DEQ EXHIBIT 17

Construction Quality Assurance Plan

Prepared for:

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and Recycling Facility
Natrona County, Wyoming

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Field Report Form
Field Report of In-Place Density of Soil Aggregate
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1.0 INTRODUCTION

This plan addresses the construction quality assurance (CQA) and construction quality control (CQC) procedures to be followed for proper construction of a mixing bed for drying and loading of non-hazardous waste soils from oil field drilling operations and local sumps. The facility will be operated by Anchor Environmental-AAA Services Inc (Owner).

This facility will be a transfer station and treatment facility for waste soils from the oil and gas industry, local sump tanks and general construction projects that need to be dried before being disposed of in the Casper Regional Solid Waste Facility or in TDS's Facility in Torrington.

This plan includes both CQA and CQC activities, since these will both be the responsibility of the Owner and require support of the design engineer. CQA activities may also include special testing performed by others, in the case of synthetic materials.

2.0 GENERAL REQUIREMENTS

2.1 PROJECT PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

All CQA personnel, Project Manager, Design Engineer of Record, and Contractor identified within this section shall not be direct employees of the Owner. The CQA Consultant (Monitor, Surveyor, and Laboratory) will not be affiliated with Contractors, Suppliers, and Manufacturers. All personnel shall be further qualified or registered as described below.

2.1.1 CQA Project Manager

The Project Manager will be responsible for moderating the pre-construction meeting and formal progress meetings, compiling meeting minutes, coordinating with the Design Engineer of Record, WDEQ-SHWD, the Owner, and Contractor in any design changes, coordinating deficiency control activities, and supervising preparation of the Final CQA Report.

2.1.2 Design Engineer of Record

The Design Engineer of Record will be responsible for supervising all design changes, approving record drawings, and acceptance of the final cover.

2.1.3 CQA Monitor

Inberg-Miller Engineers, as the engineering firm of record for the project, will designate a senior technician or staff engineer to be named and introduced at the pre-construction meeting as the CQA Monitor. This individual will be familiar with earthwork and associated testing and surveying services, and able to communicate both verbally and in writing.

The CQA Monitor will be responsible for daily record keeping, initiating Deficiency Records, tracking progress of deficiency correction, updating the Project Manager on status of deficiency correction, maintaining photographic records, and coordinating the CQA Surveyor and CQA Laboratory.

2.1.4 CQA Surveyor

Inberg-Miller Engineers, as the engineering firm of record for the project, will designate a surveyor to be named and introduced at the pre-construction meeting as the CQA Surveyor.

The CQA Surveyor will be responsible for establishing the final liner grid system, obtaining pre-and post-final cover placement survey data, calculating final cover thickness at each grid point, assisting with preparation of record drawings.

2.1.5 CQA Laboratory

Inberg-Miller Engineers, as the engineering firm of record, will provide CQA laboratory testing services. Personnel will be assigned to the project for testing depending on availability and Contractor's schedule.

The CQA Laboratory will be responsible for performing field and laboratory testing for density control, collecting necessary samples, and completing and submitting density test reports.

The CQA Laboratory will be supervised by a professional engineer with NICET certified technicians knowledgeable and experienced in soil testing.

2.1.6 Contractor

The Contractor for the project will be selected based on a competitive bidding process. In evaluating Bidders, Owner will consider the qualifications of Bidders and may consider the qualifications and experience of Subcontractors, Suppliers, and other individuals or entities proposed for those portions of the work. The identity of Subcontractors, Suppliers, and other individuals or entities must be submitted with the bids.

Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders, proposed Subcontractors, Suppliers, individuals, or entities to perform the work in accordance with the contract documents.

The Contractor will be required to submit a schedule for the project indicating milestones so that verification of progress can be made. The Contractor will be required to designate a representative and introduce them as a point of contact at the pre-construction meeting.

The Contractor is responsible for compliance with final cover density and thickness requirements, performance of work in accordance with the construction contract, and correction of deficiencies.

2.2 MEETINGS

Prior to beginning of construction, a meeting will be convened to coordinate personnel having a role in CQA for the project. Meeting participants will include the Project Manager, Design Engineer of Record, CQA Monitor, the Owner, and Contractor representatives. Additionally, the WDEQ-SHWD will be appraised of the meeting date, time, and place for attendance of their personnel at their option. All attendees will be provided a copy of this CQA plan, and construction plans and specifications will be made available for their review prior to the meeting. The Project Manager will moderate the meeting.

The following specific agenda items will be addressed during the meeting:

1. Construction document review
2. Health and safety planning and responsibilities
3. Project personnel responsibilities
4. Document control
5. Lines of communication
6. Borrow source and materials
7. Manufacturers CQC testing
8. Contractor CQC testing
9. Soil CQA testing
10. Concrete CQA Testing
11. Liner CQA Testing
12. CQA surveying
13. Deficiency correction
14. Contract changes
15. Pay application requirements and processing
16. Progress meetings
17. Project schedule

A site walk-through will occur at the conclusion of the meeting to clarify questions brought up during the meeting and orient project personnel prior to construction. The Project Manager will be responsible for documenting meeting minutes and distribution to attendees, and leading the site walk-through.

Informal CQA progress meetings will be held between the CQA Monitor and Contractor on a daily basis to review the results of CQA testing and surveying. Informal progress meetings will be used to communicate test results, daily work plans, and discuss any deficiencies. The results of progress meetings will be communicated to the Project Manager periodically, but at least once per week.

Formal CQA progress meetings will be held at a frequency of at least once per month between the Project Manager, CQA Monitor, Contractor, and the Owner. Other personnel present in the pre-construction meeting may attend as necessary. The purpose of the formal meetings is to determine that

this CQA plan is being followed and that all documentation and corrections are current and in order. Meeting minutes will be prepared by the Project Manager and distributed to attendees.

2.3 DESIGN AND SPECIFICATION CLARIFICATIONS OR MODIFICATIONS

All design and specification clarifications or modifications will be made in accordance with the terms of the construction contract. Revised drawings and/or specifications, or further instructions will be made under supervision of the Design Engineer of Record and WDEQ-SHWD. Such information will be communicated to the Contractor via a field or change order as required by the construction contract.

2.4 DEFICIENCY CONTROL

Examples of deficiencies may include either compaction levels, or concrete properties outside of specified tolerances. If deficiencies develop that are not remedied the same day of occurrence, the Project Manager will be contacted by the CQA Monitor. The CQA Monitor will present test/survey data sufficient to determine the limits of the deficient area and provide this information with a Deficiency Record to the Project Manager.

The Project Manager will determine what additional data or clarifications, if any, may be required for the Contractor to follow up on deficiencies and gather the information. If a design change is required, the Design Engineer of Record as well as the WDEQ-SHWD will be notified. If applicable, a change to the construction contract will be processed in accordance with terms of the contract. If a change to the construction contract is not applicable, the Contractor will correct deficiencies at their own expense within the current schedule.

Clarifications and/or additional requirements will be prepared as approved by the Design Engineer of Record and WDEQ-SHWD as applicable and attached to the Deficiency Record. The Project Manager and Contractor will agree on a completion date for deficiency correction, whether a change to the construction contract is required or not, and document this on the Deficiency Record. The Contractor and CQA Monitor will be provided an updated copy of the Deficiency Record.

The Contractor will be responsible for compliance with the agreed correction and completion date, and the CQA Monitor will track progress and verify satisfactory follow-up. Completion or non-completion of such deficiency corrections on schedule will be brought to the attention of the Project Manager. Completion of deficiency correction will be documented by the CQA Monitor with satisfactory re-tests or re-surveys attached to the Deficiency Record. Non-completion of deficiency correction will be addressed per the terms of the construction contract.

2.5 MATERIAL QUALITY CONTROL

The contractors will identify sources and samples of various materials. Samples must be tested by the CQA organization to determine if each material meets quality requirements defined in the technical specifications. A representative example of each sample, with corresponding test results, must be maintained on site to visually compare it with actual materials delivered to the project.

Material submittals may be used by the CQA organization to establish the acceptability of materials. When submittals are required, they must be submitted to the construction manager and be made

available to the CQA organization. Acceptance and proper review of submittals is the responsibility of the Design Engineer of Record.

Where allowed in the technical specifications, certificates of compliance may be used by the CQA organization to establish the acceptability of materials in lieu of testing. These certificates generally state the material is in compliance with a particular code, standard, or specification.

3. EARTHWORK CONSTRUCTION QUALITY ASSURANCE

3.1 EARTHWORK

The scope of the earthwork construction for the final cover system includes:

1. Excavation
2. Foundation layer

3.2 EARTHWORK CONFORMANCE AND CONSTRUCTION TESTING METHODS

The CQA laboratories and CQA monitors must perform various field and laboratory tests in accordance with applicable standards as specified in the contract documents or this manual. In most instances, the applicable test procedure is an ASTM standard.

The following test standards apply to this project:

1. ASTM D-422. Standard test method for particle-size analysis of soils.
2. ASTM D-698. Standard test method for moisture-density relationships of soils and soil-aggregate mixtures using a 5.5-pound rammer and a 12-inch drop.
3. ASTM D-854. Test method for specific gravity of soils.
4. ASTM D-1140. Test method for amount of material in soils finer than the No. 200 sieve.
5. ASTM D-1556. Standard test method for determining soil density in-place by sand cone method.
6. ASTM D-1557. Standard test method for moisture-density relations of soils and soil aggregate mixtures using a 10-pound rammer and an 18-inch drop.
7. ASTM D-2216. Standard test method for determining water content of soil-aggregate mixtures.
8. ASTM D-2217. Practice for wet preparation of soil samples for particle size analyses and determination of soil constants.
9. ASTM D-2487. Classification of soils for engineering purposes (united soil classification system).
10. ASTM D-2922, ASTM D-3017. Standard test method for determining soil density and moisture in-place by nuclear methods.

11. ASTM D-4318. Standard test method for liquid limit, plastics limit and plasticity index of soils.

12. ASTM D-5084. Test method for measurement of hydraulic conductivity of fine-grained soils.

3.3 EARTHWORK SAMPLE PROCESSING

The CQA monitors are responsible for the timely processing and testing of soil samples. The CQA manager must determine which samples will be tested on-site and which will be tested off-site. This determination will be made based on available manpower, available equipment, complexity of test and time available to determine results. For expediency, samples tested off-site must be shipped the same day as they are obtained.

3.4 EARTHWORK CONSTRUCTION PHASE TESTING

Table 1 establishes test frequencies for earthwork CQA testing. It includes conformance tests that must be performed prior to soil installation to assure soil materials meet quality standards established in the technical specifications and construction testing to assure installed materials meet specified installation requirements. The test frequencies listed establish a minimum number of required tests. Extra testing must be conducted whenever work or materials are suspect, marginal, or of poor quality. Extra testing may also be performed to provide additional data for engineering evaluation. Any re-tests performed as a result of a failing test cannot contribute to the total number of tests performed in satisfying the minimum test frequency.

Table 1 Soil Conformance and Construction Testing

Required Tests	ASTM Designation	Test Frequency
Foundation Soil Conformance Testing		
Gradation	D422	1/ sample submittal
Permeability	D2434	1/ sample submittal
Foundation Soil Cover Construction Testing		
Gradation	D422	1/ sample submittal
Standard Proctor	D698	1/ sample submittal
Density, Nuclear Method	D2922	1/1,500 sf
Moisture Content, Nuclear Method	D3017	1/1,500 sf
Liner Cover Soil Conformance Testing		
Gradation	D422	1/ material type
Liner Cover Soil Construction Testing		
Gradation	D422	1/5,000 cy

Required Tests	ASTM Designation	Test Frequency
Relative Density	D4254	1/ material type
Density, Nuclear Method	D2922	1/1,000 sf
Moisture Content, Nuclear Method	D3017	1/1,000 sf

3.5 EARTHWORK TEST NUMBERING FOR FIELD DENSITY TESTS

The CQA monitors must maintain daily test reports and summaries of field density test results performed by nuclear method. Daily test reports must be maintained that identify soil components, date tested, monitor performing the test, and sequential test number. The data must be summarized by sequential test number.

4. GEOSYNTHETICS

The objectives of the geosynthetics CQA program are to:

1. Assure geosynthetic materials manufactured for the project meet quality standards defined in the technical specifications

2. Assure proper construction techniques and procedures are used during installation of geosynthetics

3. Assure the project is completed in accordance with the project construction drawings and technical specifications

4. Identify and define problems that may occur during construction and then verify these problems are corrected before construction is complete

To assure compliance, the CQA program must include a review of the installer's QC submittals, performance of material conformance testing, documentation of construction testing, and visual observation of the installations. Geosynthetics conformance testing must take place before geosynthetics installation to verify material quality. Construction testing includes activities that occur during geosynthetics installation to verify installation quality.

The following types of geosynthetics will be utilized for this project:

1. Geomembrane (GM)

4.1 GEOMEMBRANE (GM) QUALITY ASSURANCE

4.1.1 Delivery

Upon delivery of GM, the CQA monitor must:

1. Inspect GM rolls for damage potentially occurring during shipping and/or handling, then identify damaged materials and verify damaged materials are set aside and not installed.

2. Verify the GM is stored in accordance with the technical specifications and is protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, direct sunlight, and other damage.

3. Verify each roll is marked or tagged with manufacturer's name; project identification; lot number; roll number; roll dimensions and this information is documented on a geosynthetic receipt form.

4. Verify all manufacturing documentation required by the technical specifications has been received.

5. Verify a log of geosynthetics received is completed for all geomembrane materials received.

Damaged GM must be rejected or if possible, repaired. If rejected, verify material is removed from the site or stored at a location, separate from accepted GM. GM that does not have proper manufacturer's documentation must be stored at a separate location, until all documentation has been received, reviewed, and accepted.

4.1.2 Conformance Testing

One GM sample must be obtained for every 100,000 square feet of material supplied. The material must be sampled at the site by the CQA monitor or at the manufacturing plant by an independent third party under the direction of the CQA organization. Samples must be forwarded to an independent testing laboratory for the conformance testing. The CQA monitor must review all conformance test results and report any non-conformance to the Owner and CQA manager.

Perform the following conformance tests on GM:

Sheet Thickness (10 per roll)	ASTM D5994
Asperity Height (10 both sides per roll)	GRI-GM12
Sheet Density	ASTM D1505 / D 792
Tensile Properties	ASTM D638
Carbon Black Content	ASTM D 1603 / D4218
Carbon Black Dispersion	ASTM D5596

4.1.3 Review of Installer's Geomembrane Panel Drawings

Before installing any geomembrane, the installer must submit shop drawings in accordance with the technical specifications. The shop drawings must show the proposed layout of the panels, including panel identification numbers, field seams, and any other details that do not conform to the construction drawings. The CQA monitor must review these drawings prior to geomembrane installation.

4.1.4 GM Subgrade Preparation

Prior to GM deployment, the surface on which the GM will be installed must be prepared in accordance with the technical specifications. Before GM installation, the CQA monitor and geosynthetics installer must inspect the surface. The CQA monitor must verify the following:

1. The soil subgrade underlying GM has been prepared in accordance with the composite subgrade preparation technical specifications.

2. No sharp objects or other materials that could puncture the GM are present on the soil subgrade.

3. The anchor trench dimensions have been checked, and the trenches are free of sharp objects and stones.

4. There are no excessively soft areas.

5. All construction stakes have been removed.

6. The geosynthetics installer has certified in writing on a form acceptable to the CQA manager that the surface on which the geomembrane will be installed is acceptable.

4.1.5 Panel Layout As-Built

During installation, the CQA monitor must maintain an up to date panel layout drawing that shows the following as-built information:

1. Orientation and size of each geomembrane panel

2. Roll numbers associated with each panel

3. Assigned panel numbers

4. Assigned seam numbers

5. Destructive test locations

6. Repair locations

4.1.6 GM Placement Documentation

During installation, the CQA monitor must maintain an up to roll layout drawing that shows the following as-built information:

1. Record panel numbers and dimensions on a panel/seam log.

2. Observe the panel surface as it is deployed and record all panel defects and defect corrective actions (panel rejected, patch installed, extrudate placed over the defect, etc.) on a repair sheet.

3. Verify where required, corrective actions are made in accordance with the technical specifications.

4. Verify equipment used during deployment operations does not damage the geomembrane.

5. Verify equipment used on the geomembrane does not leak hydrocarbons onto the geomembrane and that corrective measures are taken to prevent leakage.

6. Verify the surface beneath the geomembrane has not deteriorated since previous acceptance.

7. Verify no stones, construction debris, or other items are beneath the geomembrane that could damage the geomembrane.

8. Verify a slip-sheet is used to deploy geomembrane over GCL.

9. Verify the geomembrane is not dragged across a potentially damaging surface. If the geomembrane is dragged across a surface that could damage the geomembrane, the geomembrane is inspected for scratches and repaired or rejected, if necessary.

10. Verify the geomembrane is not deployed in the presence of excess moisture (fog, dew, mist, etc.).

11. Verify the geomembrane is not placed when the air temperature is less than 40□F, or when standing water or frost is on the soil liner.

12. Verify crews working on the geomembrane do not smoke, wear shoes that could damage the liner, or engage in activities that could damage the geomembrane.

13. Verify methods used to deploy the geomembrane minimize wrinkles and that panels are anchored to prevent movement by the wind.

14. Verify installer corrects any damaged geomembrane resulting from movement by wind.

15. Verify no more panels are deployed than can be seamed on the same day.

The CQA monitor must inform both the installer and the construction manager if any of the above conditions are not met.

4.1.7 Panel Welding Documentation

Before the start of geomembrane welding and during welding operations, each welder and welding apparatus must be tested in accordance with the technical specifications to verify that it is functioning properly. One trial weld must be taken before the start of work and one at mid-shift. The trial weld sample must be 6 feet long and 12 inches wide, with the seam centered lengthwise. The CQA monitor must observe all trial welding operations and verify that the installer quantitatively tests each trial weld for peel adhesion and bonded seam strength (ASTM D4437). (Peel adhesion tests will be referred to as

"peel" and bonded seam strength tests will be referred to as "shear" in this manual.) The purpose of peel and shear tests is to evaluate seam strength and to evaluate long-term performance. Shear strength measures the continuity of tensile strength through the seam and into the parent material. Peel adhesion measures the strength of the bond created by the welding process. Results of peel and shear tests must be recorded on a trial weld form. Trial welds must be completed under conditions similar to those under which production seams will be welded. Trial welds must meet specified requirements for peel and shear and the failure must be ductile or a film tearing bond (FTB) for a wedge weld. An FTB means the test specimen breaks at the edge of the outside of the seam, but not in the seam. If at any time the CQA monitor believes that a welding apparatus is not functioning properly, a trail weld must be performed. If there are wide changes in temperature (±30ºF.), humidity, or wind speed, another trail weld must be performed. The trail weld must be allowed to cool to ambient temperature before it is tested.

During geomembrane welding operations, the CQA monitor must:

1. Verify the installer has the number of welding apparatuses and spare parts necessary to continuously perform the work.

2. Verify equipment used for welding will not damage the geomembrane.

3. Verify extrusion welders are purged before beginning a weld so that all heat-degraded extrudate is removed from the nozzle of the welder.

4. Verify seam grinding is completed less than 1 hour before seam welding, and the upper sheet is beveled (extrusion welding only).

5. Verify ambient temperature is measured 6 inches above the geomembrane surface is between 40 and 130 Fahrenheit.

6. Verify ends of extrusion welds that are more than 5 minutes old, are ground to expose new material before restarting a weld.

7. Verify contact surfaces of the panels are clean and free of dust, grease, dirt, debris, and moisture before welding.

8. Verify welds are free of dust, rocks, and other debris.

9. Verify cross seams are ground to a smooth incline before welding (fusion welding only).

10. Verify all seams are overlapped a minimum of 3 inches or in accordance with manufacturer's recommendations, whichever is more stringent.

11. Verify solvents or adhesives are not present in the seam area.

12. Verify procedures used to temporarily hold the panels together do not damage the panels and do not preclude CQA testing.

13. Verify panels are being welded in accordance with the plans and technical specifications.

14. Verify there is no free moisture in the weld area.

4.1.8 Non Destructive Seam Testing

The purpose of nondestructive geomembrane seam testing is to detect discontinuities or holes in the seams. Nondestructive geomembrane tests include vacuum and air pressure testing. Nondestructive testing must be performed over the entire length of the seam.

It is the installer's responsibility to perform all nondestructive testing as part of his QC program, record the results and report the results to the CQA monitor. The CQA monitor's responsibility is to observe and independently document that the installer's QC testing is in compliance with the technical specifications and to independently document seam defects and panel defects that the installer detects.

Nondestructive testing procedures are described below:

- For welds tested by vacuum method the weld is placed under suction utilizing a vacuum box constructed with rigid sides, a transparent top for viewing the seams, a neoprene rubber gasket attached to the bottom of the rigid sides, a vacuum gauge on the inside, and a valve assembly attached to a vacuum hose connection. The box is placed over a seam section that has been thoroughly saturated with a soapy water solution (1-ounce soap to 1-gallon water). The rubber gasket on the bottom of the box must fit snugly against the soaped seam section of the panel, to ensure a leak-tight seal. A vacuum pump is energized and the vacuum box pressure reduced to approximately 5-psi gauge. Any pinholes, porosity, or non-bonded areas are detected by the appearance of soap bubbles in the vicinity of the defect. Dwell time must not be less than 10 seconds.

- Air pressure testing is used to test double seams that have an enclosed air space between them. Both ends of the air channel must be sealed. A pressure feed device, usually a needle equipped with a pressure gauge, is inserted into one end of the channel. Air is then pumped into the channel to a minimum specified pressure. A five-minute relaxing period is allowed for the pressure to stabilize. The air chamber must sustain the pressure as specified in the technical specifications. Following a passed pressure test, the opposite end of the tested seam must be punctured to release the air. The pressure gauge must return to zero, if not, a blockage is likely in the seam channel. When a blockage is detected it must be located and the seam re-tested on both sides of the blockage. The penetration holes must be repaired after testing.

During nondestructive testing, the CQA monitor must:

1. Review technical specifications regarding test procedures and verify all testing is completed in accordance with the technical specifications

2. Verify equipment operators are fully trained and qualified to perform their work

3. Verify test equipment meets project technical specifications

4. Verify the entire length of each seam is tested in accordance with the technical specifications

5. Observe all testing and independently record results on the panel/seam log and the panel layout drawing

6. Identify any failed areas detected by the installer by marking the area with a waterproof marker, verify the installer is aware of the required repair, and record completion of the repair on the repair log

7. Verify all repairs are completed and tested in accordance with the project technical specifications

8. Record non-destructive testing of the repairs on the repair log

4.1.9 Destructive Seam Sampling and Field Testing

The purpose of destructive seam sampling and testing is to assure seam quality. Two seam specimens must be taken at the beginning and end of each seam for destructive testing (peel and shear). In addition, one specimen must be obtained from each butt seam for peel testing. However, additional specimens may be taken if the CQA monitor suspects that a seam does not meet specification requirements. Reasons for taking additional samples may include, but are not limited to:

1. Wrinkling in seam area

2. Excess crystallinity

3. Suspect seaming equipment or techniques

4. Weld contamination

5. Insufficient overlap

6. Adverse weather conditions

7. Failing tests

The Installer must remove specimens identified by the CQA monitor and then test the specimens for peel and shear. During sampling, the CQA monitor must:

1. Observe sample cutting

2. Mark each specimen with an identifying number and record the seam number, welder, weld date and weld time relative to the specimen number

3. Record specimen locations on the panel layout drawing and panel-seam logs

4. Record the specimen locations, weather conditions, and reason specimens were taken (e.g., random specimen, visual appearance, result of a previous failure, etc.)

The Installer must test seam specimens at the project site using a tensiometer capable of quantitatively measuring shear and peel strengths in accordance with ASTM D4437. For double wedge welding, both sides of the air channel must be tested for peel strength. The CQA monitor must observe the tests. A specimen passes when the break is a ductile FTB. An FTB means the test specimen breaks at the edge or the outside of the seam, but not in the seam. In addition, the seam strength must meet specified values.

If any of the specimens fail to meet specified seam quality, the Installer can, at his discretion, reconstruct the entire seam, or take another test sample ten feet towards the other end of the seam from the point of the failed specimen. At that point, the installer can repeat the field peel and shear tests. If subsequent specimens fail to meet specified seam quality, this procedure must be repeated until the length of poor quality seam is established. Repeated failures indicate that the seaming equipment or operator is not performing properly, and appropriate corrective action must be taken immediately.

In the case of butt seams, if the peel tests fails, the entire butt seam must be capped.

Specimens from which passing peel and shear tests have been documented must bound all seams. In the case of butt seams, one passing peel test is required in either the original weld or the cap seam.

4.1.10 Repairs

Repairs are required where geomembrane panels and or seems contain a flaw where a destructive test sample has been taken and where a "T" intersection exists at corners of welded panels. All of these repairs must be made in accordance with the technical specifications. The CQA monitor must locate required repairs and record completion of repair work on a repair log. Acceptable repair techniques include the following:

1. Patching — used to repair large holes, tears, large panel defects, undispersed raw materials, welds, contamination by foreign matter, destructive sample locations, and "T" locations in panel welds.

2. Extrusion — used to repair small defects in the panels and seams. In general, this procedure must be used for defects less than ½-inch in the largest dimension.

3. Capping — used to repair failed welds or to cover seams where welds cannot be non-destructively tested.

4. Removal — used to replace areas with large defects where the preceding methods are not appropriate. Also used to remove excess material (wrinkles, fishmouths, intersections, etc.) from the installed geomembrane. Areas of removal must be patched or capped.

4.1.11 Wrinkles

During placement of soil materials over geomembrane, temperature changes or creep may cause wrinkles to develop in the geomembrane. Any wrinkles which can fold over must be repaired either by cutting out excess material or, if possible, by allowing the geomembrane to contract by temperature reduction. In no case can material be placed over the geomembrane that could result in the geomembrane folding. The CQA monitor must monitor geomembrane for wrinkles and notify the installer if wrinkles are being covered by soil. The CQA monitor is then responsible for documenting corrective action to remove the wrinkles.

4.1.12 Geomembrane Anchor Trench

The geomembrane anchor trench must be left open until seaming is completed. Expansion and contraction of the geomembrane must be accounted for in the liner placement. The anchor trench must be backfilled in the morning when temperatures are coolest to reduce bridging of the geomembrane.

The anchor trench will also be incorporated into the subsurface drainage system, requiring proper free-draining anchor trench backfill and filter fabric to prevent infiltration of fine-grained soil. Backfill and filter-fabric materials will be checked for compliance with specified grading criteria upon arrival at the project site, and visually monitored for consistency during the completion of the project. Anchor trench backfill will be visually checked for dimensional conformance with the plans and consistent grades to avoid trapping moisture.

4.1.13 Geomembrane Acceptance

Geomembrane installation is accepted when the following conditions are met:

1. The installation is finished
2. All seams have been inspected and tested and all required tests have been completed, the tests pass and test data has been reviewed and approved
3. All required installer and manufacture-supplied documentation has been received and reviewed
4. All as-built record drawings have been completed and verified by the CQA monitor to show the true panel dimensions, the locations of all seams, trenches, pipes, appurtenances, and repairs

5. CONCRETE CONSTRUCTION QUALITY ASSURANCE

5.1 CONCRETE

The scope of the concrete construction for all containment structures includes:

1. Concrete
2. Reinforcement

5.2 CONCRETE CONFORMANCE AND CONSTRUCTION TESTING METHODS

The CQA laboratories and CQA monitors must perform various field and laboratory tests in accordance with applicable standards as specified in the contract documents or this manual. In most instances, the applicable test procedure is an ASTM standard.

The following test standards apply to this project:

1. ASTM C-1064. Standard test method for temperature of freshly mixed concrete.
2. ASTM C-172. Standard test method for sampling freshly mixed concrete.
3. ASTM C-143. Test method for slump of hydraulic-cement concrete.
4. ASTM C-138. Test method for density (unit weight), yield, and air content of freshly mixed concrete.
5. ASTM C-231. Standard test method for air content of freshly mixed concrete by pressure method.
6. ASTM C-31. Standard test method for making and curing concrete test specimens in the field..
7. ASTM C-94. Standard specification for ready-mix concrete.
8. ASTM C-617. Capping cylindrical concrete specimens.
9. ASTM C-1231. Use of unbounded caps in determination of compressive strength of hardened concrete cylinders.
10. ASTM C-39. Compressive strength of cylindrical concrete specimens.

5.3 CONCRETE SAMPLE PROCESSING

The CQA monitors are responsible for the timely processing and testing of concrete samples. The CQA manager must determine which samples will be tested on-site and which will be tested off-site. This determination will be made based on available manpower, available equipment, complexity of test and time available to determine results. For expediency, samples tested off-site must be shipped the same day as they are obtained.

5.4 CONCRETE CONSTRUCTION PHASE TESTING

Table 1 establishes test frequencies for concrete CQA testing. It includes conformance tests that must be performed prior to concrete installation to assure concrete materials meet quality standards established in the technical specifications and construction testing to assure installed materials meet specified installation requirements. The test frequencies listed establish a minimum number of required tests. Extra testing must be conducted whenever work or materials are suspect, marginal, or of poor quality. Extra testing may also be performed to provide additional data for engineering evaluation. Any re-tests

performed as a result of a failing test cannot contribute to the total number of tests performed in satisfying the minimum test frequency.

Table 2 Concrete Conformance and Construction Testing

Required Tests	ASTM Designation	Test Frequency
Concrete Aggregate Conformance Testing		
Gradation	D422	1/ sample submittal
LA-Abrasion	C535/C131	1/ sample submittal
Sulfate Soundness	C88	1/ sample submittal
Concrete Construction Testing		
Gradation	D422	1/200 cy
Concrete Temperature	C1064	1/ 50 cy
Concrete Slump	C143	1/ 50 cy
Concrete Air Content and Unit Weight	C138/C231	1/ 50 cy
Concrete Compressive Strength Test Specimens	C31	1/ 50 cy
Compressive Strength (1-7dy, 3-28dy)	C39	1/ 50 cy

5.5 CONCRETE TEST NUMBERING FOR FIELD DENSITY TESTS

The CQA monitors must maintain daily test reports and summaries of field density test results performed during concrete placment. Daily test reports must be maintained that identify concrete properties, date tested, monitor performing the test, and sequential test number. The data must be summarized by sequential test number.

6. CONSTRUCTION QUALITY ASSURANCE OF OTHER FACILITY COMPONENTS

This section covers construction quality assurance for other types of construction that will be part of either a closure project or a lined expansion project. This section will be written at the time of construction to be specific to these types of construction.

The construction quality assurance for other types of construction are expected to include:

1. Stormwater culverts
2. Ditches
3. Seeding

7. DOCUMENTATION

The quality assurance plan depends on thorough monitoring and documentation of all construction activities. Therefore, the CQA Organization must document that all quality assurance requirements have been addressed and satisfied. Documentation must consist of daily record keeping, testing and installation reports, nonconformance reports (if necessary), progress reports, photographic records, records of design and specification revisions, and a construction report.

7.1 DAILY RECORD KEEPING

The CQA Monitor will complete a Field Report form for each day of Contractor activity on the site. Areas worked, observations of progress, weather conditions, and a summary of compliance with this CQA Plan will be recorded. Refer to the attached blank form. Additionally, test and surveying results will be reviewed for deficiencies daily. At the end of each work day, all uncorrected deficiencies will be documented on a Deficiency Record.

7.2 TESTING DATA SHEETS

The CQA Laboratory will complete a Field Report of In-place Density of Soil and Aggregate. This report will document the vertical and horizontal location of soil density, and other information indicated on the attached blank form.

7.3 SURVEY RECORDS

The CQA Surveyor will maintain a survey field book and notes and update it with new data for each day of surveying on the project. Information included will be location and grade for all stakes set and cuts and fills marked on each stake.

7.4 DEFICIENCY RECORDS

A Deficiency Record form is attached. The application of Deficiency Records was described in Section 2.4.

7.5 PHOTOGRAPHS

Photographic records will be maintained by the CQA Monitor to show periodic progress of the work and to help illustrate deficiencies as necessary. Photographs will be in a digital format for final filing. A photographic record index will be maintained by the CQA Monitor to identify the photograph subject, location, date, time, and other pertinent information.

7.6 FINAL REPORT

Upon final completion of the final cover placement, a Final CQA Report will be prepared under the supervision of the Project Manager. This report will include all CQA documents prepared during the course of the project and the following:

1. A summary of deficiencies and their correction, with reference to re-tests, re-surveys or other supporting documentation for satisfactory follow-up

2. A summary of any deviations from the original design

3. A complete set of record drawings stamped by a licensed surveyor and the Design Engineer of Record

8.0 CONSTRUCTION QUALITY CONTROL PLAN

Construction Quality Control (CQC) activities are those carried out by the contractor to control the quality of the project during construction so that the installed and completed project is acceptable according to the technical specifications. CQC activities also include the manufacturer quality control provided during manufacture of the various cover components. Each manufacturer, contractor, and installer is responsible for developing their own quality control plan in compliance with the specifications, and will be required to submit a CQC plan prior to commencing the work.

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