CLOSURE TURF™ AND HYDROTURF™ INSTALLATION GUIDANCE DOCUMENTS

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CONTENTS

TABLES

1.0 INTRODUCTION

1.1 Purpose

This Construction Quality Assurance (CQA) Plan has been prepared to provide the Owner, Operator, Design Engineer, Construction Quality Assurance Professional of Record (POR), and the Contractor the means to govern the construction quality and to satisfy the environmental protection requirements under current State regulations. More specifically, the CQA Plan addresses the soil and geosynthetic components of the final cover system for the closure area. This installation manual addresses both the ClosureTurf™ and HydroTurf™ products.

This CQA Plan is divided into the following parts:

- Section 1 – Introduction
- Section 2 – Construction Quality Assurance for Geosynthetics
- Section 3 – Sand Installation
- Section 4 – HydroTurf™ Installation
- Section 5 – Reporting

1.2 Definitions

Whenever the terms listed below are used, the intent and meaning will be interpreted as indicated.

ASTM

American Society for Testing and Materials.

Construction Quality Assurance (CQA)

A planned system of activities that provides the Operator and permitting agency assurance that the facility was constructed as specified in the design. Construction quality assurance includes observations and evaluations of materials, and workmanship necessary to determine and document the quality of the constructed facility. Construction quality assurance (CQA) refers to measures taken by the CQA organization to assess if the installer or contractor is in compliance with the plans and specifications for a project.

Construction Quality Assurance (CQA) Monitors

These are representatives of the POR who work under direct supervision of the POR. The CQA monitor is responsible for quality assurance monitoring and performing onsite tests and observations. The CQA monitor is on site full-time during construction and reports directly to the POR. The CQA monitor performing daily QA/QC observation and testing shall be NICET-certified in geotechnical engineering technology at level two or higher for soils and FML testing; a CQA monitor with a minimum of four years of directly related experience; or a graduate engineer or geologist with one year of directly related experience. Field observations, testing, or other activities associated with CQA may be performed by the CQA monitor(s) under the direction of the POR. Additional CQA monitors may be used. If working under the direction of a CQA monitor, the second CQA monitor will have a minimum of one year of directly related experience.

Construction Quality Assurance Professional of Record (POR)

The POR is an authorized representative of the Operator and has overall responsibility for construction quality assurance and confirming that the facility was constructed in general accordance with plans and specifications approved by the permitting agency and contract documents. The POR must be licensed as a Professional Engineer where the project is located and experienced in geosynthetics testing and its interpretations. Experience and education should include geotechnical engineering, engineering geology, soil mechanics, geotechnical laboratory testing, construction quality assurance, and quality control testing, and hydrogeology. The POR must show competency and experience in certifying like installations, and be approved by the permitting agency, and be presently employed by or practicing as a geotechnical engineer in a recognized geotechnical/environmental engineering organization. The credentials of the POR must meet or exceed the minimum requirements of the permitting agency. Any references to monitoring, testing, or observations to be performed by the POR should be interpreted to mean the POR or CQA monitors working under the POR's direction. The POR or his designated representative will be on-site during all final cover system construction.

The POR may also be known in applicable regulations and guidelines as the CQA Engineer, Resident Project Representative, or the Geotechnical Professional (GP).

Contract Documents

These are the official set of documents issued by the owner or operator. The documents include bidding requirements, contract forms, contract conditions, specifications, contract drawings, addenda, and contract modifications.

Contract Specifications

These are the qualitative requirements for products, materials, and workmanship upon which the contract is based.

Contractor

This is the person or persons, firm, partnership, corporation, or any combination, private or public, who, as an independent contractor, has entered into a contract with the Operator and who is referred to throughout the contract documents by singular number and masculine gender.

Design Engineer

These individuals or firms are responsible for the design and preparation of the project construction drawings and specifications. Also referred to as "designer" or "engineer."

Earthwork

This is a construction activity involving the use of soil materials as defined in the construction drawings and specifications.

Final Cover System Evaluation Report (FCSER)

Upon completion of closure activities, the certification will be in the form of the FCSER which will be signed by the POR and include all the documentation necessary for certification closure.

Film Tear Bond (FTB)

A failure in the geomembrane sheet material on either side of the seam and not within the seam itself.

Fish Hook

A semi-conical opening of the seam that is formed by an edge wrinkle in one sheet of the geomembrane.

Geomembrane Liner (GM)

This is a synthetic lining material, also referred to as geomembrane, membrane liner, or sheet. The term Flexible Membrane Liner (FML) is also used for GM.

Turf

This is a synthetic structured material consisting of one or more geotextiles tufted with polyethylene yarns that resemble grass blades.

Geosynthetics Contractor

This individual is also referred to as the "contractor" or “installer”, and is the person or firm responsible for geosynthetic construction. This definition applies to any person installing FML or other geosynthetic materials, even if not his primary function.

Independent Testing Laboratory

A laboratory that is independent of ownership or control by the permittee or any party to the construction of the final cover or the manufacturer of the final cover products used.

Manufacturing Quality Assurance (MQA)

A planned system of activities that provides assurance that the raw materials were constructed (manufactured) as specified.

Manufacturing Quality Control (MQC)

A planned system of inspection that is used to directly monitor and control the manufacture of a material.

Nonconformance

This is a deficiency in characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate. Examples of non-conformances include, but are not limited to, physical defects, test failures, and inadequate documentation.

Operator

The organization that will operate the disposal unit.

Operator's Representative

This is the person that is an official representative of the operator responsible for planning, organizing, and controlling the design and construction activities.

Panel

This is a unit area of the GM or FML or Turf, which will be seamed in the field.

Quality Assurance

This is a planned and systematic pattern of procedures and documentation to ensure that items of work or services meet the requirements of the contract documents. Quality assurance includes quality control. The POR and CQA monitor will perform quality assurance.

Quality Control

These actions provide a means to measure and regulate the characteristics of an item or service to comply with the requirements of the contract documents. The contractor will perform quality control.

Representative Sample

A representative sample of FML or Turf material consists of 1 or more specimens (commonly referred to as coupons) from the same rectangular portion of FML or Turf material, oriented along a seam that is removed for field or laboratory testing purposes.

Specimen

(With respect to FML destructive testing) – A specimen is the individual test strip (sometimes called coupon) from a sample location. A sample location usually consists of many specimens.

2.0 CONSTRUCTION QUALITY ASSURANCE FOR GEOSYNTHETICS

2.1 Introduction

This section describes CQA procedures for the installation of geosynthetic components of the Closure Turf ™.

The scope of geosynthetic-related construction quality assurance includes the following elements:

- Geomembrane Liner Component
  - 50-mil Structured Linear Low-Density Polyethylene (LLDPE) or High Density Polyethylene (HDPE) – Agru Super Grip Net (or equivalent) with the spikes placed on the landfill surface on top slopes and side slopes. Minimum required material properties for the geomembrane are listed in Table 2.2.
- Synthetic Turf Component
  - Woven polypropylene geotextiles tufted with polyethylene yarns. The required material properties are shown in Table 2.3.

The overall goal of the geosynthetics quality assurance program is to assure that proper construction techniques and procedures are used, the geosynthetic contractor implements his quality control plan in accordance with this CQA Plan, the construction and testing of all elements of the final cover are performed in accordance with this CQA Plan and the Closure Plan, and that the project is built in accordance with the project construction drawings and technical specifications. The quality assurance program is intended to identify and define problems that may occur during construction and to observe that these problems are avoided and/or corrected before construction is complete. The final documentation, prepared after project completion, will confirm that the construction meets design intent and specifications and that all final cover construction and Quality Assurance/Quality Control (QA/QC) testing are performed in accordance with this CQA Plan.

2.2 Geosynthetics Quality Assurance

A structured geomembrane is the geosynthetic component for the final cover system. All testing requirements and minimum required properties are listed in Tables 2.1 and 2.2. Construction quality control for the geosynthetic installation will be performed by the geosynthetic installation contractor. Construction quality assurance for the geosynthetic installation will be performed by the POR to assure the geosynthetic is constructed as specified in the design. Construction must be conducted in accordance with the project

construction drawings, which will be developed in accordance with this CQA Plan and in accordance with specifications outlined in this CQA Plan. To monitor compliance, a quality assurance program will include the following:

- A review of the manufacturer's quality control submittals;
- Material conformance testing;
- Field and construction testing; and
- Construction monitoring.

The manufacturer's quality control submittals will include resin and physical material testing. Conformance testing refers to verification tests conducted by an independent third party laboratory to confirm the material meets the required specification prior to acceptance of the geosynthetic from the manufacturer. Field and construction testing includes testing that occurs during geosynthetics installation.

Quality assurance testing will be conducted in accordance with this CQA Plan, the project construction drawings, and specifications. The CQA monitor will observe field-testing. Documentation must meet the requirements of this CQA Plan.

2.3 Geomembrane Component

This section describes handling, testing, and installation of geomembrane. Agru 50-mil LLDPE Super Grip Net (or equivalent HDPE) with the spikes placed on the landfill or soil subgrade surface will be used on top slopes and side slopes.

2.3.1 Delivery

Upon delivery of the geomembrane, the CQA monitor will observe that:

- The geomembrane is delivered in rolls and is not folded. Folded geomembrane is not acceptable because the highly crystalline structure of the geomembrane will be damaged if it is folded. Any evidence of folding (other than from the manufacturing process) or other shipping damage is cause for rejection of the material.
- Equipment used to unload and store the rolls or pallets does not damage the geomembrane.
- The geomembrane is stored in an acceptable location in accordance with the specifications and stacked not more than five rolls high. The geomembrane is protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, or other damage.
- Manufacturing documentation required by the specifications has been received and reviewed for compliance with the specifications. This documentation will be included in the FCSER.
- The geosynthetics receipt log form has been completed for materials received.

Damaged geomembrane may be rejected and removed from the site or stored at a location separate from accepted geomembrane. Geomembrane that does not have proper manufacturer's documentation must be stored at a separate location until documentation has been received, reviewed, and accepted.

Table 2.1

Required Testing for Structured LLDPE Geomembrane Component

Responsible Party	Type of Test		Standard Test Method	Frequency of Testing
Resin Manufacturer	Resin	Density	ASTM D 1505	Per manufacturer quality control and every resin lot
		Melt Flow Index	ASTM D 1238 (90/2.16 and 190/21.6)	
	Resin/Compound Quality Evaluation		Per manufacturer's quality control specifications	Per manufacturer's quality control specifications
Geomembrane Manufacturer	Manufacturer's Quality Control		Testing per GRI Standard, GRI Test Method GM17 for 50 mil LLDPE[1]	
Conformance Testing by 3rd Party Independent Laboratory	Thickness[2]		ASTM D 5994	Per manufacturer quality control requirements and every resin lot
	Drainage Stud Height		GRI GM12 ASTM D7466	
	Friction Spike Height		GRI GM12 ASTM D7466	
	Specific Gravity/Density		ASTM D 792, Method B	
	Carbon Black Content		ASTM D 4218	
	Carbon Black Dispersion		ASTM D 5596[3]	
	Tensile Properties		ASTM D 6693 Type IV Specimen	
3rd Party CQA	Destructive Seam Field Testing[4]	Shear & Peel	ASTM D 6392	Various for field, lab, and archive
3rd Party CQA	Non-Destructive Seam Field Testing	Air Pressure	GRI GM6	All dual-track fusion weld seams
		Vacuum	ASTM D 4437	All non-air pressure tested seams when possible
		Other		Concurrence of State

[1] UV Resistance testing not required for geomembrane, which is to be immediately covered.

[2] Field thickness measurements for each panel must be conducted. Use ASTM D 5994 and perform 1 series of measurements among the leading edge of each panel, with individual measurements no greater than 5 feet apart. No single measurement will be less than the required nominal thickness in order for the panel to be acceptable.

[3] Only near spherical agglomerates for 10 views: 9 views in category 1 or 2, and 1 view in category 3.

[4] Break elongation calculated using 2-inch initial gauge length.

[5] Passing criteria for seams are listed in Table 2.2.

Table 2.2
Minimum Required Properties of the Structured LLDPE Geomembrane Component

Property	Test Method	Minimum Required Property
Thickness, mils Minimum average Lowest individual reading Lowest individual of 8 of 10 readings	ASTM D 5994	 47.5 42.5 45
Density, g/cc (maximum)	ASTM D 792, Method B	0.939
Drainage Stud Height (min. ave.)	GRI GM12	130
Friction Spike Height (min. ave.)	GRI GM12	175
Tensile Properties[1] Break Strength, lb./in (min. ave.) Break Elongation, % (min. ave.)	ASTM D 6693, Type IV	 105 300
Tear Resistance, lb. (min. ave.)	ASTM D 1004	30
Puncture Resistance, lb. (min. ave.)	ASTM D 4833	55
Break Resistance Strain, % (min)	ASTM D 5617	30
Carbon Black Content[2], %	ASTM D 1603	2.0 – 3.0
Oxidative Induction Time (OIT) (min. ave.) Standard OIT, minutes	ASTM D 3895	≥100
Carbon Black Dispersion[3], Category	ASTM D 5596	1 or 2 and 3
Oven Aging at 85ºC Standard OIT – % retained after 90 days or High Pressure OIT – % retained after 90 days	ASTM D 5721 ASTM D 3895 ASTM D 5885	 35 60
Seam Properties Shear Strength, lb./in Peel Strength, lb./in	ASTM D 6392	 100 76 (65, Extrusion Weld)

[1] Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction. Break elongation is calculated using a gauge length of 2.0 inches.
[2] Other methods such as ASTM D 4218 or microwave methods are acceptable if an appropriate correlation can be established.
[3] Only near spherical agglomerates for 10 views: 9 views in Category 1 or 2, and 1 view in Category 3.
[4] The condition of the test should be 20 hr. UV cycle at 75ºC followed by 4 hr. condensation at 60ºC.
[5] UV resistance is based on percent-retained value regardless of the original HP-OIT value.

2.3.2 Conformance Testing

One geomembrane sample will be obtained for every resin lot of material supplied and for each 100,000 square feet of geomembrane. The material will be sampled at the manufacturer plant by the CQA monitor before the rolls are shipped to the site. The samples will be forwarded to the third-party laboratory for the following conformance tests:

- Density (ASTM D 792, Method B)
- Carbon black content (ASTM D 4218)
- Carbon black dispersion (ASTM D 5596)
- Thickness (ASTM D 5994)
- Tensile properties (ASTM D 6693/Type IV Specimen)

No material shall be delivered to the site until all the independent laboratory analysis conforms to the material specifications.

The density of the geomembrane must be less than 0.939 g/cc; the carbon black content must be between 2 percent and 3 percent; and recycled or reclaimed material must not be used in the manufacturing process.

The design engineer may require additional test procedures and will inform the third party laboratory in writing. The POR must review all test results and report any nonconformance to the design engineer prior to product installation. In addition to the conformance thickness tests shown above, field thickness measurements must be taken at maximum 5-foot intervals along the leading edge of each geomembrane panel. No single measurement may be less than 10 percent below the required nominal thickness for the panel to be accepted (i.e., for 50-mil geomembrane a minimum thickness of 45 mils is required), and the average must be at least 47.5 mils.

Sampling Procedure. Samples will be taken across the entire roll width. Unless otherwise specified, samples should be approximately 15 inches long by the roll width. The CQA monitor must mark the machine direction and the manufacturer's roll identification number on the sample. The CQA monitor must also assign a conformance test number to the sample and mark the sample with that number.

2.3.3 Anchor Trench Backfill

General fill material placed in anchor trenches will be placed in uniform lifts, which do not exceed 12 inches in loose thickness and are compacted. In-place moisture/density tests may be taken at the discretion of the CQA monitor to evaluate the quality of the backfill. The test results will not be required as part of the final documentation. Slightly rounded corners will be provided in anchor trenches where the geomembrane enters the trench so as to avoid sharp bends in the geomembrane. No loose soil (e.g., excessive water content) will be allowed to underlie the anchored components of final cover system. Vertical anchor trenches as well as anchor trenches along the toe shall not be backfilled until sand infill of the synthetic turf is in place.

2.3.4 Geomembrane Installation

Surface Preparation. Prior to any geomembrane installation, the subgrade (e.g., intermediate cover soil) should be inspected by the CQA and geosynthetics contractor. The POR or CQA monitor must observe the following:

Prior to deployment of the geomembrane the subgrade shall be inspected by the CQA monitor to insure that the final grades on the slopes as well as benches dimension and grades conforms with the design grades of the closure. Survey shots as well as drawings as-built shall be carefully reviewed and evaluated to insure the surface grades will drain as intended in the design drawings. As built drawings shall show the slope and with dimensions of the drainage benches and down chute details

- The intermediate cover soil is free of surface irregularities and protrusions.
- The intermediate cover soil surface does not contain stones or other objects that could damage the geomembrane. The surface will be smooth and free of foreign and organic material, sharp objects, stones greater than 3/8 inches, or other deleterious material.
- The anchor trench dimensions have been checked, and the trenches are free of sharp objects and stones.
- The geomembrane will not be placed during inclement weather such as rain or high winds.
- Construction stakes and hubs have been removed and the resultant holes have been backfilled. There are no rocks, debris, or any other objects on the foundation soil surface.
- The geosynthetics contractor, POR or his representative, and the permittee or his representative have certified in writing that the surface on which the geomembrane will be installed is acceptable.

Panel Placement. Prior to the installation of the geomembrane, the contractor must submit drawings showing the panel layout, indicating panel identification number, both fabricated (if applicable) and field seams, as well as details not conforming to the drawings. The POR must review field conditions and approve revised panel layout plan if the field conditions vary from the original plan layout.

The CQA monitor must maintain an up-to-date panel layout drawing showing panel numbers that are keyed to roll numbers on the placement log. The panel layout drawing will also include seam numbers and destructive test locations.

During panel placement, the POR or CQA monitor must:

- Observe that the geomembrane is placed in direct and uniform contact with underlying intermediate cover soil or subgrade soil.

- Record roll numbers, panel numbers, and dimensions on the panel or seam logs. Measure and record thickness of leading edge of each panel at 5-foot maximum intervals. No single thickness measurement can be less than the required nominal thickness.
- Observe the sheet surface, as it is deployed and record panel defects and repair of the defects (panel rejected, patch installed, extradite placed over the defect, etc.) on the repair sheet. Repairs must be made in accordance with the specifications and located on a repair drawing.
- Observe that support equipment is not allowed on the geomembrane during handling (See Section 2.3.9).
- Observe that the surface beneath the geomembrane has not deteriorated since previous acceptance.
- Observe that there are no stones, construction debris, or other items beneath the geomembrane that could cause damage to the geomembrane.
- Observe that the geomembrane is not dragged across a surface that could damage the material. If the geomembrane is dragged across an unprotected surface, the geomembrane must be inspected for scratches and repaired or rejected, as necessary.
- Record weather conditions including temperature, wind, and humidity. The geomembrane must not be deployed in the presence of excess moisture (fog, dew, mist, etc.). In addition, geomembrane seaming operation should not be performed when the air temperature is less than 35°F or greater than 104°F, or when standing water or frost is on the ground, unless these requirements are waived by the design engineer. Excessive wind is that which can lift and move the geomembrane panels.
- The CQA monitor may consider welding at temperatures outside the recommended values only after demonstration by the welding crew that the weld trials can accomplished the required welding specifications.
- Observe that people working on the geomembrane do not smoke, wear shoes that could damage the liner, or engage in activities that could damage the liner.
- Observe that the method used to deploy the sheet minimizes wrinkles but does not cause bridging and that the sheets are anchored to prevent movement by the wind (the contractor is responsible for any damage to or from windblown geomembrane). Excessive wrinkles should be walked-out or removed at the discretion of the CQA monitor as described in section 2.3.7 and 2.3.8.
- Observe that no more panels are deployed than can be seamed on the same day.
- Observe that horizontal or cross seams on the side slope are staggered in order not to produce a long horizontal seam across the slope. Adjacent panels should be continuous in as much as possible on both sides of the horizontal seam.

Field Seaming. The contractor must provide the POR with a seam and panel layout drawing and update this drawing daily as the job proceeds. No panels should be seamed until the panel layout drawing has been accepted by the POR. A seam numbering system must provide a unique number for each seam and be agreed to by the POR and contractor prior to the start of seaming operations. One procedure is to identify the seam by adjacent panels. For example, the seam located between Panels 306 and 401 would be Seam No. 306/401.

Prior to geomembrane welding, each welder and welding apparatus (both wedge and extrusion welder) must be tested, at a minimum, at daily start-up and immediately after any break, and/or anytime the machine is turned off for more than 30 minutes in accordance with the specifications to determine if the equipment is functioning properly. The final documentation should include the names for each seamer and the time and the temperatures for each seaming apparatus used each day. One trial weld will be taken prior to the start of work. In addition, a trial weld will also be obtained prior to seaming the tie-in. The trial weld sample must be 3 feet long and 12 inches wide, with the seam centered lengthwise. The minimum number of specimens per trial weld test must be two coupons for shear and two coupons for peel. Both the inner and outer welds of dual track fusion welds must be tested for each peel test coupon (or additional coupons will be required). Trial weld samples must comply with "Passing Criteria for Welds" included in Section 2.3.5 – Construction Testing. The CQA monitor must observe welding operations, quantitative testing of each trial weld for peel and shear, and recording of the results on the trial weld form. The trial weld will be completed under conditions similar to those under which the panels will be welded. Regarding the locus-of-break patterns of the different seaming methods in shear and peel, the following are unacceptable break codes per their description in ASTM D 6392:

Hot Wedge:	AD and AD-Brk>25%
Extrusion Fillet:	AD1, AD2, AD-WLD (unless strength is achieved)

Additionally, there should be no apparent weld separation (i.e., greater than 1/8 inch). The third party strength tests must meet the manufacturer's specifications for the sample sheets, or percentage of the manufacturer's parent sheet strength as determined by the manufacturer. For dual-track fusion welds, both sides (the inner and outer weld) must meet the minimum requirements for a satisfactory peel test. If, at any time, the CQA monitor believes that an operator or welding apparatus is not functioning properly, a weld test must be performed. If there are wide changes in temperature (±30° Fahrenheit), humidity, or wind speed, the test weld should be repeated. The test weld must be allowed to cool to ambient temperature before testing. If a weld test fails the shear or peel test, the length of the non-passing weld will be identified at a 10-foot interval, and the failed area will be patched. Patching will be performed by placing additional geomembrane material over the failed area or removing the failed geomembrane weld and patching it with additional geomembrane per POR's direction. The welding for patches must comply with the welding passing criteria requirements outlined in this section.

Construction quality assurance documentation of trial seam procedures will include, at a minimum, the following:

- Documentation that trial seams are performed by each welder and welding apparatus prior to commencement of welding and prior to commencement of the second half of the workday.
- The welder, the welding apparatus number, time, date, ambient air temperature, and welding machine temperatures.

During geomembrane welding operations, the CQA monitor must observe the following:

- The contractor has the number of welding apparatuses and spare parts necessary to perform the work.
- Equipment used for welding will not damage the geomembrane.
- The extrusion welder is purged prior to beginning a weld until the heat degraded extradite is removed (extrusion welding only).
- Seam grinding has been completed less than one hour before seam welding, and the upper sheet is beveled (extrusion welding only).
- The ambient temperature, measured 6 inches above the geomembrane surface, is between 35°F and 104°F, or manufacturer's recommended temperature limits if they are more stringent.
- The end of old welds, more than five minutes old, are ground to expose new material before restarting a weld (extrusion welding only).
- The contact surfaces of the sheets are clean, free of dust, grease, dirt, debris, and moisture prior to welding.
- The weld is free of dust, rocks, and other debris.
- The seams are overlapped a minimum of 3 inches for extrusion and hot wedge welding, or in accordance with manufacturer's recommendations, whichever is more stringent. Panels should be overlapped (shingled) in the downgrade direction.
- No solvents or adhesives are present in the seam area.
- The procedure used to temporarily hold the panels together does not damage the panels and does not preclude CQA testing.
- The panels are being welded in accordance with the plans and specification. Seams should be oriented parallel to the line of maximum slope with no horizontal seams on side slopes. In corners and odd-shaped geometric locations, the number of field seams should be minimized.
- There is no free moisture in the weld area.
- Measure surface sheet temperature every two hours.

- Observe that at the end of each day or installation segment, unseamed edges are anchored with sandbags or other approved device. Penetration anchors will not be used to secure the geomembrane.

2.3.5 Construction Testing

Nondestructive Seam Testing. The purpose of nondestructive testing is to detect discontinuities or holes in the seam. It also indicates whether a seam is continuous and non-leaking. Nondestructive tests for geomembrane include vacuum testing for extrusion welds and air pressure testing for dual-track fusion welds. Nondestructive testing must be performed over the entire length of the seam.

Nondestructive testing is performed entirely by the contractor. The CQA monitor's responsibility is to observe and document that testing performance is in compliance with the specifications and document any seam defects and their repairs.

Nondestructive testing procedures are described below.

- For welds tested by vacuum method, the weld is placed under suction utilizing a vacuum box made of rigid housing with a transparent viewing window, a soft neoprene rubber gasket attached to the open bottom perimeter, a vacuum gauge on the inside, and a valve assembly attached to the vacuum hose connection. The box is placed over a seam section that has been thoroughly saturated with a soapy water solution (1 oz. soap to 1 gallon water). The rubber gasket on the bottom perimeter of the box must fit snugly against the soaped seam section of the liner, to ensure a leak-tight seal. The vacuum pump is energized, and the vacuum box pressure is reduced to approximately 3 to 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 ten seconds.
- Air pressure testing is used to test double seams with an enclosed air space. Both ends of the air channel should be sealed. The pressure feed device, usually a needle equipped with a pressure gauge, is inserted into the channel. Air is then pumped into the channel to a minimum pressure of 30 psi. The air chamber must sustain the pressure for five minutes without losing more than 4 psi. 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 most likely present in the seam channel. Locate the blockage and test the seam on both sides of the blockage. The penetration holes must be sealed after testing.

During nondestructive testing, the CQA monitor must perform the following work:

- Review technical specifications regarding test procedures.
- Observe that equipment operators are fully trained and qualified to perform their work.
- Observe that test equipment meets project specifications.

- Observe that the entire length of each seam is tested in accordance with the specifications.
- Observe all continuity testing and record results on the appropriate log.
- Observe that testing is completed in accordance with the project specifications.
- Identify the failed areas by marking the area with a waterproof marker compatible with the geomembrane and inform the contractor of any required repairs, then record the repair area on the repair log.
- Observe that repairs are completed and tested in accordance with the project specifications.
- Record completed and tested repairs on the repair log and the repair drawing.

Destructive Seam Testing. Destructive seam tests for geomembrane seams will be performed at a frequency of at least one test for each 500 linear feet of seam length. At a minimum, a destructive test will be completed for each welding machine used for seaming. A destructive test will also be completed for individual repairs (or additional seaming for the failed welds) of more than 10 feet of seam length. The CQA monitor must perform additional tests if he suspects a seam does not meet specification requirements. Reasons for performing additional tests may include, but are not limited to the following:

- Wrinkling in seam area
- Non-uniform weld
- Excess crystallinity
- Suspect seaming equipment or techniques
- Weld contamination
- Insufficient overlap
- Adverse weather conditions
- Possibility of moisture, dust, dirt, debris, and other foreign material in the seam
- Failing tests

There are two types of destructive testing required for the geomembrane installation: peel adhesion (peel) and bonded seam strength (shear) in accordance with ASTM D 6392. 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 strength determines weld quality. Test welds must be allowed to cool naturally to ambient temperature prior to testing.

The CQA monitor selects locations where seam samples will be cut for laboratory testing. Select these locations as follows:

- A minimum of one stratified location for every 500 feet of field seam length or major fraction thereof.

- Sample locations should not be disclosed to the contractor prior to completion of the seam.
- A maximum frequency must be agreed to by the contractor, POR, and the Operator at the pre-construction meeting. However, if the number of failed samples exceeds 5 percent of the tested samples, this frequency may be increased at the discretion of the POR. Samples taken as the result of failed tests do not count toward the total number of required tests.

Sampling Procedures. The contractor will remove samples at locations identified by the CQA monitor. The CQA monitor must:

- Observe sample cutting.
- Mark each sample with an identifying number that contains the seam number and destructive test number.
- Record sample location on the panel layout drawing and destructive seam log.
- Record the sample location, weather conditions, and reason sample was taken (e.g., random sample, visual appearance, result of a previous failure, etc.).

For each destructive test obtain one sample approximately 45 inches long by 12 inches wide, with the weld centered along the length. Cut two 1-inch-wide coupons from each end of the sample (a total of 4 coupons). The contractor must test two of these coupons in shear and two in peel (one shear and one peel from each end) using a tensiometer capable of quantitatively measuring the seam strengths. For double wedge welding, both sides of the air channel will be tested in peel. The CQA monitor must observe the tests and record the results on the destructive seam test log. A geomembrane seam sample passes the field testing when the break is a film tear bond (FTB) and the seam strength meets the required strength values for peel and shear given previously in Table 2.2 and below in the subsection "Passing Criteria for Welds" for both field testing and third party laboratory testing. As previously discussed, both welds have to pass for dual-track welds. Also, it is recommended that additional samples be obtained as discussed in the following paragraph if there is apparent separation of the weld (i.e., greater than 1/8 inch) during peel testing.

If one or both of the 1inch specimens fail in either peel or shear, the contractor can, at his discretion: (1) reconstruct the entire seam between passed test locations, or (2) take two additional test samples 10 feet or more in either direction from the point of the failed test and repeat this procedure. For tracking purposes the additional samples should be identified by assigning an identifying letter to the initial destructive test sample number (e.g., DS-6A and B). Only satisfactory tests count toward the required minimum number, and additional tests (i.e., A and B) count as one test, if passing. If the second set of tests pass, the contractor can reconstruct or cap-strip the seam between the two passed test locations. If subsequent tests fail, the sampling and testing procedure is repeated until the length of the poor quality seam is established. Repeated failures indicate that either the seaming equipment or operator is not performing properly, and appropriate corrective action must be taken immediately.

If the field test coupons are satisfactory, divide the remaining sample into three parts: one 12inch by 12inch section for the contractor, one 12inch by 16inch section for the third party laboratory for testing, and one 12inch by 12inch section for the Operator to archive. The laboratory sample will be shipped to the third party laboratory for delivery and subsequent testing.

If the laboratory test fails in either peel or shear, the contractor must either reconstruct the entire seam between passing test locations or recover additional samples at least 10 feet on either side of the failed sample for retesting. Sample size and disposition must be as described in the preceding paragraph. This process is repeated until passed tests bracket the failed seam section. Seams must be bounded by locations from which passing laboratory tests have been taken. Laboratory testing governs seam acceptance. In no case can field-testing of repaired seams be used for final acceptance.

Third Party Laboratory Testing. Destructive samples can be shipped to a third party laboratory for seam testing or tested at the site with the installer equipment tensiometer under the supervision of the CQA monitor. Testing for each sample will include five bonded seam shear strength tests and five peel adhesion tests (ten for dual-track welds). For dual-track welds each peel test specimen (coupon) will be tested on both sides of the air channel (i.e., the inner and outer welds). At least four of the five specimens tested in peel and shear will meet the minimum strength requirements. The minimum peel strength and the minimum shear strength values must meet the manufacturer's specifications. Additionally, 4 of 5 of the peel test coupons must have no greater than 25 percent seam separation. For dual-track welds if either weld exhibits greater than 25 percent separation or does not meet the required strength, that coupon is considered out of compliance and two out of compliance coupons cause the weld to fail. The third party laboratory must provide test results in timely manner, in writing or via telephone, to the POR. Certified test results are to be provided within five days. The CQA monitor must immediately notify the POR in the event of a calibration discrepancy or failed test results.

Passing Criteria for Welds. Passing criteria are established by Geosynthetic Institute GRI Test Method GM-19 for geomembrane seams. A passing extrusion or fusion-welded seam will be achieved when the following values are tested. The following values listed for shear and peel strengths are for 4 out of 5 test specimens (the 5th specimen can be as low as 80 percent of the listed values) for 50-mil LLDPE geomembrane. Elongation measurements should be omitted for field-testing.

- Shear strength (lb./in) 100
- Shear elongation at break (%) 50
- Peel strength (lb./in) 76 (65 extrusion weld)
- Peel separation (%) 25

2.3.6 Repairs

Any portion of the geomembrane with a detected flaw, or which fails a nondestructive or destructive test, or where destructive tests were cut, or where nondestructive tests left cuts or holes, must be repaired in accordance with the specifications developed for each

phase of final cover construction and consistent with application parts (e.g., material requirements, installation, testing, etc.) of Section 2 of this CQA Plan. The CQA monitor must locate and record all repairs on the repair sheet and panel layout drawing. Repair techniques include the following:

- Patching – used to repair large holes, tears, large panel defects, undispersed raw materials, contamination by foreign matter, and destructive sample locations.
- Extrusion – used to repair small defects in the panels and seams. In general, this procedure should be used for defects less than 3/8-inch in the largest dimension.
- Capping – used to repair failed welds or to cover seams where welds or bonded sections cannot be nondestructively tested.
- Removal – used to replace areas with large defects where the preceding methods are not appropriate. Also used to remove excess material (wrinkles, fish mouths, intersections, etc.) from the installed geomembrane. Areas of removal will be patched or capped.

Repair procedures include the following:

- Abrade geomembrane surfaces to be repaired (extrusion welds only) no more than one hour prior to the repair.
- Clean and dry surfaces at the time of repair.
- Extend patches or caps at least 6 inches beyond the edge of the defect, and round corners of material to be patched and the patches to a radius of at least 3 inches. Bevel the top edges of patches prior to extrusion welding.
- Perform testing on repair seams consistent with Section 2.3.5 – Construction Testing.

2.3.7 Wrinkles

Wrinkles must be walked-out or removed as much as possible prior to field seaming. Any wrinkles which can fold over must be repaired either by cutting out excess material or, if possible, by allowing the liner to contract by temperature reduction. In no case can material be placed over the geomembrane, which could result in the geomembrane folding. The CQA monitor must monitor geomembrane for wrinkles and notify the contractor if wrinkles are being formed above the maximum tolerance level as described below. The CQA monitor is then responsible for documenting corrective action to remove the wrinkles.

Wrinkles occur during the geomembrane installation due to changes in liner temperatures and deployment methods. The wrinkles may interfere with the installation of the synthetic turf layer as well as the final appearance of the closure turf cover.

Minimizing wrinkles through a formal CQA wrinkle management program can greatly reduce problems resulting from geomembrane wrinkles and bridging. The program should provide specific guidance to the CQA monitors. Large wrinkles typically start at the welding seams and extend from that point across the geomembrane width. For this

reason after each panel welding the sheet should be hand pull in order to avoid the formation of ridging along the vertical seams. This technique is typically referred to as "snapping" and shall be implemented after welding every geomembrane panel. Additionally, slightly pretension pulling may be necessary at certain lower areas of the geomembrane panel to reduce diagonal wrinkles. The CQA monitor shall implement a wrinkle management program to include the following guidelines:

- Enforce snapping procedures after welding or seaming every panel as described above.
- After panel deployment and before welding, any horizontal wrinkles must be walked down or wiggled down the slope to minimize wrinkles after welding.
- Limit maximum wrinkle height to 4 inches during warmer ambient temperatures and potentially less wrinkle height of 2 to 3 inches in cooler temperatures.
- No geomembrane wrinkle should be folded over. See next section
- Ensure snapping techniques are implemented after each panel is welded.
- Physically remove wrinkles by walking them or by pretension pulling on the sheet after welding each panel.
- Avoid backfilling the anchor trenches until the synthetic grass and sand infill placement of the closure turf component. This will allow to make correction in the field during the deployment of both the geomembrane and the synthetic grass component. Note that wrinkles will travel down the slopes and cannot be redistributed up slopes, so is important that both top and bottom anchor trenches remain open so that pulling adjustments can be made.
- Mechanically remove fish mouths larger than 5 inches in height by cutting, overlapping, flattening, and extrusion welding a patch over the affected geomembrane.

Avoid backfilling the anchor trenches until the synthetic grass and sand infill placement of the closure turf component. This will allow making correction in the field during the deployment of both the geomembrane and the synthetic grass component. Note that wrinkles will travel down the slopes and cannot be redistributed up slopes, so it is important that bottom anchor trenches remain open so that pulling adjustments can be made.

2.3.8 Folded Material

Folded geomembrane must be removed. Remnant folds evident after deployment of the roll that are due to manufacturing process are acceptable.

2.3.9. Equipment on Geomembrane Materials

Construction equipment on the final cover system will be minimized to reduce the potential for geosynthetics liner material puncture. The CQA monitor will verify that small equipment such as generators are placed on scrap geomembrane material (rub sheets) above geosynthetic materials in the final cover system.

Unless otherwise specified by the POR, rubber tire/track equipment over geosynthetics proposed by contractor shall be approved by the engineer. No equipment will be left running and unattended over the constructed geomembrane. Rubber tired / tracked ATV's and trucks are acceptable if wheels pressure is less than 5 psi.

Driver shall check for sharp edges embedded rocks, or other foreign materials stuck into or protruding from tires/track prior to driving on the geomembrane. Path driven on geomembrane shall be as straight as possible with no sharp turns, sudden stops or quick starts.

2.3.10 Geomembrane Anchor Trench

The geomembrane anchor trench will be left open until seaming and placement of the synthetic grass and sand infill placement have been completed. Expansion and contraction of the geomembrane should be accounted for in the geomembrane placement. Prior to backfilling, the depth of penetration of the geomembrane into the anchor trench must be verified by the CQA monitor at a minimum of 100foot spacing along the anchor trench. The anchor trench should be filled in the morning when temperatures are coolest to reduce bridging of the geomembrane.

2.3.11 Geomembrane Acceptance

The contractor retains all ownership and responsibility for the geomembrane until acceptance by the Operator. In the event the contractor is responsible for placing cover over the geomembrane, the contractor retains all ownership and responsibility for the geomembrane until all required documentation is complete, and the cover material is placed. After panels are placed, seamed, tested successfully, and any repairs are made, the completed installation will be walked by the operator's and contractor's representatives. Any damage or defect found during this inspection will be repaired properly by the installer. The installation will not be accepted until it meets the requirements of both representatives. In addition, the geomembrane will be accepted by the POR only when the following has been completed:

- The installation is finished.
- Seams have been inspected and verified to be acceptable.

- Required laboratory and field tests have been completed and reviewed.
- Required contractor-supplied documentation has been received and reviewed.
- As built record drawings have been completed and verified by the POR. The as built drawings show the true panel dimensions, the location of seams, trenches, pipes, appurtenances, and repairs.

2.4 Turf Component

The turf layer installation consists of the placement and seaming of the synthetic grass component (two woven geotextiles made of polypropylene 13 and 18 pic tufted with polyethylene yarns) overlying the geomembrane drain liner on the top slopes and side slopes. The CQA monitor will provide on-site observation of the installation. The POR will make sufficient site visits during the drainage layer installation to document the installation in the final documentation. The Turf will meet the material property requirements listed in Table 2.3.

2.4.1 Delivery

Upon delivery the CQA monitor must observe the following:

- The turf is wrapped in rolls with protective covering.
- The rolls are not stacked more than 3 high.
- The rolls are not damaged during unloading.
- Protect the turf from mud, soil, dirt, dust, debris, cutting, or impact forces.
- Each roll must be marked or tagged with proper identification.

Any damaged rolls will be rejected and removed from the site or stored at a location separate from accepted rolls, designated by the Operator. Rolls that do not have proper manufacturer's documentation will also be stored at a separate location until documentation has been received and approved.

2.4.2 Testing

The turf manufacturer (or supplier) will conduct quality control testing and certify that materials delivered to the site comply with project specifications for each phase of final cover construction.

Table 2.3
Typical Values Turf Component

Property Turf Component	Test Method	Minimum Required Property
Yarn count (Denier)	ASTM D 1907	8000 (min 7300)
Tensile Grass @ Break lbs. (N)	ASTM D 2256	15 lbs (MARV)
Elongation @ Break %	ASTM D 2256	30-80%
CBR Puncture	ASTM D6241	900 LBs (MARV)
Tape thickness (micron)	ASTM D 3218	100 Varies based on client request
Width (mm)	N/A	1 to 2 mm
Tensile Product	ASTM D4595	1000 Lb/ft. (MARV)
Coating Temp	N/A	N/A
Yarn Weight Minimum (grams per sq. cm)	ASTM D 5261	19 oz./sy (0.063) (MARV)
Double 13/18 Pic Polybag (grams per sq. cm)	ASTM D 5261	6 oz./sy (0.023) (MARV)
Product Weight w/o ballast (grams per sq. cm)	ASTM D 5261	25 oz./sy (0.091) ±1oz/sy
Pile Height Minimum (cm)	Varies on client request	1.25 in (3.17)
Tufting Gauge (cm)	N/A	0.5 (1.27) to 3/4 inch (1.9)
Transmissivity with underlying structured geomembrane Normal stress 50 psf and 0.33 gradient (m2/sec)	ASTM D 4716	2.5E-03 m^2/sec, Minimum
Internal Friction of combined components	ASTM D 5321	35 degrees, Minimum
UV Resistance and Stability. Tensile testing after weathering Climate Zone 200W/m^2 30 years exposure –accelerated or projected	ASTM G 147 (02)	55% Retained Strength, Minimum 30 year exposure
Sand in-fill Gradation and Ballast	ASTM D 6913	SP/SW at a minimum of half inch as ballast weight to be approved by Engineer-of-Record prior to installation

2.4.3 Manufacturer Quality Control

Turf manufacturer shall provide inspection records of the tufting procedures for the Turf material. These will include visual inspection records of the following properties every 150,000 sq. ft:

- Tufting Gauge
- Pile height
- Roll Length and roll numbers.

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Manufacturer shall also provide documentation on the geotextile product and yarn manufacturer minimum properties.

2.4.4 Conformance Testing

One Turf sample will be obtained for every 400,000 sq. ft of material supplied to the site. The material will be sampled at the site or at the plant by a CQA representative. The samples will be forwarded to the third-party laboratory for the following conformance tests:

- Yarn Weight ASTM D5261
- CBR Puncture ASTM D6241
- Tensile Product ASTM D 4595
- Tensile Strength of Yarn ASTM D2256

2.4.5 Turf Installation

Surface Preparation. Prior to turf installation, the CQA monitor must observe the following:

- The bottom liner has been prepared in accordance with the specifications and the geomembrane has been installed as outlined in Section 2.3.4.
- The geomembrane installation documentation has been completed over the areas that will be covered by the synthetic turf.
- The supporting surface (i.e., the geomembrane) does not contain stones or debris that could damage the turf.

Turf Placement. Prior to the installation of the turf, the contractor shall submit drawings showing the panel layout, indicating panel lengths, direction of deployment and the sequence proposed for flipping the panels after seaming. The POR must review field conditions and approve the panel sequencing placement and the proposed direction of flipping after sewing as well as any revision to the panel layout. During panel placement, the POR or CQA monitor must.

- Observe the Turf as it is deployed and record defects and disposition of the defects (panel rejected, patch installed, etc.). Repairs are to be made in accordance with the specifications.
- Verify that equipment used does not damage the turf or underlying geomembrane by handling, trafficking, leakage of hydrocarbons, or by other means.

- Verify that all panels are deployed from the top of the slope in a way that the leading edge of the roll stays at the top of the slope with the grass filaments always pointing upwards.
- Verify that the turf is anchored to prevent movement by the wind (the contractor is responsible for any damage resulting to or from windblown turf.
- Verify that the turf remains free of contaminants such as soil, grease, fuel, etc.
- Observe that the turf is laid smooth and free of tension, stress, folds, wrinkles, or creases.
- Observe that on slopes the turf is secured with sand bag anchoring at the top of the slope and then rolled down the slope.
- Observe the deployment of the panels to insure proper flipping in order to exposed the grass surface up after seaming operations. Deployement should be done on the adjacent turf panel to avoid damage.
- Observe that the seaming operation is performed using a 4-inch overlap and fastened with heavy-duty textile stitching machine. A single stitch prayer type seam is constructed using Nulong sewing machine or equivalent. The thread shall be 207 Polyester or equivalent. Sewing should occur between the 1st and 2nd row of stiches to avoid exposure of the black geotextile after flipping the panel.
- The CQA monitor shall review the specifications of the thread to be used for sewing the turf.
- Observe that after seaming operations, the ends of the Synthetic Turf panels are permanently anchored in the perimeter anchor trenches and covered with a minimum of two feet of soil.

2.4.6 Turf Repair Procedure:

- All turf repairs will be completed by using a heatbonded seam. This can be accomplished by using a hand held leister or a Varimat V2 leistering machine.
- All seams with considerable length should use the Varimat V2 leistering machine. This gives consistent pressure (77 lbs) throughout the seam. Seam strength is a combination between weight and temperature. The temperature of the Varimat V2 leistering machine should be discussed prior to use because temperature control is a variable that can be increased/decreased depending on weather conditions.
- A hand held leister should be used in smaller/concentrated areas. This may include areas around well heads or patches where turf was cut.

2.4.7 Equipment on the Turf:

No equipment shall be allowed on slopes exceeding 15% until the sand infill is in place. In flatter slopes, such as top decks, ATV and vehicles will be allowed prior to infill placement if the tire pressure is less than 30 psi. Post construction drivability tire pressures should be limited on the slopes to 30 to 60 psi based on slope angle. Allowable tire pressures may be increased to 80 psi depending on subgrade conditions and engineer of record approval.

3.0 SAND INSTALLATION

The sand layer will be of ½-inch thick nominal. The sand will be worked into the Turf layer as in-fill between the synthetic yarn blades. The physical characteristics of the sand layer will be evaluated through visual observation (and laboratory testing if deemed necessary by the POR) before construction and visual observation during construction. Additional testing during construction will be at the discretion of the POR.

The sand layer may be placed using any appropriate equipment capable of completing the work and should only receive minimal compaction required for stability. No equipment shall be allowed on slopes exceeding 15% until the sand infill is in place. In flatter slopes, such as top decks, ATV and vehicles will be allowed prior to infill placement if the tire pressure is less than 15 psi.

Conveyor Systems and or Express Blowers can be used to spread and place the sand in-fill. Contractor shall explain in detail in the pre-construction meeting the method of sand deployment to be used. The method shall be approved by the Engineer. For slopes 3H:1V or steeper the sand infill shall be placed using long reach conveyors belts or using water or air express blower methods.

The CQA monitor will verify that the geosynthetics are not displaced while the sand layer is being placed.

The sand aggregate to be used shall consist of highly permeable sand with an SW or SP curve specification. The curve should indicate the material consisting of medium sand having approximately 10% coarse and 10% fine sand.

The minimum initial lift of sand infill will be determined based on the type of placement equipment, and the slope and geometry considerations of the slope. An average of 0.5 to 0.75 inches is recommended for equipment with light ground pressure of less than 30 psi.

The sand placement shall be done in front of the deployment equipment to improve the bearing capacity of the cover system below.

An average thickness of ½ inch of sand infill shall be applied before allowing lightweight vehicles on the turf. This is particularly important on slopes steeper than 3H to 1V where light rubber or tracked vehicles could start pulling on the turf before the sand infill is in place.

Let it be noted that sand placement cannot occur with snow or ice on turf. Rain or wet conditions do not hamper the placement of sand (ballast) onto the turf, however wet sand or turf conditions severely hinder the ability to broom the sand in correctly. The sand will dry very quickly when spread evenly and exposed to atmospheric conditions conducive to drying the material. The sand can then be broomed into the sand correctly.

During construction the CQA monitor will:

- Verify that grade control is performed prior to work.
- Verify that underlying geosynthetic installations are not damaged during placement operations. Mark damaged geosynthetics and verify that damage is repaired.
- Verify that average thickness of ½ inch (nominal) of sand is placed on the synthetic turf. Frequency will be 20 measurements per acre of final cover installed.

4.0 HydroBinder Installation

HydroTurf™ installation for down chutes requires placement of the geomembrane panel through the channel surface and into the adjacent vertical trenches designed for anchoring the system. If the panel is not wide enough to cover the channel additional panels should be seamed in accordance with the regulatory approval method and be secure into the vertical anchor trenches at the edges of the panels. Do not backfill until turf has been installed.

Once the membrane is placed, any noticeable wrinkles should be pulled to the toe of channel or the adjacent vertical anchor trenches. The membrane should lay flat and be free of measureable wrinkles before the turf is placed. If the turf roll is not wide enough to cover the channel and be secured into the vertical anchor trenches, a sewn seam must be performed to ensure the turf seam is wide enough. All noticeable turf wrinkles should also be pulled to the toe of the channel or the adjacent anchor trenches. Once the membrane and turf are placed into the down chute the top horizontal anchor trench should be backfilled and compacted.

Infill should be placed in between the synthetic grass. The material will be blown or spread with mechanical equipment. The infill layer may be placed using any appropriate equipment capable of completing the work and should only receive minimal compaction required for stability. The infill is to be spread using low ground pressure equipment and 3 point spreader or a pull-behind spreader. Alternative Conveyor Systems and or Express Blowers can be used to spread and place the in-fill. Contractor shall explain in detail in the pre-construction meeting the method of infill deployment to be used. The Engineer shall approve the method.

The cement sand mix shall comprise of either a Quickcrete product (Sand Topping Mix) or a Sackcrete product (Sand Mix). These are the only two approved products to be used as infill for the HydroTurf™ system. Both products can be delivered in either pallet form of 60 lb. bags or 2000 lbs. super sac. The cement product should be installed into the turf while it is in a dry state. The cement shall be worked into the tufts so the tufts are in an upright position with the infill at a measurable ½ to ¾ inch nominal depth. This is achieved with common shop broom and yard rakes. Once the cemented infill is installed as described, the cemented infill must then be hydrated. The hydration process must occur the day of the cemented infill placement. The cemented infill is hydrated thoroughly with a ‘misted’ spray type to avoid displacement of the non-hydrated infill.

The installer must also be aware not to overhydrate the in-fill so that water begins to runoff and cause loss of cemented infill during the process. The general objective is to soak the area to start the hydration process but not to inundate with water beyond saturation.

Once hydration is completed as described, backfill and compaction of the vertical anchor trenches should be backfilled. The HydroTurf™ channel will be at minimum performance levels within 24 hours and continue to increase in strength over the next few weeks.

5.0 Reporting

The POR on behalf of the Operator will submit to the State a final documentation for record of the constructed final cover system.

The quality assurance plan depends on thorough monitoring and documentation of construction activities. Therefore, the POR and CQA monitor will document that quality assurance requirements have been addressed and satisfied. Documentation will consist of daily record keeping, testing and installation reports, nonconformance reports, progress reports, photographic records, and design and specification revisions. The appropriate documentation will be included the FCSER.

Preparation of Final Documentation

The POR, on behalf of the Operator, will submit to the State Regulatory Agencies a FCSER for record of finale cover system constructed.

Testing, evaluation, and submission of the FCSER for the final cover system during construction will be in accordance with this CQA Plan. The construction methods and test procedures documented in the FCSER will be consistent with this CQA Plan.

At a minimum, the documentation will contain:

- A summary of all construction activities.
- All laboratory and field-test results.
- Manufacturer's certifications for all geosynthetics.
- Documentation of thickness verification of sand layer.
- Sampling and testing location drawings.
- A description of significant construction problems and the resolution of these problems.
- A statement of compliance with the permit CQA plan and construction plans.
- The reports will be signed and sealed by a professional engineer(s) licensed in the State where the work is performed.

The as-built record drawings will accurately site the constructed location of work items, including the anchor trenches. The POR will review and verify that as built drawings are correct. As built drawings will be included in the final documentation.

The FCSER will be signed and sealed by the POR, signed by the site operator, and submitted to the MSW Permits Section of the Waste Permits Division of the State for approval.

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