

Attachment D

Construction Quality Assurance Plan

Quality Assurance/Quality Control Plan

Pond 1 Ash Disposal Area Closure
Clinch River Plant

Appalachian Power Company
Clinch River Plant, Carbo, Virginia

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LIST OF ACRONYMS

AEP	American Electric Power
APCo	Appalachian Power Company
CQA	Construction Quality Assurance
GDN	Geocomposite Drainage Net
PVC	Polyvinyl Chloride
QAO	Quality Assurance Officer
QA/QC	Quality Assurance/Quality Control
VDEQ	Virginia Department of Environment Quality

1.0 PERSONNEL AND QUALIFICATIONS

The quality assurance personnel involved in the Pond 1 Closure construction activities includes a Construction Quality Assurance (CQA) Certifying Engineer, Quality Assurance (QA) Officer, and QA Inspectors (collectively referred to hereafter as CQA Personnel). The qualifications, responsibilities, and authority of these personnel are defined in the following sections.

1.01 Construction Quality Assurance Certifying Engineer

The CQA Certifying Engineer shall have overall CQA responsibility and authority to ensure the Closure is constructed as specified and in accordance with this *QA/QC Plan*. The CQA Certifying Engineer shall be a registered Professional Engineer (P.E.) in the Commonwealth of Virginia and shall be an employee or representative (consulting engineer) of American Electric Power (AEP). All construction certification documents shall be prepared under the direction of the CQA Certifying Engineer.

1.02 Quality Assurance Officer

The QA Officer shall direct the CQA activities during construction and shall supervise the QA Inspectors. The QA Officer shall be an employee or representative of AEP and shall understand the site design, proper construction practices, and the applicability and theory of the quality assurance activities.

Specific responsibilities and areas of authority of the QA Officer include:

- Review and fully understand all aspects of the proposed closure plan and construction techniques.
- Keep and maintain QA/QC records and provide QA Reports to the CQA Certifying Engineer documenting results of inspections, testing, and remedial actions during construction.
- Advise the CQA Certifying Engineer of work that should be corrected, rejected, or uncovered for inspection, and identify work that may require special testing, inspection, or approval.
- Review inspection and test results and reject defective work.
- Direct the QA Inspectors in performing site inspections and testing.
- Advise the CQA Certifying Engineer where deviations from design plans and construction requirements are detected.
- Archive QA/QC samples.

1.03 Quality Assurance Inspectors

The QA Inspectors shall be employees of AEP, Appalachian Power Company (APCo), or an independent consultant or inspection services contractor contracted by AEP. The QA Inspectors shall be trained in the proper use of the test methods and equipment for which they are responsible. They shall be able to calibrate their equipment, conduct the required tests, record and interpret data, and record their observations.

Specific responsibilities of the QA Inspectors include:

1. Conduct observations and tests to assess compliance with the plans, construction requirements, and quality assurance documents.
2. Monitor tests and construction procedures conducted by the construction contractors.
3. Report to the QA Officer the results of all inspections and observations including work that does not meet the construction requirements, fails to meet contract requirements, or deviates from permissible construction procedures.

2.0 RECORD RETENTION PROCEDURES

The QA Officer shall be responsible for keeping and maintaining QA/QC records during the diversion construction for Ash Pond 1A/1B. QA/QC records shall be kept and maintained at the field office. Upon completion of the construction phase, the QA/QC records or summaries of QA/QC records shall be included in the construction certification report. Hard copies of the records shall be stored and maintained at the Clinch River Plant.

QA/QC records that shall be kept and maintained include, but shall not be limited to the following:

1. QA Officers' and QA Inspectors' daily logs;
2. Equipment calibration records;
3. Field testing records;
4. Laboratory testing records and reports; and,
5. Record drawings showing plan views of test locations; cross sections; necessary details; and any deviations from the approved plans and construction requirements.

3.0 SAMPLE ARCHIVING

The QA Officer shall be responsible for archiving QA/QC samples during each phase of the construction. QA/QC samples shall be archived at an on-site location during each construction phase until VDEQ approves the construction certification report, after which the samples will be discarded.

QA/QC samples sent off-site for testing shall be kept by the respective laboratories for 90 days after the sample is received to ensure samples are available in the event re-testing is required. Specific QA/QC samples or other materials may be archived on-site at the request of AEP.

4.0 CONSTRUCTION PROCEDURES

The following sections discuss the construction procedures and associated CQA for subgrade earthwork and cap system construction.

4.01 SUBGRADE CONSTRUCTION

The proposed facility subgrade elevations are shown on the plans and will be established by an excavation and grading of the in-situ materials. If required, clean fill material from other borrow sources will be obtained to complete the subgrade construction. Subgrade construction activities at the site will include stripping existing vegetation, placement and compaction of in-situ material, and proof-rolling. All of these activities will be performed and monitored on a daily basis by CQA Personnel.

4.01.1 Contouring and Structural Fill

In areas where subgrade will be established by excavation, soil and/or ash will be cut to the lines and grades shown on the plans. Excavated materials generated from this process will be used as contouring fill or structural fill. Excavated soil may be stockpiled for future use as cover soil.

Quality assurance criteria for contouring fill and structural fill shall include the following and are listed in Table 5.1:

- Relative compaction testing of each lift of contouring or structural fill in accordance to ASTM D6938.
- The final subgrade surface will be visually inspected by the CQA Personnel and proof-rolled to verify a stable in-situ foundation exists prior to geosynthetic installation.
- The finished subgrade surface will be firm, uniform, and consistent with the design lines and grades.

4.02 Cap System Construction

The cap system includes sequentially 30 mil PVC geomembrane, an infiltration drainage layer (Geocomposite Drainage Net), and vegetative cover soils, as shown on the plans. Construction of the cap system will be performed in accordance with this QA/QC Plan.

4.02.1 Pre Construction Testing

The cap system should be tested for puncture resistance prior to construction in general accordance with ASTM D5514 "Standard Test Method for Large Scale Hydrostatic Puncture Testing of Geosynthetics, Procedure C". In accordance with ASTM D5514, a 2-ft by 2-ft geomembrane sample over laid with the geocomposite sample shall be compressed between the ash subgrade bottom layer and the cover soil upper layer. The fly ash shall be compacted in the lower box to establish a firm smooth subgrade. Cover soil placed in the upper box shall be a compacted 18" lift to approximately 90 percent of the standard proctor (ASTM D698).

Once the testing apparatus is set up; first a 5-psi pressure will be applied to simulate

the load induced by the dozer and sustained for approximately 7 hours. Finally, the pressure should be increased to 7 psi to simulate the static load of additional placement of topsoil cover soil for approximately 20 hours. Upon completion of the test, the geomembrane shall be visually inspected for punctures. The test is considered passed if there are no punctures found in the geomembrane.

The cover soil sample shall be taken from the project borrow site and shall contain particle sizes up to the maximum allowable per the construction specifications. The largest particle contained in the sample shall be in direct contact with the geomembrane. The largest particle size that undergoes a successful puncture resistance test will determine the maximum particle size approved for this project. A test shall be ran for each borrow source or if soils within a borrow source significantly change.

4.03 30 mil PVC Geomembrane Installation

The final subgrade surface will be covered with an approved geomembrane. The geomembrane serves as the principal hydraulic barrier to infiltration in the cap system and will be installed in accordance with project construction requirements. All geomembrane installation activities will be monitored on a daily basis by CQA Personnel.

4.03.1 Material Specifications

Quality assurance activities for the geomembrane material consist of obtaining written documentation and test results from the synthetic liner manufacturer that the supplied geomembrane liner panels comply with the minimum specifications for a 30 mil PVC liner pursuant to ASTM D7176 PVC Material Specifications. Prior to or coincident with shipment of geomembrane to the project site, the QA Officer shall review and approve submittals from the Geomembrane Manufacturer which shall include:

1. Geomembrane Manufacturer's geomembrane specification sheets;
2. Geomembrane Manufacturer's Quality Control Certificates; and,
3. Other information required by the construction requirements.

No geomembrane shall be installed until the QA Officer has reviewed all certifications and supporting test data and determined that the geomembrane furnished for the project is acceptable for use.

4.03.2 30 mil PVC Installation Inspections

Installation of the 30 mil PVC geomembrane involves the placement of the liner panels, field seaming of adjacent panels together, repairs, non-destructive testing, anchoring of the geosynthetics' perimeter in trenches, and geosynthetic attachment to penetrations. Quality assurance inspection for liner installation primarily consists of the visual examination of these activities as described in the following paragraphs and as listed in Table 5.2:

Quality assurance inspection of 30 mil PVC placement includes:

1. Final inspection for imperfections in the subgrade surface and observe repairs.
2. Observe that proper procedures are followed during 30 mil PVC geomembrane layout; including, but not limited to, the weather conditions and panel layout

order.

3. Visually inspect the entire surface of each panel for tears, punctures, etc. Any defects shall be marked for repair.
4. Observe that temporary anchorage is adequate to prevent shifting during seaming.

Quality assurance inspection of 30 mil PVC field seaming includes observations to verify that:

1. The 30 mil PVC panel is free from dirt, dust, and moisture.
2. Weather conditions are acceptable for seaming.
3. The 30 mil PVC geomembrane is not damaged during seaming process.

Quality assurance inspection of 30 mil geomembrane anchors and penetration attachments includes observations to verify that:

1. Anchor trench depths, widths, and locations are as shown on the plans.
2. Trench surface and trench backfill are free of sharp edges and jagged rocks.
3. Anchor Trench backfill is compacted to 95% of the standard Proctor value.
4. The geomembrane is properly installed in the trench or to the penetration.
5. Backfilling and compaction operations do not damage the geomembrane.

In addition to the above visual inspections, the factory and field fabricated seams shall be tested as follows:

1. All factory seams shall be non-destructively tested, by specified methods, either at the factory or in the field after installation.
2. All field seams shall be non-destructively tested, by means of an air lance or air pressure testing, over their full length in accordance with Table 5.2. All areas where the seam is discontinuous shall be marked for repair, repaired by patching, and retested.
3. When seaming by thermal fusion (i.e., using a hot wedge or hot air welder), each seaming apparatus shall be tested by constructing and testing field test seams for peel and shear at the beginning of each seaming period and at least once every four hours thereafter for each seaming crew used each day. Field test seams shall meet the requirements set forth in section 4.03.3. When seaming by chemical fusion or adhesion, no seaming apparatus is used, and; therefore, field test seams are not applicable and shall not be constructed.
4. Destructive test seam sampling for laboratory peel and shear testing shall be performed at the frequencies listed in Table 5.2. The cut-out sections shall be a minimum of 12 inches wide by 40 inches long with the seam centered lengthwise. The CQA Personnel shall randomly locate the sampling location and shall not inform the seaming crew in advance of the location. All holes in the geomembrane resulting from sampling shall be immediately repaired by patching and non-destructively tested.

4.03.3 Destructive Testing

Destructive testing includes peel and shear testing of the field test seam samples and the destructive test seam samples. Peel and shear tests shall be conducted in accordance with the test methods listed in Table 5.2. Laboratory samples shall be 12 inches by 18 inches in size and labeled with the sample date, time, location, equipment, and operator. Samples shall be shipped to the laboratory in containers

that prevent deformation of the samples prior to testing. For each seam sample (including both field test seams and destructive test seams), five specimens for shear seam strength and five specimens for peel strength shall be tested. To be acceptable, the average of the peak loads recorded for the five specimens must meet the minimum seam strength criteria listed in Table 5.2.

For production field seams that fail testing, the seam shall be patched between the failed location and any passed test locations or the installer shall retrace the seam to an intermediate location (at least ten feet from the failed test location), sample, and retest. If this sample passes, then the seam shall be patched between the intermediate location and the original failed location. If the test fails, then the process is repeated. In all cases, acceptable seams shall be bounded by two passed test locations.

4.04 Infiltration Drainage Layer Construction

The purpose of the infiltration drainage layer is to provide drainage of any precipitation that percolates through the cover soil. It is comprised of a geocomposite drainage net (GDN) and shall be constructed in accordance with project construction requirements and all installation activities will be monitored on a daily basis by CQA Personnel.

4.04.1 Geocomposite Drainage Net

The geocomposite drainage net (GDN) will consist of a high density polyethylene (HDPE) geonet with nonwoven, needle-punched geotextiles heat-bonded to its upper and lower surfaces.

The geocomposite drainage net manufacturer's quality control certificates shall verify the following properties using the test method, frequency, and minimum value listed in Table 5.3.

1. Transmissivity;
2. Ply Adhesion;
3. Thickness of the geonet; and,
4. Mass per unit area of geotextile.

Prior to or coincident with shipment of geocomposite drainage net to the project site, the QA Officer shall review and approve submittals from the geocomposite drainage net manufacturer which shall include:

1. Geocomposite drainage net manufacturer's specification sheet(s);
2. Geocomposite drainage net manufacturer's quality control (MQC) certificates; and,
3. Other information required by the technical specifications.

No geocomposite drainage net shall be installed until the QA Officer has reviewed all certifications and supporting test data and determined that the geocomposite drainage net furnished for the project is acceptable for use.

All geocomposite drainage net delivery, handling, and unloading shall be performed in the presence of the CQA Personnel. During unloading, the contractor and CQA Personnel shall conduct an inspection of all delivered geocomposite drainage net for

defects and damage caused by inadequate or improper packaging, shipping, unloading, or handling. The CQA Personnel shall review packing slips or bills of lading to verify delivery of correct materials and that the roll numbers listed on packing slips match the roll numbers on the geocomposite drainage net labels. If discrepancies are found, the QA Officer shall immediately notify the manufacturer. Any geocomposite drainage net that has no label or where the label is damaged or otherwise illegible may either be sampled for laboratory analysis to determine its acceptability or rejected and removed from the project site, as directed by the QA Officer. The QA Officer shall also verify that geocomposite drainage net production lots, and associated roll numbers, delivered to the project site match the production lots and roll numbers recorded on the approved MQC certificates. If discrepancies are found, the QA Officer shall immediately notify the manufacturer.

All geocomposite drainage net installation operations shall be performed in the presence of the CQA Personnel. During geocomposite drainage net installation, the CQA Personnel shall verify and/or document the following:

1. Geocomposite drainage net is only deployed on geomembrane that has been installed in accordance with the specifications and QA/QC Plan, and has been accepted by the contractor, geomembrane installer, and QA Officer;
2. Equipment and tools used to deploy and place geocomposite drainage net will not puncture, tear, or otherwise damage the geocomposite drainage net and shall protect the underlying geomembrane from damage;
3. Geocomposite drainage net is unrolled and placed in such a manner as to minimize dragging of panels into position ("spotting");
4. Geocomposite drainage net is placed in accordance with the construction requirements, including shingling panels such that the "downstream" panel overlaps the "upstream" panel in order to minimize the possibility of lifting panel edges during placement of covering material; and offsetting all panel seams parallel to the toe of a slope ("longitudinal seams") at the specified distance from the toe of the slope;
5. Proper temporary anchorage and ballast is immediately used to prevent wind uplift and panel movement; and,
6. Geocomposite drainage net panel edges and ends are overlapped and tied in accordance with the construction specifications and completed geocomposite drainage net seams lay flat and are free of any rocks, loose soil, or other debris.

The CQA Personnel shall complete a final visual examination of all geocomposite drainage net panels, seams, and repairs prior to accepting the geocomposite drainage net installation. The geocomposite drainage net installer shall repair any areas identified during the final inspection as not being in accordance with the construction requirements. No geocomposite drainage net shall be covered with protective cover until it has been accepted by the QA Officer. Once accepted, geocomposite drainage net shall be covered as soon as possible in accordance with the construction requirements.

4.04.2 Cap Protection Layer (Vegetative Cover Soil)

A vegetative layer, consisting of 24 inches of soil or an approved alternate, will be placed on all cap geocomposite drainage net areas that reach the final lines and grades shown on the plans. The vegetative layer will be placed immediately after the

geocomposite drainage net is installed in the completed areas of each facility development phase. The vegetative layer will be constructed using soils obtained from on-site and off-site borrow sources. The cap erosion layer shall consist of a maximum particle size of 9 inches for the first 18 inches and a maximum particle size of 3 inches for the top 6 inches.

Quality assurance criteria for the vegetative layer are listed in Table 5.4 and also include the following:

- Materials (e.g., topsoil, fertilizer, seed) provided meet construction specifications;
- Materials are placed as specified;
- During the construction care period (a minimum of one full growing season), erosion protection is to be maintained; and,
- If required, periodic irrigation will be utilized to produce satisfactory growth.

4.05 Drainage Collection System

A system of drainage collection channels and pipes will be installed, as indicated in the Construction Specifications and Project Drawings, to collect and divert surface water. The drainage collection systems will be constructed in accordance with the Construction Specifications and Project Drawings.

Quality assurance criteria for the drainage system will include visual inspection and testing of the following components and materials throughout the construction of drainage collection systems:

- 12 oz. Non-Woven Geotextile
- Aggregate
- Rip Rap and Grouted Rip Rap
- Piping Systems
- Concrete
- Gabion Mattress Installation

4.05.1 12 oz. Nonwoven Geotextile

12 oz. Nonwoven Geotextile (NWGT) shall be installed in accordance with the Construction Specifications and Project Drawings.

The 12 oz. nonwoven geotextile quality control certificates shall verify the following properties using the test method, frequency, and minimum values listed in Table 5.5.

1. Mass per Unit Area
2. Grab Tensile Strength
3. Trapezoid Tear
4. Puncture Strength
5. CBR Puncture Strength
6. UV Resistance (MIN) @ 500 Hours

Prior to or coincident with shipment of 12 oz. nonwoven geotextile to the project site, the QA Officer shall review and approve submittals from the geotextile manufacturer which shall include:

1. 12 oz. nonwoven geotextile manufacturer's specification sheet(s);
2. 12 oz. nonwoven geotextile manufacturer's quality control (MQC) certificates;

- and,
3. Other information required by the construction specifications.

12 oz. nonwoven geotextile shall not be installed until the QA Officer has reviewed all certifications and supporting test data and determined the 12 oz. nonwoven geotextile furnished for the project is acceptable for use.

All 12 oz. nonwoven geotextile delivery, handling, and unloading shall be performed in the presence of the CQA Personnel. During unloading, the contractor and CQA Personnel shall conduct an inspection of all delivered 12 oz. nonwoven geotextile for defects and damage caused by inadequate or improper packaging, shipping, unloading, or handling. The CQA Personnel shall review packing slips or bills of lading to verify delivery of correct materials and that the roll numbers listed on packing slips match the roll numbers on the 12 oz. nonwoven geotextile labels. If discrepancies are found, the QA Officer shall immediately notify the manufacturer. Any 12 oz. nonwoven geotextile that has no label or where the label is damaged or otherwise illegible may either be sampled for laboratory analysis to determine its acceptability or rejected and removed from the project site, as directed by the QA Officer. The QA Officer shall also verify that 12 oz. nonwoven geotextile production lots, and associated roll numbers, delivered to the project site match the production lots and roll numbers recorded on the approved MQC certificates. If discrepancies are found, the QA Officer shall immediately notify the manufacturer.

All 12 oz. nonwoven geotextile installation operations shall be performed in the presence of the CQA Personnel. During 12 oz. nonwoven geotextile installation, the CQA Personnel shall verify and/or document the following:

1. 12 oz. nonwoven geotextile is only deployed on geomembrane that has been installed in accordance with the specifications and QA/QC Plan, and has been accepted by the contractor, geomembrane installer, and QA Officer;
2. Equipment and tools used to deploy and place 12 oz. nonwoven geotextile will not puncture, tear, or otherwise damage the geotextile and shall protect the underlying geomembrane from damage;
3. 12 oz. nonwoven geotextile is unrolled and placed in such a manner as to minimize dragging of panels into position ("spotting");
4. 12 oz. nonwoven geotextile is placed in accordance with the construction requirements, including shingling panels such that the "downstream" panel overlaps the "upstream" panel in order to minimize the possibility of lifting panel edges during placement of covering material;
5. Proper anchorage and ballast is immediately used to prevent panel movement; and,
6. 12 oz. nonwoven geotextile panel edges and ends are overlapped and secured in accordance with the construction specifications and completed 12 oz. nonwoven geotextile seams lay flat and are free of any rocks, loose soil, or other debris.

The CQA Personnel shall complete a final visual examination of all 12 oz. nonwoven geotextile panels, seams, and repairs prior to accepting the 12 oz. nonwoven geotextile installation. The 12 oz. nonwoven geotextile installer shall repair any areas identified during the final inspection as not being in accordance with the construction specifications. No 12 oz. nonwoven geotextile shall be covered with protective cover

until it has been accepted by the QA Officer. Once accepted, 12 oz. nonwoven geotextile shall be covered as soon as possible in accordance with the construction requirements.

4.05.2 Aggregate

Aggregate shall be placed for pipe bedding material and as filter material. Aggregate shall be placed in accordance with the procedures described in the Construction Specifications and Project Drawings.

Quality assurance criteria for aggregate placement shall include the following:

- The subgrade surface will be visually inspected by the CQA Personnel and verify a stable in-situ foundation exists prior aggregate placement;
- Aggregate Materials shall conform to the requirements of the Construction Specifications and the Project Drawings. Aggregates shall be free of organic materials, soil, trash, or any other unapproved materials; and,
- Aggregate shall be placed in a manner to limit aggregate segregation or any deviation from the material specification required by the Construction Specifications and the Project Drawings.

4.05.3 Rip Rap and Grouted Rip Rap

Rip Rap and Grouted Rip Rap shall be installed as specified in the Construction Specifications and the Project Drawings. CQA personnel shall be present during Rip Rap and Grouted Rip Rap placement operations.

Quality Assurance criteria for Rip Rap placement shall include:

- The observation of rip rap placement in accordance with ASTM D6825.
- The placement shall conform to the height and thicknesses specified in the Project Drawings.
- Verify the class of Rip Rap per the Project Drawings.

Quality Assurance and Quality Control criteria for Grouted Rip Rap shall include:

- The observation of installation procedure for compliance with the Construction Specifications and Project Drawings.
- Prior to the placement of grout, the point of placement shall be visually inspected and any debris, fines, silt, water or deleterious material shall be removed prior to grouting.
- Observe for verification the sprinkling of water on Rip Rap immediately before pouring grout.
- Testing the grout for Temperature (ASTM C1064), Slump (ASTM C143), Air Content (ASTM C231 / C173), and compressive strength (ASTM C31) shall be performed at a minimum of every 50 cubic yards of grout delivered to the project site. Temperature, Slump, Air Content, and Compressive Strength shall meet the requirements in Table 5.6.
- Observe for verification approximately 1.5 lbs. of fiber mesh is included per cubic yard of grout placed.
- Observe the consolidation of grout and verify the filling of voids.
- Observe the cleaning and washing of any grout spilling prior to grout setup.

4.05.4 Piping Systems

Piping Systems shall installed in accordance to the Construction Specifications and the Project Drawings. Pipes shall be installed in accordance with the manufacturer's installation specifications and procedures.

Quality Assurance and Quality Control criteria for piping systems shall include:

- Manufacturer's certification of material properties for pipe.
- Pipe bedding and backfilling are placed per specification.
- Pipes, fittings, interconnections, etc., are located and configured as specified and designed.
- Installation and construction procedures are as specified by the manufacturer or as indicated on the Project Drawings.
- The handling of the joined pipe line is conducted in such a manner that the pipe is not damaged.
- Ropes, fabric, or rubber-protected slings and straps are used when handling the pipe.
- Slings, straps, or other methods used for handling pipe are not positioned at joints.
- Chains, cables, or hooks are not inserted into the pipe ends as a means of handling pipe.
- Field-cutting of pipes is performed in accordance with the manufacturer's recommendation.
- When pipe laying is not actively in progress, the open end of the pipe that has been placed is closed using a watertight plug.
- No pipe is brought into position until the preceding length has been bedded and secured in its final position.
- Placement of backfill over the pipe is conducted in accordance with the requirements of the manufacturer's installation instructions, Construction Specifications, and Project Drawings.

The lengths of pipe will be assembled at joints and connections in accordance to the manufacturer's installation specifications. CQA personnel will monitor the assembly process for compliance to the manufacturer's specification.

4.05.5 Concrete

Concrete shall be installed in accordance with the Construction Specifications and the Project Drawings. Concrete mix design shall conform to Virginia Department of Transportation (VDOT) A4 general concrete mix.

Quality assurance and quality control criteria for concrete placement shall include:

- The observation of installation procedures for compliance with the Construction Specifications and Project Drawings.
- Prior to the placement of concrete, the point of placement shall be visually inspected and any debris, silt, water, or deleterious material shall be removed prior to placing concrete.
- Reinforcement shall be visually inspected for correct bar size, spacing, and cover

prior to concrete placement.

- Testing the concrete for Temperature (ASTM C1064), Slump (ASTM C143), Air Content (ASTM C231 / C173), and compressive strength (ASTM C31) shall be performed at a minimum of every 50 cubic yards of concrete delivered to the project site. Temperature, Slump, Air Content, and Compressive Strength shall meet the requirements in Table 5.7.

4.05.6 Gabion Mattress Installation

Gabion mattresses shall be installed in accordance with the Construction Specifications, manufacturer installation specifications, and the Project Drawings. Gabion mattresses shall be Maccaferri (or approved equal) galvanized gabion mattresses and filled with sound aggregate or rock fragments imported to the site from a commercial quarry. Fill aggregate shall not consist of any demolished concrete materials.

Quality assurance and quality control criteria for gabion mattress installation shall include:

- The observation of the installation process for compliance with the Construction Specifications and the Project Drawings.
- Gabion mattresses comply with the manufacturer's specifications.
- The observation of gabion mattress subgrade is in compliance with section 4.01.1 Contouring and Structural Fill Requirements.
- Gabion anchor stakes shall be visually inspected for spacing and dimension requirements as specified in the Project Drawings and the manufacturer's specifications.
- Fill aggregate used for gabion mattresses fill shall comply with the aggregate size for the lower diversion channel and the upper diversion channel as specified by the Construction Requirements and the Project Drawings.

5.0 TABLES

Table 5.1: Contouring Fill and Structural Fill Layer

Test	Frequency and Timing	Acceptance Parameters	Sample Location	Test Failure Procedures
Free of Unacceptable Materials	Continuous visual observation	Free of residual waste, debris, foreign, or deleterious materials	In-situ soils comprising foundation	Remove unacceptable material and replace with fill materials.
Proof Rolling	Visually soft surfaces and at Finish Grade	No movement under rubber-tired construction equipment (min. 20 tons GVW)	Final Subgrade graded surface	Remove unacceptable material and replace with fill materials.
Relative Compaction Testing	Once per Lift	Structural Fill - 95% of the Standard Proctor Value 30 mil PVC Subgrade - 90% of the Standard Proctor Value	Locations selected by CQA personnel	Compact to required relative compaction or remove material and replace fill materials.
Abrupt Grade Change	Visual observations, prior to surveying	Grade changes no greater than 45° or creases no deeper than 1 inch	Final Subgrade graded surface	Regrade surface and/or remove excessive creases by altering roller pattern.
Survey to Confirm Top of Subgrade	100 ft. Grid plus breaks and other critical locations	Equals the elevation approved in the permit with appropriate grades maintained.	Top of finished subgrade layer	Regrade and resurvey

Table 5.2: Flexible Geomembrane Liner (30-mil PVC)

Test	Frequency and Timing	Acceptance Parameters	Sample Location	Test Failure Procedures
Placement Observations	Continuous	Meeting the criteria stated in Section 4.03.2 of the QA/QC Plan.	Placed Material	Replace / Repair as needed
Field Seaming Observations	Each Seam	Meeting the criteria stated in Section 4.03.2 of the QA/QC Plan.	Seamed Material	Replace / Repair as needed
Anchor Trench Observations	Each Trench	Meeting the criteria stated in Section 4.03.2 of the QA/QC Plan.	Each Trench	Replace / Repair as needed
Non-Destructive Testing	Full Length of Field and Factory Seams and each repair.	Visual observation of the Air Lance test performed in accordance to ASTM D4437 and Air Pressure Test performed in accordance to ASTM D7177 for 30 mil PVC.	Full length (100%) of all field seams and factory seams	Replace / Repair as needed, retest
Field Test Seams	Beginning of each seaming period for each seaming crew, and every 4 hours thereafter for each seaming crew.	5 specimens each for peel and shear testing. Tested in accordance to ASTM D6392 and Section 4.03.3 of the QA/QC Plan. Shear specimens shall not break through the weld. Peel Strength - 15 lbs. Shear Strength - 58.4 lbs.	Beginning of each seaming period for each seaming crew and every 4 hours thereafter for each seaming crew.	No production seaming is to be performed until Field Test Seams meet or exceed the required acceptance parameters.
Destructive Test Samples	Every 500 ft. of field seam or once per day, per installation crew; whichever is greater.	5 specimens each for laboratory peel and shear testing. Tested in accordance to ASTM D6392 and section 4.03.3 of the QA/QC Plan. Shear specimens shall not break through the weld. Peel Strength - 15 lbs. Shear Strength - 58.4 lbs.	Randomly Selected	Replace / Repair Seam in accordance to the procedures described in section 4.03.3 of the QA / QC plan.

Notes: Testing equipment will be calibrated per ASTM methods and procedures and applicable equipment manufacturer's recommendations; calibration documentation will be retained per Section 4 of QA/QC Plan.

Table 5.3: Cap Drainage Component (Geocomposite Drainage Net)

Test	Frequency and Timing	Acceptance Parameters	Sample Location	Test Failure Procedures
Transmissivity	At least 1 per 540,000 ft. ²	5.0 X 10 ⁻⁴ (m ² /sec) (min. avg.)	Geocomposite Factory Lot	Reject Failed Roll
Ply Adhesion	At least 1 per 100,000 ft. ²	1.0 lb. /in (min. avg.)	Geocomposite Factory Lot	Reject Failed Roll
Thickness of Geonet	At least 1 per 100,000 ft. ²	250 mils (min. avg.)	Geocomposite Factory Lot	Reject Failed Roll
Mass per Unit Area of the Geotextile	At least 1 per 100,000 ft. ²	8 oz./yd. ² (MARV) (Top and Bottom)	Geocomposite Factory Lot	Reject Failed Roll
Inventory and Visual Inspection	Each Roll during delivery	Log roll and Shipping data; Inspect rolls for defects/damage	On-site material stockpile	If shipping data does not match submitted MQC data, do not allow installation
Placement Observations	Continuous	Meeting the criteria stated in section 4.04.1 of the QA / QC plan.	Placed Material	Replace / Repair areas as required
Field Seaming Observations	Each Seam	Butt Seams: 24" Overlap with ties spaced every 6 inches Panel Overlap: 3-6" overlap with ties spaced every 5 ft. Covering Geotextile shall be mechanically seamed.	Placed Material	Adjust panels as needed to provide adequate seams. Replaced / Repair areas as needed.

Table 5.4: Cap Protection Layer (Vegetative Cover Soil)

Test	Frequency and Timing	Acceptance Parameters	Sample Location	Test Failure Procedures
Visual Classification	Continuous During Placement	Maximum Particle size of 9" for the first 18" and maximum particle size of 3" in the top 6"	Borrow sources, stockpiles, and placed materials	Reject unacceptable materials and use acceptable materials
Free of Unacceptable Material	Visual observation during placement	Free of residual waste, debris, foreign, or deleterious materials	Borrow sources, stockpiles, and placed materials	Reject unacceptable materials and use acceptable materials
Survey to confirm top of cap system	100 ft. grid plus grade breaks and other critical locations	Equals the elevation approved in the permit; appropriate grades maintained; total thickness = 24"	Top of Finished vegetative cover	Regrade / Fill with appropriate material and resurvey.

Table 5.5: Nonwoven Geotextile

Test	Frequency and Timing	Acceptance Parameters		Sample Location	Test Failure Procedures
		6 oz. NWGT	12 oz. NWGT		
Mass Per Unit Area	At least 1 per 100,000 ft. ²	6 oz/sy	12 oz/sy	NWGT Factory Roll	Reject Failed Roll
AOS	At least 1 per 100,000 ft. ³	0.2 mm	N/A	NWGT Factory Roll	Reject Failed Roll
Permittivity	At least 1 per 100,000 ft. ⁴	0.4 sec. ⁻¹	N/A	NWGT Factory Roll	Reject Failed Roll
Grab Tensile Strength	At least 1 per 100,000 ft. ²	160 lbs.	300 lbs.	NWGT Factory Roll	Reject Failed Roll
Trapezoidal Tear	At least 1 per 100,000 ft. ²	60 lbs.	115 lbs.	NWGT Factory Roll	Reject Failed Roll
Puncture (pin) Strength	At least 1 per 100,000 ft. ²	60 lbs.	140 lbs.	NWGT Factory Roll	Reject Failed Roll
CBR Puncture Strength	At least 1 per 100,000 ft. ²	320 lbs.	800 lbs.	NWGT Factory Roll	Reject Failed Roll
UV Resistance (MIN) @ 500 Hours	At least 1 per 540,000 ft. ²	70 / Formulation	70 / Formulation	NWGT Factory Roll	Reject Failed Roll
Inventory and Visual Inspection	Each Roll during delivery	Log roll and Shipping data; Inspect rolls for defects/damage		On-site material stockpile	If shipping data does not match submitted MQC data, do not allow installation
Placement Observations	Continuous	Meeting the criteria stated in section 4.05.1 of the QA / QC plan.		Placed Material	Replace / Repair areas as required
Field Seaming Observations	Each Seam	Seams secured by methods described in Construction Specification.		Placed Material	Adjust panels as needed to provide adequate seams. Replaced / Repair areas as needed.

Table 5.6: Grout Testing

Test	Frequency and Timing	Acceptance Parameters	Sample Location	Test Failure Procedures
Temperature	1 Test per 50 CY each day of grout placement	40°F- 90°F	Point of Placement	Reject Load or adjust mix as approved by the QA Officer or Owner's Engineer
Slump	1 Test per 50 CY each day of grout placement	6" - 8"	Point of Placement	Reject Load or adjust mix as approved by the QA Officer or Owner's Engineer
Air Content	1 Test per 50 CY each day of grout placement	5.5% - 7.5%	Point of Placement	Reject Load or adjust mix as approved by the QA Officer or Owner's Engineer
Compressive Strength	1 set of 5 cylinders cast per 50 CY each day of grout placement.	2500 psi at 28 days	Point of Placement	Test at 56 days, report results to the Owner, QA Officer, and Owner's Engineer

Table 5.7: Concrete Testing

Test	Frequency and Timing	Acceptance Parameters	Sample Location	Test Failure Procedures
Temperature	1 Test per 50 CY each day of grout placement	40°F- 90°F	Point of Placement	Reject Load or adjust mix as approved by the QA Officer or Owner's Engineer
Slump	1 Test per 50 CY each day of grout placement	2"- 4"	Point of Placement	Reject Load or adjust mix as approved by the QA Officer or Owner's Engineer
Air Content	1 Test per 50 CY each day of grout placement	6.5% +/- 1.5%	Point of Placement	Reject Load or adjust mix as approved by the QA Officer or Owner's Engineer
Compressive Strength	1 set of 5 cylinders cast per 50 CY each day of grout placement.	4000 psi at 28 days	Point of Placement	Test at 56 days, report results to the Owner, QA Officer, and Owner's Engineer