thickness of no greater than 12 inches. For the remaining lifts, the loose lift thickness shall not exceed the lesser of the lift thickness used to construct the test pad or nine inches. Thickness for the lift will be established by installing grade poles on at least a 70-foot grid and at all control points. The grade poles must not be installed deeper than 1 inch into the underlying clay liner. The grade poles must be marked at the appropriate depth to establish the grade. After the grade for the lift has been checked and approved by QC personnel, the grade poles shall be removed. The clay material will be inspected for dry clod size during placement of each lift of radon barrier.</p>	<p>Verify that the required grading tolerance is achieved as follows:</p> <ul style="list-style-type: none"> <li>a. Ensure that the required frequency for placement of grade poles has been met.</li> <li>b. Compare soil level with the marked level on the grade poles.</li> <li>c. Use a string line where necessary between poles to check for high or low spots.</li> <li>d. Define out of specification areas and advise the project manager to rework those areas.</li> <li>e. Review areas reworked and approve areas meeting criteria.</li> <li>f. Continue "b" through "d" above until all areas meet criteria.</li> <li>g. Indicate areas meeting criteria in the "Embankment Construction Lift Approval Form".</li> </ul> <p style="text-align: center;"><b>- OR -</b></p> <p>Dig a hole and measure the loose lift thickness at a rate of one per lot. A lot is defined as 10,000 square feet of a single lift and record on the "Lift Approval Form". The location of the measurement shall be chosen on the basis of random numbers.</p> <ul style="list-style-type: none"> <li>a. Approve lots which meet the specified lift thickness.</li> <li>b. If the thickness is greater than the specified thickness, measure the thickness at four points (north, east, south, and west) within ten feet of the first measurement. Average the five measurements together.</li> <li>c. Approve lifts with an average less than or equal to the specified lift thickness.</li> <li>d. Rework and retest lots with an average lift thickness greater than the specified lift thickness.</li> </ul> <p>Inspect the loose clay material during the unloading and spreading process for each uncompacted lift to ensure any dry clods that are present are less than or equal to one (1) inch. Record inspection of the clod size on the "Embankment Construction Lift Approval</p>	<p>Observe, at a minimum, five percent of the measurements performed by the QC personnel to ensure that the measurements are being performed correctly. Verify that the measurements are being performed at the correct frequency and that the documentation is being completed. Verify that the clod size inspection has been performed and documented for each uncompacted lift.</p>

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**WORK ELEMENT - RADON BARRIER PLACEMENT**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>KEYING-IN:</b> Segments of cell radon barrier constructed at times more than 30 days apart than each other shall be keyed-in to each other at vertical steps no greater than nine inches and at least twice as wide as they are high.</p> <p><b>COMPACTION:</b> Radon barrier material will be compacted to at least 95 percent of standard Proctor with a moisture content between optimum and 5 percent over optimum.</p> <p><b>PERMEABILITY:</b> The radon barrier shall have an in-place permeability of less than or equal to <math>1 \times 10^{-6}</math> cm/sec for the bottom layer. The radon barrier shall have an in-place permeability of less than or equal to <math>5 \times 10^{-8}</math> cm/sec for the final top foot.</p>	<p>Form”.</p> <p>Verify that the new liner has been properly keyed-in to the existing liner. Record deficiencies on the “Embankment Construction Lift Approval Form”.</p> <p>Conduct in-place moisture-density 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.</p> <p>a. Approve lots which meet the specified moisture and compaction.</p> <p>b. Rework and retest lots not meeting the specified moisture or compaction.</p> <p>Proctors shall be performed at a rate of one test per borrow lot. A borrow lot is defined as 3,000 cubic yards (compacted) or less of a specific material type. Record the location of the Proctor sample on the "Sampling Log".</p> <p>Conduct in-place permeability tests at a rate of one test per lot and record the results on the "Field Permeability Test" form. A lot is defined as 2,000 cubic yards (compacted) of <math>1 \times 10^{-6}</math> cm/sec or 200 cubic yards (compacted) of <math>5 \times 10^{-8}</math> cm/sec radon barrier. The permeability test shall be run in close proximity to a moisture-density test location.</p> <p>a. Approve lots that meet the specified permeability.</p> <p>b. Rework and retest lots not meeting the specified permeability.</p> <p>c. Restore all test areas with the approved construction method.</p>	<p>Verify that the keying-in of the liner has been documented.</p> <p>Observe, at a minimum, five percent of the tests performed by the QC personnel to ensure that the tests and observations are being performed correctly. Verify that the tests are being performed at the correct frequency and that the documentation is being completed.</p> <p>Observe, at a minimum, five percent of the tests performed by the QC personnel to ensure that the tests and observations are being performed correctly. Verify that the tests are being performed at the correct frequency and that the documentation is being completed.</p>

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SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>LAYER THICKNESS:</b> For the LLRW embankment, the bottom (<math>1 \times 10^{-6}</math> cm/sec permeability) layer shall be at least 1.0 feet thick. For the 11e.(2) embankment top slopes, the bottom (<math>1 \times 10^{-6}</math> cm/sec permeability) layer shall be at least 3.0 feet thick. For the 11e.(2) embankment side slopes, the bottom (<math>1 \times 10^{-6}</math> cm/sec permeability) layer shall be at least 2.5 feet thick. For the LLRW and 11e.(2) embankments, the top (<math>5 \times 10^{-8}</math> cm/sec permeability) layer shall be at least 1.0 feet thick.</p>		
<p><b>LINER TRANSITIONS BETWEEN RADON BARRIER WITH DIFFERENT SPECIFIED PERMEABILITIES:</b> The radon barrier with the higher permeability (i.e. the bottom radon barrier) shall be final graded from grade to 0.4 feet below grade design grade. Survey on a 50 ft grid and key points.</p>	<p>Survey the radon barrier surface on a 50 ft grid and at key points. Final survey measurements will be documented and provided to the QC Officer and Construction QA Officer.</p> <ol style="list-style-type: none"> <li>a. Indicate where the radon barrier meets design line and grade.</li> <li>b. Rework and resurvey areas not meeting the specified grade.</li> </ol>	<p>Review the final survey data. Verify the frequency of the survey points.</p>
<p><b>RADON BARRIER DRYING PREVENTION:</b> To prevent the radon barrier from drying, water will be applied to the clay surface on an as needed basis or the radon barrier will be covered with 6 inches of loose clay. Finished radon barrier shall be covered with 12 inches of filter zone, sacrificial soil layer, or 6 inches of loose clay within 30 days of completion. Unfinished radon barrier shall be covered with 6 inches of loose clay within 30 days of the last activity for the lift. Desiccation cracks larger than one-fourth inch wide and one-inch deep in the radon barrier will be reported to the DRC and will be documented as a non-conformance item when discovered.</p>	<p>Observe the liner surface for drying. Advise project manager of any deficiencies. Record corrective actions taken (where required) on the "Daily Construction Report".</p>	<p>Verify that the liner is being inspected.</p>
<p><b>SNOW REMOVAL:</b> When radon barrier material is to be placed and the work area is covered with snow,</p>	<p>Observe that snow is removed. Advise the project manager of deficiencies. Construction may not</p>	<p>Verify that snow removal is being documented.</p>

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<p>the snow must be removed.</p> <p><b>COLD WEATHER PLACEMENT OF RADON BARRIER:</b> For purposes of this CQA/QC Manual, “frozen” is defined as a soil temperature of less than or equal to 27°F. Radon barrier shall not be placed above frozen material. In addition, no frozen material shall be processed or placed.</p> <p>If the air temperature has dropped below 32°F since the last lift of radon barrier was approved, one of the following three scenarios apply:</p> <p>(1) If less than 30 days have passed since the date of lift approval and the last lift of radon barrier has been covered since the approval date with at least 9 inches of loose clay or 6 inches of compacted clay, then the cover clay may be worked with no additional testing of the lower approved lift.</p> <p>(2) If less than 30 days have passed since the date of lift approval and the last lift of radon barrier has not been covered with at least 9 inches of loose clay or 6 inches of compacted clay, then:</p> <p>(a) Perform spring start-up testing as discussed below; or</p> <p>(b) Monitor the radon barrier 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 radon barrier construction. If the temperature 1 inch beneath the surface is less than or equal to 27°F, re-work and re-test density and permeability of the affected area after the clay temperature has risen above 27°F.</p>	<p>continue without taking corrective actions to remove the snow. Record corrective actions (where required) in the "Daily Construction Report".</p> <p>As needed, observe the area where radon barrier is to be placed. If frozen material is observed, cease placement of radon barrier. If frozen material is suspected, measure soil temperature. Record the stopping of placement in the "Daily Construction Report."</p> <p>Review ambient air temperature records as measured at the site meteorological station. Document status of radon barrier cover placement on the "Daily Construction Report." Monitor radon barrier temperature when triggered under 2.(b). Clay temperature shall be measured between 6:00 am and 8:00 am on the day that radon barrier will be placed. Temperature measurements shall include a location that is most likely to be coldest; i.e., if there is a portion of the radon barrier that is shaded or at a low point. Temperature monitoring frequency shall be at least one point per 100,000 square feet or one point per contiguous project area, whichever is smaller.</p> <p>If the initial radon barrier temperature measurement is less than or equal to 27°F, the affected area may be resampled before 8:30 am the same day as follows:</p> <p>a. Measure the radon barrier temperature at a frequency of one measurement per lot (defined as no more than 10,000 square feet).</p> <p>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.</p>	<p>Verify that radon barrier is tested during cold weather conditions.</p>

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**WORK ELEMENT - RADON BARRIER PLACEMENT**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>(3) If more than 30 days have passed since the date of lift approval, perform spring start-up testing.</p> <p>In addition, the final lift of <math>5 \times 10^{-8}</math> cm/sec radon barrier requires that the Type B filter zone and sacrificial soil be placed over the radon barrier prior to the end of the work day when ambient temperatures will drop below 32 degrees Fahrenheit. If this protective cover is not applied prior to freezing conditions, an additional density test and permeability test shall be performed directly prior to covering the radon barrier final surface with filter zone and sacrificial soil. This process must be repeated whenever any final surface material is not covered with the filter zone and sacrificial soil prior to overnight freezing conditions.</p> <p><b>SPRING START-UP:</b> See “Cold Weather Placement of Radon Barrier” above for situations that trigger this specification.</p> <p>For spring start-up testing, the surface lift is treated as protective cover, regardless of whether it was an approved lift of radon barrier at one time or not. Excavate 9 inches below the clay surface and re-test for density and permeability. Excavation for testing purposes may consist of removing 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 level of effort as prescribed by the approved test pad for radon barrier construction.</p>	<p>Perform an additional density test and permeability test on <math>5 \times 10^{-8}</math> cm/sec final surface that has been exposed to overnight freezing conditions prior to placement of the Type B filter zone and sacrificial soil material. If passing test results are achieved, but it is not possible to cover all of the exposed radon barrier material with filter zone and sacrificial soil prior to the end of the workday, testing must be repeated for the exposed materials. This testing may be performed outside of the approved lift area so long as the area tested is representative of the clay in the approved lift area (i.e., was constructed at the same time and with the same method).</p> <p>Perform density and permeability testing at the frequencies outlined for radon barrier construction above. This testing may be performed outside of the approved lift area so long as the area tested is representative of the clay in the approved lift area (i.e., was constructed at the same time and with the same method). Moisture testing is not required for spring start-up.</p> <p>a. Approve lots that meet specification. The protective cover lift may be worked in place and tested to become the next lift of radon barrier.</p> <p>b. For lots that do not meet specification, test the surface at successively deeper 9 inch increments until a passing lift is found; remove all failing lifts; re-work all failing areas; and re-test.</p> <p>Document that repairs are completed to the same level of effort as required by the approved test pad for radon barrier construction.</p>	

**LLRW and 11e.(2) CQA/QC MANUAL**  
**TABLE 1 - QA/QC ACTIVITIES**  
**WORK ELEMENT - RADON BARRIER PLACEMENT**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>CONTAMINATION OF RADON BARRIER:</b> The radon barrier material shall not become contaminated with radioactive soils or debris during construction. The in-place clay may contain up to 5 percent additional rocks and sand above the content found in the classification test.</p>	<p>Visually check radon barrier for contamination by foreign materials. Remove clays which have been contaminated above the specified requirements.</p>	<p>Verify that removal of contaminated material has been properly documented.</p>
<p><b>FINAL GRADING:</b> Final grading shall be from grade to 0.2 feet above grade. Survey on a 50 ft grid and key points. Upon completion, the surface shall be rolled with a smooth drum roller.</p>	<p>Survey the foundation on a 50 ft grid and at key points. Final survey measurements will be documented and provided to the QC officer and Construction QA Officer.</p> <ol style="list-style-type: none"> <li>a. Indicate where the radon barrier meets design line and grade.</li> <li>b. Rework and resurvey areas not meeting the specified grade.</li> </ol>	<p>Review the final survey data. Verify the frequency of the survey points.</p>
<p><b>EROSION CONTROL FOR EXPOSED SOIL:</b> If DRC-approved final grade 5 x 10-8 cm/sec radon barrier soil surfaces are not covered by filter zone within 30 days of lift approval, the following erosion control repair measures shall apply.</p> <p>Semi-annually, inspect exposed radon barrier soil surfaces for evidence of erosion. Rivulet or gullied areas wider than 6 inches or deeper than 6 inches require maintenance to fill the rivulet or gully and restore the area to design grade. Soils imported as fill shall meet the requirements of "Radon Barrier Borrow Material", above. Maintenance shall be performed within 30 calendar days when needed.</p> <p>Erosion control blankets, mats, or fiber mulch may be used, in accordance with the manufacturer's instructions, for erosion prevention. DRC shall be notified at least 48 hours prior to deployment of</p>	<p>Perform monthly inspections. Document the inspection as well as associated maintenance activities on the Daily Construction Report.</p>	

**LLRW and 11e.(2) CQA/QC MANUAL**  
**TABLE 1 - QA/QC ACTIVITIES**  
**WORK ELEMENT - RADON BARRIER PLACEMENT**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
erosion control blankets, mats, or fiber mulch. If used, such erosion control materials shall be removed prior to filter zone construction.		
<b>RADIOLOGICAL SAMPLING FOR EXPOSED SOIL:</b> If DRC-approved final grade 5 x 10-8 cm/sec radon barrier soil surfaces are not covered by filter zone within 30 days of final approval, the area shall be either: (a) sampled and radiologically released in accordance with the Environmental Monitoring Plan; or (b) have a minimum of 6 inches of clay removed and replaced prior to filter zone placement. Under option (b), no environmental sampling is required.	Coordinate sampling and analysis with environmental personnel. Attach a copy of the release report to the lift approval documentation.	
<b>HEAVY EQUIPMENT ON RADON BARRIER:</b> Heavy equipment travel will be minimized on top of the finished radon barrier. Heavy equipment will not be operated on saturated radon barrier.	Observe work on radon barrier. Advise the project manager of problems with equipment on the radon barrier. Record corrective actions taken (where required) on the "Daily Construction Report".	Verify that the work is being inspected.
<b>QUALITY ASSURANCE SAMPLING:</b> Assurance samples for radon barrier materials tests are to be obtained at the following minimum frequency:  1. In-place moisture-density tests (ASTM D6938): 1 per 50,000 cubic yards.  2. Moisture/density relationship testing (ASTM D698): 1 per 50,000 cubic yards.  3. Classification tests (ASTM D2487, D1140, and D4318): 1 per 50,000 cubic yards.  A minimum of one of each of the above tests is required for each year that radon barrier is placed.	Coordinate with QA personnel in obtaining the quality assurance samples. Record the samples on the "Sample Log" and moisture-density test on the "Density Testing Log". Promptly report result of QC testing to Construction QA Officer so that a comparison of QA and QC testing results can be made.	Conduct or coordinate quality assurance sampling and testing in accordance with the designated frequencies. Obtain test results of QC samples so that a comparison of QA and QC test results can be made. The Construction QA Officer, in consultation with the QC officer, shall be responsible for determining the adequacy of correlation and documentation of the rationale used to determine adequacy. If the correlation is not adequate, new QC and QA samples shall be taken immediately. The construction QA Officer, in consultation with the QC officer, shall then evaluate the accuracy of the QC sampling and testing and, if necessary, provide for improved sampling and testing procedures and closer inspection and control. Record findings of quality assurance sampling in the "Daily QA Report".  Provide written approval of the radon barrier. Notify DRC that the radon barrier is ready for inspection.
<b>DRC APPROVAL:</b> The DRC shall approve documentation associated with completed radon	Notify the Construction QA Officer that the radon barrier is ready for inspection by the DRC. Obtain	

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**WORK ELEMENT - RADON BARRIER PLACEMENT**

<b>SPECIFICATION</b>	<b>QUALITY CONTROL</b>	<b>QUALITY ASSURANCE</b>
barrier. Documentation shall include all QC and QA records associated with construction, as well as photographs of the completed surface. In addition, 48 hour notification shall be provided to the DRC prior to placement of filter zone material over the finished radon barrier. EnergySolutions may proceed with filter zone placement 48 hours after DRC notification if the DRC has not inspected and has not notified the Director of Engineering of its intent to inspect the radon barrier surface.	written authorization on the "Liner Inspection Form" from the Construction QA Officer that the radon barrier has been inspected. Obtain documentation confirming the DRC approval of the radon barrier documentation.	

**LLRW and 11e.(2) CQA/QC MANUAL  
TABLE 1 - QA/QC ACTIVITIES  
WORK ELEMENT - FILTER ZONE**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>SCOPE:</b> This work element applies to the <u>Class A West, Class A, Class A North,</u> and 11e.(2) embankments.</p> <p><b>QUALITY OF ROCK:</b> The rock shall have a "Rock Quality" score of at least 50 based on the following tests: Specific Gravity (ASTM C-128), Absorption (ASTM C-127), Sodium Soundness (ASTM C-88), and L.A. Abrasion (ASTM C-131 or ASTM C-535). The procedures for scoring "Rock Quality" are found in Appendix C.</p> <p><b>TYPE B FILTER ZONE PERMEABILITY:</b> The type B filter zone rock on the Class A and Class A North embankments will have a minimum permeability of 3.5 cm per second.</p> <p>The filter zone rock on the 11e.(2) embankment will have a minimum hydraulic conductivity of 42 cm/sec.</p> <p><b>GRADATION:</b> LLRW embankment rock gradation shall be as specified on the currently approved engineering drawings <del>9821 and 0408010014</del>. 11e.(2)</p>	<p>As described in NUREG-1623, appendix F, perform at least one petrographic examination for each rock source in accordance with ASTM C-295. If a combination of limestone, sandstone, and igneous rock is found for a source, percentages of each type of material shall be determined for scoring.</p> <p>Perform Na soundness, LA abrasion, absorption, and specific gravity testing at a rate of one set of tests per 10,000 cubic yards of rock. Record the location of all collected samples in the "Sampling Log".</p> <p>a. Approve rock for use in the filter zone which meet the specifications for rock quality.</p> <p>b. Rock not meeting the specifications for rock quality can not be used.</p> <p>Perform permeability testing at a rate of one test per 10,000 cubic yards placed. Record the location of all samples in the "Sampling Log".</p> <p>a. Approve rock for use in the filter zone which meet the specified gradation.</p> <p>b. Rock not meeting the specified gradation can not be used.</p> <p>For Type B filter zone rock, if material is to be stockpiled, perform gradation testing at a rate of one test per 2,500 cubic yard stockpile. If Type B filter</p>	<p>Verify the frequency of laboratory quality control tests and compliance of test results.</p> <p>Perform quality assurance testing at a minimum of one set of tests per 100,000 cubic yards of rock. A minimum of one set of tests is required each year that filter zone is placed. Record the samples on the "Sampling Log". Promptly report results to the Construction QA Officer so that a comparison of QA and QC testing results can be made. The Construction QA Officer, in consultation with the QC officer, shall be responsible for determining the adequacy of correlation and documentation of the rationale used to determine adequacy. If the correlation is not adequate, new QC and QA samples shall be taken immediately. The Construction QA Officer, in consultation with the QC officer, shall then evaluate the accuracy of the QC sampling and testing and, if necessary, provide for improved sampling and testing procedures and closer inspection and control. Record findings of the quality assurance sampling in the "Daily QA Report".</p> <p>Verify the frequency of laboratory tests and compliance of test results.</p> <p>Verify the frequency of laboratory quality control tests and compliance of test results.</p>

**LLRW and 11e.(2) CQA/QC MANUAL  
TABLE 1 - QA/QC ACTIVITIES  
WORK ELEMENT - FILTER ZONE**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>embankment rock gradation shall be as specified on the currently approved engineering drawing 9420-4.</p>	<p>zone rock material is transferred directly to the cell from the production plant, perform at least one test per source per day material is placed, or at least one test per 2,500 cubic yards. For Type A filter zone rock, perform gradation testing at a rate of one test per 10,000 cubic yards. In addition, perform a minimum of one test per change in soil type by ASTM D 2488. Record the location of all samples in the "Sampling Log".</p> <p>a. Approve rock for use in the filter zone which meet the specified gradation.</p> <p>b. Rock not meeting the specified gradation can not be used.</p>	<p>Perform quality assurance testing at a minimum of one set of tests per 100,000 cubic yards of rock. A minimum of one set of tests is required each year that filter zone is placed. Record the samples on the "Sampling Log". Promptly report results to the Construction QA Officer so that a comparison of QA and QC testing results can be made. The Construction QA Officer, in consultation with the QC officer, shall be responsible for determining the adequacy of correlation and documentation of the rationale used to determine adequacy. If the correlation is not adequate, new QC and QA samples shall be taken immediately. The Construction QA Officer, in consultation with the QC officer, shall then evaluate the accuracy of the QC sampling and testing and, if necessary, provide for improved sampling and testing procedures and closer inspection and control. Record findings of the quality assurance sampling in the "Daily QA Report".</p>
<p><b>PLACEMENT:</b> Filter zone material will be placed over the radon barrier. The thickness of the filter zone layer for the LLRW embankments shall be as specified on the currently approved engineering drawings <del>9821 and 0408010014</del>. The thickness of the filter zone layer for the 11e.(2) embankment shall be as specified on the currently approved engineering drawings 9420-4, 9420-5, and 9420-6. Filter zone material shall be handled in such a manner as to prevent contamination from waste material and segregation of finer materials.</p>	<p>Observe the placement of the filter zone material. Ensure that soil fines are not concentrated in localized areas. If soil fines are concentrated in localized areas, the project manager shall be directed to evenly distribute the fines or to remove them. Record corrective actions (where required) in the "Daily Construction Report".</p>	<p>Verify that QC personnel observe the placement of the filter zone material such that soil fines are not concentrated in localized areas.</p>
<p><b>SNOW REMOVAL:</b> When filter zone material is to be placed and the work area is covered with snow, the snow must be removed.</p>	<p>Observe that snow is removed. Advise the project manager of any deficiencies. Construction may not continue without taking corrective actions to remove the snow. Record corrective actions (where required) in the "Daily Construction Report".</p>	<p>Verify that snow removal is being documented.</p>
<p><b>FINAL GRADING:</b> Thickness for the lift will be</p>	<p>Verify that the grade poles are marked at the</p>	<p>Review documentation for final grading.</p>

**LLRW and 11e.(2) CQA/QC MANUAL**  
**TABLE 1 - QA/QC ACTIVITIES**  
**WORK ELEMENT - FILTER ZONE**

<b>SPECIFICATION</b>	<b>QUALITY CONTROL</b>	<b>QUALITY ASSURANCE</b>
<p>established by installing grade poles on at least a 50' grid and at all control points. The grade poles shall consist of PVC pipe (approximately ½-inch diameter) with surveyors ribbon (or other distinguishable markings) attached to the appropriate lift thickness. The poles shall be held in place by placing the filter rock adjacent to the base of the grade pole to secure it in a vertical position (long axis of the grade pole perpendicular to the radon barrier surface). With the grade pole marked at the appropriate thickness and secured at the appropriate locations, the filter rock may be placed throughout the project area. The base of the grade poles shall rest on the surface of the radon barrier and therefore will not damage the radon barrier surface. After the grade has been checked and approved by QC personnel, the grade poles shall be removed from the filter zone placed directly above the radon barrier.</p>	<p>appropriate depth to establish grade for the layer that will be placed. Observe the installation of some of the grade poles to ensure that the installation method has been followed and verify that the grade poles have not penetrated or damaged the surface of the radon barrier.</p> <p>Verify the required grade is achieved at all control points throughout the placed filter rock in the project area. Rework and re-verify areas not meeting the specified grade. Ensure all grade poles have been removed following verification of grade. Document all inspections and corrective actions, where required, on the "Daily Construction Report".</p>	

**LLRW and 11e.(2) CQA/QC MANUAL**  
**TABLE 1 - QA/QC ACTIVITIES**  
**WORK ELEMENT - SACRIFICIAL SOIL PLACEMENT**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>SCOPE:</b> This work element applies to the <u>Class A West Class A, and Class A North</u> embankments.</p>		
<p><b>PLACEMENT:</b> Sacrificial soil will be placed over the filter zone as specified on currently approved engineering drawings <del>9821 and 0408010014</del>. Sacrificial soil shall be handled in such a manner as to prevent contamination from waste material and segregation of finer materials.</p>	<p>Observe the placement of the sacrificial soil. Ensure that fines are not concentrated in localized areas. If fines are concentrated in localized areas, the project manager shall be directed to evenly distribute the fines or to remove them. Record corrective actions (where required) in the "Daily Construction Report".</p>	<p>Verify that QC personnel observe the placement of the sacrificial soil such that fines are not concentrated in localized areas.</p>
<p><b>GRADATION:</b> Gradation of the sacrificial soil shall be as specified on the currently approved engineering drawings <del>9821 and 0408010014</del>.</p>	<p>If material is to be stockpiled, perform gradation testing at a rate of one test per 2,500 cubic yard stockpile. If material is transferred directly to the cell from the production plant, perform at least one test per source per day material is placed, or at least one test per 2,500 cubic yards. In addition, perform a minimum of one test per change in soil type by ASTM D 2488. Record the location of all samples in the "Sampling Log".</p> <ol style="list-style-type: none"> <li>a. Approve material for use as sacrificial soil which meet the specified gradation.</li> <li>b. Material not meeting the specified gradation can not be used.</li> </ol>	<p>Verify the frequency of laboratory tests and compliance of test results.</p>
<p><b>SNOW REMOVAL:</b> When sacrificial soil is to be placed and the work area is covered with snow, the snow must be removed.</p>	<p>Observe that snow is removed. Advise the project manager of any deficiencies. Construction may not continue without taking corrective action to remove the snow. Record corrective actions (where required) in the "Daily Construction Report".</p>	<p>Verify that snow removal is being documented as per DRC requirement.</p>
<p><b>FINAL GRADING:</b> Thicknesses for the lift will be established by installing grade poles on at least a 50' grid and at all control points. The grade poles must be marked at the appropriate depth to establish grade. After the grade has been checked and approved by QC personnel, the grade poles shall be removed.</p>	<p>Verify the required grade is achieved at all control points. Rework and re-verify areas not meeting the specified grade.</p>	<p>Review the documentation for final grading.</p>

**LLRW and 11e.(2) CQA/QC MANUAL  
TABLE 1 - QA/QC ACTIVITIES  
WORK ELEMENT - ROCK EROSION BARRIER**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>SCOPE:</b> This work element applies to the C <u>Class A West class A, Class A North</u>, and 11e.(2) embankments.</p> <p><b>QUALITY OF ROCK:</b> The rock shall have a "Rock Quality" score of at least 50 based on the following tests: Specific Gravity (ASTM C-128), Absorption (ASTM C-127), Sodium Soundness (ASTM C-88), and L.A. Abrasion (ASTM C-131 or ASTM C-535). The procedures for scoring "Rock Quality" are found in Appendix C.</p> <p><b>GRADATION:</b> Gradation of the rock for the LLRW embankments shall be as specified on the currently approved engineering drawings <u>9821 and 0408010014</u>. Gradation of the rock for the 11e.(2) embankment shall be as specified on the currently approved engineering drawing 9420-4.</p>	<p>As described in NUREG-1623, appendix F, perform at least one petrographic examination for each rock source in accordance with ASTM C-295. If a combination of limestone, sandstone, and igneous rock is found for a source, percentages of each type of material shall be determined for scoring.</p> <p>Record the location of all collected samples in the "Sampling Log". Test rock at a rate of one set of test for every 10,000 cubic yards of rock.</p> <p>a. Approve rock for use in the rock erosion barrier which meet the specifications for rock quality.</p> <p>b. Rock not meeting the specifications for rock quality can not be used.</p> <p>Perform gradation testing, in accordance with ASTM D-5519 or C-136, at a rate of one test per 10,000 cubic yards. Record the location of all samples in the "Sampling Log".</p> <p>a. Approve rock for use in the rock erosion barrier which meet the specified gradation.</p> <p>b. Rock not meeting the specified gradation can not be used.</p>	<p>Verify the frequency of laboratory quality control tests and compliance of test results.</p> <p>Perform quality assurance testing at a minimum of one set of tests per 100,000 cubic yards of rock. A minimum of one set of tests is required each year that filter zone is placed. Record the samples on the "Sampling Log". Promptly report results to the Construction QA Officer so that a comparison of QA and QC testing results can be made. The Construction QA Officer, in consultation with the QC officer, shall be responsible for determining the adequacy of correlation and documentation of the rationale used to determine adequacy. If the correlation is not adequate, new QC and QA samples shall be taken immediately. The Construction QA Officer, in consultation with the QC officer, shall then evaluate the accuracy of the QC sampling and testing and, if necessary, provide for improved sampling and testing procedures and closer inspection and control. Record findings of the quality assurance sampling in the "Daily QA Report".</p> <p>Verify the frequency of laboratory quality control tests and compliance of test results.</p> <p>Perform quality assurance testing at a minimum of one set of tests per 100,000 cubic yards of rock. A minimum of one set of tests is required each year that filter zone is placed. Record the samples on the "Sampling Log". Promptly report results to the Construction QA Officer so that a comparison of QA and QC testing results can be made. The Construction QA Officer, in consultation with the QC officer, shall be responsible for determining the adequacy of</p>

**LLRW and 11e.(2) CQA/QC MANUAL  
TABLE 1 - QA/QC ACTIVITIES  
WORK ELEMENT - ROCK EROSION BARRIER**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>PLACEMENT:</b> Rock erosion material will be placed over the filter zone. Thickness of rock erosion barrier shall be 18 inches inside the centerline of the perimeter ditch and 12 inches outside the centerline of the perimeter ditch. Rock erosion material shall be handled in such a manner as to prevent contamination from waste material and segregation of finer materials.</p>	<p>Observe the placement of the filter zone material. Ensure that soil fines are not concentrated in localized areas. If soil fines are concentrated in localized areas, the project manager shall be directed to evenly distribute the fines or to remove them. Record corrective actions (where required) in the "Daily Construction Report".</p>	<p>correlation and documentation of the rationale used to determine adequacy. If the correlation is not adequate, new QC and QA samples shall be taken immediately. The Construction QA Officer, in consultation with the QC officer, shall then evaluate the accuracy of the QC sampling and testing and, if necessary, provide for improved sampling and testing procedures and closer inspection and control. Record findings of the quality assurance sampling in the "Daily QA Report".</p>
<p><b>SNOW REMOVAL:</b> When rock erosion barrier material is to be placed and the work area is covered with snow, the snow must be removed.</p>	<p>Observe that snow is removed. Advise the project manager of any deficiencies. Construction may not continue without taking corrective action to remove the snow. Record corrective actions (where required) in the "Daily Construction Report".</p>	<p>Verify that QC personnel observe the placement of the filter zone material such that soil fines are not concentrated in localized areas.</p> <p>Verify that snow removal is being documented as per DRC requirement.</p>
<p><b>FINAL GRADING:</b> Thickness for the lift will be established by installing grade poles on at least a 50' grid and at all control points. The grade poles shall consist of PVC pipe (approximately ½-inch diameter) with surveyor ribbon (or other distinguishable markings). The grade poles must be marked at the appropriate depth to establish grade. After the grade has been checked and approved by QC personnel, the grade poles shall be removed.</p>	<p>Verify the required grade is achieved at all control points. Rework and re-verify areas not meeting the specified grade. Document all inspections and corrective actions, where required, on the "Daily Construction Report".</p>	<p>Review the documentation for final grading.</p>
<p><b>NOTICE OF COVER CONSTRUCTION:</b> Provide written notice of the completion of cover construction to the DRC within 30 days of completion of each phase</p>	<p>Verify the DRC has been notified of completion of cover construction within 30 days of completion of each phase of cover construction.</p>	<p>Verify the DRC has been notified of completion of cover construction within 30 days of completion of each phase of cover construction.</p>

LLRW and 11e.(2) CQA/QC MANUAL  
TABLE 1 - QA/QC ACTIVITIES  
WORK ELEMENT - ROCK EROSION BARRIER

**SPECIFICATION**

**QUALITY CONTROL**

**QUALITY ASSURANCE**

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of cover construction in the "cut and cover" operation.

**LLRW and 11e.(2) CQA/QC MANUAL**  
**TABLE 1 - QA/QC ACTIVITIES**  
**WORK ELEMENT - DRAINAGE DITCH IMPORTED BORROW**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>SCOPE:</b> This work element applies to the <u>Class A West, Class A, Class A North,</u> and 11e.(2) embankments.</p>		
<p><b>CLEARING AND GRUBBING:</b> Remove vegetation, debris, organic, or deleterious material from areas to be used for borrow. Grubbing depth will depend on the type of vegetation, debris, organic, or deleterious material on the site. If the area is free of these materials then no clearing and grubbing will be necessary.</p>	<p>Inspect the area once clearing and grubbing has been completed. Record observations and corrective actions (where required) on the "Daily Construction Report".</p>	<p>Verify that the clearing and grubbing has been inspected by QC.</p>
<p><b>MATERIAL:</b> The imported borrow shall be classified as CL or ML soils by ASTM D-2487.</p>	<p>Perform laboratory classification tests at a rate of 1 test per lot prior to use of material in the road. A lot is defined as a maximum of 3,000 cubic yards (compacted) of specified material type. Record the location of the classification sample on the "Sampling Log".</p> <p>a. Approve lots (which meet the specified classification) for use in the road.</p> <p>b. Lots not meeting the specified classification can not be used.</p>	<p>Verify the frequency of laboratory tests and compliance of test results.</p>
<p><b>LIFT THICKNESS:</b> Drainage ditch borrow material shall be placed in lifts with an uncompacted thickness of less than or equal to 9 inches. Thickness for the lift will be established by installing grade poles on at least a 50-foot grid lengthwise and at all control points. The grade poles must not be installed deeper than 1 inch into the underlying clay liner. The grade poles must be marked at the appropriate depth to establish the grade. After the grade has been checked and approved by QC personnel, the grade poles shall be removed.</p>	<p>Verify that the required grading is achieved as follows:</p> <p>a. Ensure that the required frequency for placement of grade poles has been met.</p> <p>b. Compare soil level with the marked level on the grade poles.</p> <p>c. Use a string line where necessary between poles to check for high or low spots.</p> <p>d. Define those areas that are high out of specification and advise the project manager to re-work those areas.</p> <p>e. Review areas re-worked and approve 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 "Embankment Construction Lift Approval Form".</p>	<p>Observe, at a minimum, five percent of the measurements performed by QC personnel to ensure that the measurements are being performed correctly. Verify that the measurements are being performed at the correct frequency and that the documentation is being completed.</p>

**LLRW and 11e.(2) CQA/QC MANUAL  
TABLE 1 - QA/QC ACTIVITIES  
WORK ELEMENT - DRAINAGE DITCHES**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>SCOPE:</b> This work element applies to the <u>Class A West, Class A, Class A North,</u> and 11e.(2) embankments.</p> <p><b>EXCAVATION:</b> Excavation shall be made to the lines, grades, and dimensions prescribed in the approved plans. Prior DRC approval in writing must be obtained before diverting ditches from the current approved design. The purpose and duration of diversion shall be specified in any request to do so.</p> <p>Any over excavation shall be backfilled with select materials and compacted to 95 percent of standard Proctor. The uncompacted lift thickness shall not exceed 9 inches.</p> <p><b>FINAL GRADING:</b> Smooth roll the excavated surface to prepare for filter zone. Final grading of this surface shall be <math>\pm 0.1</math> of a foot.</p> <p><b>FILTER ZONE AND ROCK EROSION BARRIER:</b> The filter zone and rock erosion barrier shall be constructed in accordance with the specifications outlined under work elements "Filter</p>	<p>Provide daily observation of the cell excavation. Record observations and corrective actions (where required) on the "Daily Construction Report".</p> <p>In areas of over excavation, conduct in-place density test 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 lift of a specified type of material. Test locations shall be chosen on the basis of random numbers.</p> <ol style="list-style-type: none"> <li>a. Approve lots which meet the specified compaction.</li> <li>b. Rework and retest lots not meeting the specified compaction.</li> </ol> <p>Proctors shall be performed at a rate of one test per 100,000 square feet 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".</p> <p>Inspect the surface for smoothness. Survey the surface on a 50 ft grid and at key points. Final survey measurements will be documented and provided to the QC officer and Construction QA Officer.</p> <ol style="list-style-type: none"> <li>a. Indicate where the surface meets design line and grade.</li> <li>b. Rework and resurvey areas not meeting the specified grade.</li> </ol> <p>See work elements "Filter Zone" and "Rock Erosion Barrier".</p>	<p>Observe, at a minimum, five percent of the tests performed by the QC personnel to ensure that the tests and observations are being performed correctly. Verify that the tests are being performed at the correct frequency and that the documentation is being completed.</p> <p>Review the final survey data. Verify the frequency of the survey points.</p> <p>See work elements "Filter Zone" and "Rock Erosion Barrier".</p>

**LLRW and 11e.(2) CQA/QC MANUAL  
TABLE 1 - QA/QC ACTIVITIES  
WORK ELEMENT - DRAINAGE DITCHES**

<b>SPECIFICATION</b>	<b>QUALITY CONTROL</b>	<b>QUALITY ASSURANCE</b>
<p>Zone" and "Rock Erosion Barrier".</p> <p><b>EROSION CONTROL FOR EXPOSED SOIL:</b> If reviewed and approved drainage ditch soil surfaces are not covered by filter zone within 30 days of lift approval, the following erosion control repair measures shall apply.</p> <p>Semi-annually, inspect exposed drainage ditch soil surfaces for evidence of erosion. Rivulet or gullied areas wider than 6 inches or deeper than 6 inches require maintenance to fill the rivulet or gully and restore the area to design grade. Soils imported as fill shall meet the requirements of "Drainage Ditch Imported Borrow", above. Maintenance shall be performed within 30 calendar days when needed, unless additional time is approved by DRC.</p> <p>Erosion control blankets, mats, or fiber mulch may be used, in accordance with the manufacturer's instructions, for erosion prevention. DRC shall be notified at least 48 hours prior to deployment of erosion control blankets, mats, or fiber mulch. If used, such erosion control materials shall be removed prior to filter zone construction.</p> <p><b>RADIOLOGICAL SAMPLING FOR EXPOSED SOIL:</b> If reviewed and approved drainage ditch soil surfaces are not covered by filter zone within 30 days of lift approval, the area shall either (a) be sampled and radiologically released in accordance with the Environmental Monitoring Plan; or (b) have a minimum of 6 inches of clay removed and replaced prior to filter zone placement. Under option (b), no environmental sampling is required.</p>	<p>Perform monthly inspections. Document the inspection as well as associated maintenance activities on the Daily Construction Report.</p>	<p>Coordinate sampling and analysis with environmental personnel. Attach a copy of the release report to the lift approval documentation.</p>

**LLRW and 11e.(2) CQA/QC MANUAL  
TABLE 1 - QA/QC ACTIVITIES  
WORK ELEMENT - INSPECTION ROAD**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE														
<p><b>SCOPE:</b> This work element applies to the <u>Class A West, Class A, Class A North,</u> and 11e.(2) embankments.</p>																
<p><b>MATERIAL:</b> The material used to construct the road shall conform to the following specification:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Sieve Size</th> <th style="text-align: left;">% Passing</th> </tr> </thead> <tbody> <tr> <td>1-1/2"</td> <td>100</td> </tr> <tr> <td>3/4"</td> <td>75-95</td> </tr> <tr> <td>1/2"</td> <td>62-82</td> </tr> <tr> <td># 4</td> <td>38-58</td> </tr> <tr> <td># 16</td> <td>16-36</td> </tr> <tr> <td># 200</td> <td>0-18</td> </tr> </tbody> </table>	Sieve Size	% Passing	1-1/2"	100	3/4"	75-95	1/2"	62-82	# 4	38-58	# 16	16-36	# 200	0-18	<p>Perform laboratory classification tests at a rate of 1 test per lot prior to use of material in the road. A lot is defined as a maximum of 3,000 cubic yards (compacted) of specified material type. Record the location of the classification sample on the "Sampling Log".</p> <ol style="list-style-type: none"> <li>a. Approve lots (which meet the specified classification) for use in the road.</li> <li>b. Lots not meeting the specified classification can not be used.</li> </ol>	<p>Verify the frequency of laboratory tests and compliance of test results.</p>
Sieve Size	% Passing															
1-1/2"	100															
3/4"	75-95															
1/2"	62-82															
# 4	38-58															
# 16	16-36															
# 200	0-18															
<p><b>SUBSURFACE PREPARATION:</b> The subsurface will be scarified and re-compacted to at least 95 percent of a standard proctor (ASTM D-698).</p>	<p>Conduct in-place density 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 material. The test location shall be chosen on the basis of random numbers.</p> <ol style="list-style-type: none"> <li>a. Approve lots which meet the specified compaction.</li> <li>b. Rework and retest lots not meeting the specified compaction.</li> </ol> <p>Proctors shall be performed at a rate of one test per borrow lot. A borrow lot is defined as 3,000 cubic yards (compacted) or less of a specific material type. Record the location of the Proctor sample on the "Sampling Log".</p>	<p>Observe, at a minimum, five percent of the tests performed by the QC personnel to ensure that the tests and observations are being performed correctly. Verify that the tests are being performed at the correct frequency and that the documentation is being completed.</p>														
<p><b>ROAD THICKNESS:</b> The compacted road shall be 12 inches thick plus or minus 0.2 feet.</p>	<p>Measure the thickness of the road at both edges of the road at no greater than 50 foot intervals. Record the results on the "Lift Approval Form".</p> <ol style="list-style-type: none"> <li>a. Approve section of the road which meet the specified thickness.</li> <li>b. Rework and retest sections not meeting the required thickness.</li> </ol>	<p>Observe, at a minimum, five percent of the measurements performed by the QC personnel to ensure that the measurements are being performed correctly. Verify that the measurements are being performed at the correct frequency and that the documentation is being completed.</p>														

**LLRW and 11e.(2) CQA/QC MANUAL  
TABLE 1 - QA/QC ACTIVITIES  
WORK ELEMENT - INSPECTION ROAD**

<b>SPECIFICATION</b>	<b>QUALITY CONTROL</b>	<b>QUALITY ASSURANCE</b>
<p><b>COMPACTION:</b> The road will be compacted to at least 95 percent of standard Proctor (ASTM D-698).</p>	<p>Conduct in-place density 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 material. The test location shall be chosen on the basis of random numbers.</p> <ul style="list-style-type: none"> <li>a. Approve lots which meet the specified compaction.</li> <li>b. Rework and retest lots not meeting the specified compaction.</li> </ul> <p>Proctors shall be performed at a rate of one test per borrow lot. A borrow lot is defined as 3,000 cubic yards (compacted) or less of a specific material type. Record the location of the Proctor sample on the "Sampling Log".</p>	<p>Observe, at a minimum, five percent of the tests performed by the QC personnel to ensure that the tests and observations are being performed correctly. Verify that the tests are being performed at the correct frequency and that the documentation is being completed.</p>

**LLRW and 11e.(2) CQA/QC MANUAL  
TABLE 1 - QA/QC ACTIVITIES  
WORK ELEMENT - PERMANENT CHAIN LINK FENCES**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>SCOPE:</b> This work element applies to the <u>Class A West, Class A, Class A North,</u> and 11e.(2) embankments.</p> <p><b>MATERIALS:</b> All burial embankments and waste storage areas, including immediately adjacent drainage structures, shall be controlled areas, surrounded by six foot high, chain link fence. All permanent fence shall be chain link, six feet high, topped with three strand barbed wire, top tension wire and twisted selvedge.</p> <p>Zinc coated chain link fence shall meet the requirements of ASTM A-392 with Class I coating. Aluminum Coated fence fabric shall meet the requirements of ASTM A-491.</p> <p><u>Fence Fabric:</u> Fence fabric shall be made of 0.148 inch or larger diameter wire. The fabric shall have twisted selvedge.</p> <p><u>Wire and Ties:</u> Tension wires shall be 0.177 inch or larger diameter spiral type. Ring ties for tying fabric to supporting members shall be made of 0.148 inch or larger diameter wire. Wire ties for tying fabric to support members shall be made of 0.12 inch or larger diameter wire. Ties to line posts shall be made of 0.192 inch or larger diameter wire. All wire shall have Class II coating as specified by ASTM A-116.</p> <p><u>Barbed Wire:</u> Barbed wire on zinc coated fence shall meet the requirements of ASTM A-121, including a Class I zinc coating. Barbed wire shall be made of 0.099 inch or larger diameter wire with 0.080 inch or larger diameter wire four point barbs on 5 inch centers. When aluminum or aluminum coated fence is used, aluminum coated barbed ware shall be used meeting the requirements of ASTM A-0491. The support arm</p>	<p>Obtain a copy of the manufacture's specification for the materials to be used in the construction of the fence. Verify that the materials meet the required specifications. Document materials acceptance on the "Daily Construction Report".</p>	<p>Verify that the materials to be used in the construction of the fence have been approved.</p>

**LLRW and 11e.(2) CQA/QC MANUAL  
TABLE 1 - QA/QC ACTIVITIES  
WORK ELEMENT - PERMANENT CHAIN LINK FENCES**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>on the fence for the barbed wire shall be capable of supporting a 200 pound vertical load at the end of the arm without permanent deflection.</p> <p><u>Posts:</u> Line posts may be "H" section or pipe. The minimum strength requirements are as follows:</p> <ol style="list-style-type: none"> <li>1. Load at top: 600 lbs.</li> <li>2. Maximum Moment: 1200 ft-lbs.</li> <li>3. Maximum permanent set: 0.010 in.</li> </ol> <p>"H" posts shall be coated in accordance with the requirements of ASTM A-123. Pipe posts shall conform to the requirements of ASTM A-120 (Schedule 40) for zinc coated pipe. All pipe posts shall be fitted with a weather resistant tip, designed to fit securely over the post, and carry an apron around the outside of the post.</p> <p><u>Fittings:</u> Fittings shall be malleable cast iron or pressed steel and be coated in accordance to ASTM A-123.</p> <p><u>Gates:</u> Gate posts and frames shall be constructed of the sizes shown on the approved plans for the various gate dimension. The corners of the gate frame shall be fastened together with pressed steel or malleable iron corner ells riveted or welded in accordance with the plans. Welded steel gate frames shall be galvanized after fabrication in accordance with the provision of ASTM A-123. Chain link fence fabric for covering the gate frames shall be the same as required for the fence. Each gate shall be furnished complete with necessary galvanized hinged, latch, and drop bar locking device for the type of gate used on the project.</p> <p><b>INSTALLATION:</b> The steel posts shall be set true to line and grade in concrete bases. The distances between posts shall be uniform and not exceeding 10 feet. Fence corners and ends shall be constructed in accordance</p>	<p>Verify that the fence is constructed in the location shown on the plans and in accordance with sheet L9. Document any problems in the "Daily Construction Report".</p>	<p>Verify that the fence has been inspected and problems have been properly documented.</p>

**LLRW and 11e.(2) CQA/QC MANUAL**  
**TABLE 1 - QA/QC ACTIVITIES**  
**WORK ELEMENT - PERMANENT CHAIN LINK FENCES**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
with Detail A on sheet L9 of the approved engineering drawings. Gates shall be constructed in accordance with Detail B on sheet L9 of the approved engineering drawings.		
A minimum of 6 inches of concrete shall be provided below the bottom of each post. End posts, pull posts, corner posts, and gate posts shall have a concrete base at least 12 inches in diameter. Bases for line posts shall be at least 10 inches in diameter.	Spot check the depth and diameter of the post holes to verify that the holes meet the required specification. Document any problems in the "Daily Construction Report".	Verify that the fence has been inspected and problems have been properly documented.
Pull posts shall be provided at 500 feet maximum intervals. Changes in line of 30 degrees or more shall be considered as corners.	Inspect the fence for proper placement of pull and corner posts. Document any problems in the "Daily Construction Report".	Verify that the fence has been inspected and problems have been properly documented.
The fabric shall be stretched taut, and securely fastened to the posts. Fastening to end, gate, corner, and pull posts shall be with stretcher bars and metal bands, spaced at one foot intervals. The fabric shall be cut and each span fastened independently at all pull and corner posts. Fastening to line posts shall be with tie wire, metal bands, or other approved method at 14 inch intervals. The top edge of fabric shall be attached to the top rail or tension cable at approximately 24 inch intervals. The bottom tension wire is required and shall be attached to the fabric with tie wires at 24 inch intervals and shall be secured to the end or pull posts with brace bands.	Inspect the fencing fabric to verify that it has been installed in accordance with the specifications. Document any problems in the "Daily Construction Report".	Verify that the fence has been inspected and problems have been properly documented.

**LLRW and 11e.(2) CQA/QC MANUAL  
TABLE 1 - QA/QC ACTIVITIES  
WORK ELEMENT – SETTLEMENT MONITORING**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>SCOPE:</b> This work element applies to the LARW, <del>Class A West</del><del>Class A</del>, <del>Class A North</del>, 11e.(2), and Mixed Waste embankments.</p> <p><b>SETTLEMENT MONUMENTS:</b> Settlement monuments constructed before January 1, 2005 consist of #4 or greater rebar that is approximately 3 feet long, secured in place using a sand-cement grout. Grout shall consist of approximately 0.5 cubic foot of low slump fiber reinforced grout per monument. The top of the rebar shall be placed roughly even with the top of the riprap rock. Each monument shall be permanently labeled, flagged, and documented on a reference drawing.</p> <p>Settlement monuments constructed after January 1, 2005 shall consist of approximately 4-foot long #5 or greater rebar that is welded to a metal plate. The metal plate shall be approximately 18 inches square with a thickness of 3/16 inch to 1/4 inch. The rebar shall be sized to extend no more than 6 inches above the rock erosion barrier surface. The settlement plate shall be placed on top of the final approved radon barrier (Class A and LARW cells) or on top of the final approved geosynthetics layer (Mixed Waste) and then secured by the rock cover layers as they are built. Each monument shall be permanently labeled, flagged, and documented on a reference drawing.</p> <p><b>SETTLEMENT MONUMENT PLACEMENT:</b> Settlement monuments constructed prior to January 1, 2005 are set at 100- and 200-foot grids, as indicated on Figure 1.</p> <p>Settlement monuments constructed after January 1, 2005 on the LARW, Class A, Mixed Waste, 11e.(2), and Class A North embankments shall be placed at the</p>	<p>Inspect settlement monuments for compliance with the specification prior to installation. Observe installation to ensure that the radon barrier or geosynthetic layer is not damaged.</p> <p>Perform and document a post-construction survey of the placed settlement monument.</p>	<p>Perform a surveillance of monument installation activities.</p> <p>Verify that surveys have been performed.</p>

**LLRW and 11e.(2) CQA/QC MANUAL**  
**TABLE 1 - QA/QC ACTIVITIES**  
**WORK ELEMENT – SETTLEMENT MONITORING**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>locations identified on Figures 1, 2, 3, <del>and 4, and 6</del> respectively.</p> <p><b>SURVEY REQUIREMENTS:</b> Surveys shall be performed with GPS or approved equivalent equipment. Tolerance shall be no more than <math>\pm 0.1</math> feet.</p> <p><b>SURVEY INTERVAL:</b> Settlement monuments constructed before January 1, 2005 shall be surveyed prior to grouting and again afterwards within 30 days of grouting for coordinate verification. Annual surveys of the existing monuments shall continue for a minimum of 5 years from the date of grouting. In cases where monuments are reset, measurements shall continue at the specified frequency continuing from the last reliable measurement. Weather conditions at the time of the survey and a discussion of the potential for frost to be present shall be documented in the survey report.</p> <p>Settlement monuments constructed after January 1, 2005 shall be set and surveyed for initial location within 30 days of the completion of final cover construction. New monuments shall be surveyed again at 2, 4, and 12 months (<math>\pm 10</math> calendar days) after the initial survey. Thereafter, monuments shall be surveyed once annually between October 1 and December 31 until a minimum of 5 years after initial placement. Weather conditions at the time of the survey and a discussion of the potential for frost to be present shall be documented in the survey report.</p> <p>During the annual survey, perform a visual inspection of the completed cover to evaluate potential areas of settlement that may not be captured by the settlement monument network.</p>	<p>Calibrate and operate survey equipment in accordance with the manufacturer's recommendations</p> <p>Perform and document the required surveys. Provide survey data to the Director of Engineering.</p> <p>Perform and document the required surveys. Provide survey data to the Director of Engineering.</p> <p>Document observations made during the inspection, and denote areas where differential settlement may be occurring. Provide documentation to the Director of Engineering.</p>	<p>Verify that monument surveys are completed as required.</p> <p>Verify that new monument surveys are completed as required.</p> <p>Perform a surveillance of visual inspection activities.</p>

**LLRW and 11e.(2) CQA/QC MANUAL  
TABLE 1 - QA/QC ACTIVITIES  
WORK ELEMENT – SETTLEMENT MONITORING**

<b>SPECIFICATION</b>	<b>QUALITY CONTROL</b>	<b>QUALITY ASSURANCE</b>
<p><b>REPORTING:</b> Settlement monitoring data shall be summarized and evaluated in the annual as-built report for each embankment.</p> <p>Calculate total and differential settlement for each settlement monument against the most recent measurement and against the baseline monument location.</p> <p>Total settlement of more than 1.5 feet at any settlement monument or differential settlement of more than 1.0 percent slope between adjacent monuments shall be reported to and evaluated by the Director of Engineering within 30 days of measurement and discussed in the annual as-built report.</p> <p>Any failure in the settlement monuments shall be documented. A replacement monument shall be reset as close as possible to the previous location, surveyed, and documented.</p>	<p>Provide settlement monitoring data to the Director of Engineering.</p>	

**LLRW and 11e.(2) CQA/QC MANUAL  
TABLE 1 - QA/QC ACTIVITIES  
WORK ELEMENT – ANNUAL AS-BUILT REPORT**

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p><b>SCOPE:</b> This work element applies to the LARW, <del>Class A West</del><del>Class A, Class A North</del>, and 11e.(2) embankments.</p> <p><b>AERIAL SURVEY REQUIREMENTS:</b> An aerial survey of the disposal cells and permitted area shall be performed between August 15 and September 15 each year.</p> <p>The aerial survey shall be performed by a registered land surveyor.</p> <p>Survey control points shall be identified in the survey report.</p> <p>Survey tolerance shall not exceed <math>\pm 0.75</math> ft. <u>Actual tolerance of the survey shall be stated in the report.</u></p> <p><b>ANNUAL AS-BUILT VOLUMES:</b> Calculate embankment volumes from the aerial survey data using AutoCAD or approved equivalent equipment.</p> <p>Provide plan view and cross-sections of the as-built embankment based on the aerial survey data. Include in each cross-section the profile of the maximum authorized waste elevation. Also include in each cross-section the elevation profile of the top of the uppermost approved waste lift (as of the time the lift was approved). Provide a clear key to each cross-section to define the meaning of each symbol and line used.</p> <p>For each embankment, report the <del>embankment</del>-design capacity, capacity used to date, and remaining capacity, <u>including overburden</u>. Compare remaining capacity with the surety reserve capacity for each embankment. <u>Report any volume of waste that is placed over the</u></p>	<p>Review the aerial survey report for compliance with this specification.</p>	

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TABLE 1 - QA/QC ACTIVITIES  
WORK ELEMENT - ANNUAL AS-BUILT REPORT

SPECIFICATION

QUALITY CONTROL

QUALITY ASSURANCE

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| [design top of waste.](#)

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Date: ~~December 15, 2010~~ ~~November 15, 2011~~ ~~March 20~~ [May 7, 2012](#)

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TABLE 2

MATERIAL SPECIFICATIONS FOR PORTLAND CEMENT CLSM

PROPERTY	TEST METHOD	MINIMUM	MAXIMUM	FREQUENCY
WET UNIT WEIGHT	ASTM D6023	100 lbs/ft <sup>3</sup>	None	1 Test/100 Cubic Yards/Lift
SLUMP -OR- FLOW -OR- FLOW CONSISTENCY	EnergySolutions Slump Test (Appendix B) EnergySolutions Efflux Test (Appendix B) Flow Consistency (ASTM D6103)	8 inches NA 8 inches	None 26 seconds None	1 Test/100 Cubic Yards/Lift 1 Test/100 Cubic Yards/Lift 1 Test/100 Cubic Yards/Lift
28 DAY COMPRESSIVE STRENGTH	ASTM D4832	150 psi	None	1 Test/2000 Cubic Yards Placed at 28 days
CEMENT	None	50 lbs for each cubic yard of CLSM	None	Inspect each load ticket prior to pour
POZZOLAN	None	None	375 lbs for each cubic yard of CLSM	Inspect each load ticket prior to pour
AGGREGATE SIZE	Gradation Test Certificate from Batch Plant	<u>Percent Passing</u> <u>Sieve</u> 100                    3/8" 60                     #8	<u>Percent Passing</u> <u>Sieve</u> 30                     100	1 Test/Pour day if material is received from exterior batch plant or 1 certification/stockpile if material is received from site batch plant.  <b>Gradation certificate shall be received by QC Technician prior to pouring any CLSM</b>

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TABLE 3

MATERIAL SPECIFICATIONS FOR FLY ASH CLSM

PROPERTY	TEST METHOD	MINIMUM	MAXIMUM	FREQUENCY
WET UNIT WEIGHT	ASTM D6023	100 lbs/ft <sup>3</sup>	None	1 Test/100 Cubic Yards/Lift
FLOWABILITY	ASTM D6103	NA	11-inch spread	1 Test/100 Cubic Yards/Lift
28 DAY COMPRESSIVE STRENGTH	ASTM D4832	150 psi	None	1 Test/2000 Cubic Yards Placed at 7 days 1 Test/2000 Cubic Yards Placed at 28 days
TYPE F FLY ASH	None	40.5% of design mix	50.5% of design mix	Inspect each load ticket prior to pour
TYPE C FLY ASH	None	25.1% of design mix	35.1% of design mix	Inspect each load ticket prior to pour
WATER	None	23.0% of design mix	25.4% of design mix	Inspect each load ticket prior to pour
ACTIVATORS	None	0.19% of design mix	0.21% of design mix	Inspect each load ticket prior to pour