FINAL CERTIFICATION REPORT
JED CELL 10 CONSTRUCTION
JED SOLID WASTE MANAGEMENT FACILITY
OSCEOLA COUNTY, FLORIDA

PREPARED FOR:

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Brantley
Engineering, LLC

Submitted: July 21, 2014

BRANTLEY ENGINEERING, LLC

July 21, 2014

Ms. Kimberly Rush, P.E.
Permitting Engineer
Florida Department of Environmental Protection (FDEP)
Central District Office
3319 Maguire Blvd., Suite 232
Orlando, Florida 32803-3767

Subject: **Final Certification Report for**
Cell 10 Construction and Quality Certification Report
JED Solid Waste Management Facility (WACS #89544)
St. Cloud, Osceola County, Florida
FDEP Permit No. SC-49-0199726-023

Dear Ms. Rush:

Brantley Engineering, LLC is writing to provide documentation and certification of the Cell 10 Construction project for the JED Solid Waste Management Facility (JED facility) located in Osceola County, Florida.

Based on our monitoring of the construction and installation activities involved with this project and the field and laboratory testing conducted throughout the project, it is our professional opinion that the Cell 10 Construction project was performed in general accordance to the project requirements and according to the design drawings and technical specifications. This certification report summarized the Construction and Quality Assurance (CQA) activities performed by Brantley Engineering, LLC during construction of the Cell 10 Disposal Area at the JED facility. The CQA activities were performed to confirm that the construction materials and procedures were in compliance with the Construction Permit No. SC-49-0199726-023 issued by the Florida Department of Environmental Protection (FDEP), Central District and in accordance with Chapter 62-701, Solid Waste Management Facilities, Florida Administrative Code (FAC).

Please find attached one electronic copy contained on a compact disc (CD) of the certification report for the construction of the Cell 10 Construction project at the JED Solid Waste Management Facility located in Osceola County, Florida. FDEP form #62-701.900(2) titled *Certification of Construction Completion of a Solid Waste Management Facility,* duly completed and signed, is also attached.

If you have any questions or need additional information regarding this certification, please contact me at (678)-427-2533 or Mr. Mike Kaiser with Progressive Waste Solutions at (904)-673-0446.

Sincerely,
Brantley Engineering, LLC

Allan S. Brantley, Florida PE#68030
President

ALLAN S. BRANTLEY LICENSE No 68030 STATE OF FLORIDA PROFESSIONAL ENGINEER
ASB 7-21-14

Cc: Mike Kaiser – PWS
Attachments

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1 INTRODUCTION

1.1 Overview

This certification report summarizes the Construction Quality Assurance (CQA) activities performed by Brantley Engineering, LLC during construction of Cell 10 at the J.E.D. Solid Waste Management (JED) facility, a Class I landfill, located in Osceola County, Florida. The JED facility is owned by Omni Waste of Osceola County, LLC (Omni), a Progressive Waste Solutions Company (PWS). The CQA activities performed by Brantley included monitoring of:

- earthwork construction;
- geosynthetics installation;
- leachate management system construction; and
- miscellaneous activities associated with development and ongoing operation of the landfill.

The CQA activities were performed to confirm that the construction materials and procedures were in compliance with Solid Waste Permit to Construct No. SC49-0199726-023-SC-MM issued by Florida Department of Environmental Protection (FDEP), Central District and in accordance with Chapter 62-701, Solid Waste Management Facilities, Florida Administrative Code (FAC).

Cell 10 was constructed in accordance with the above-mentioned permit and associated permit drawings. This certification report was prepared for Michael Kaiser, Regional Engineer of PWS. The report was prepared by Allan Brantley, PE, and reviewed by Sam Nejad, PE, both of Brantley Engineering, LLC.

1.2 Report Organization

The remainder of the certification report is organized as described below.

- Section 2 provides a brief description of the project;
- Section 3 presents a summary of the CQA program;
- Section 4 provides a description of the CQA monitoring and testing activities performed during earthwork related construction activities in Cell 10;
- Section 5 provides a description of the CQA monitoring and testing activities performed during the geosynthetics installation in Cell 10;
- Section 6 provides a description of the CQA monitoring and testing activities performed during construction of the leachate collection system in Cell 10;

- Section 7 presents a description of the CQA monitoring and testing performed during miscellaneous construction activities associated with development and ongoing operation of the landfill; and
- Section 8 presents a summary of the observations resulting from the CQA monitoring and testing activities performed by Brantley and a certification statement signed and sealed by a professional engineer registered in the State of Florida.

A List of CQA Monitoring and Liner Installation Personnel for this project is included in Appendix A. Pre-Construction Soils Laboratory Testing Results are included in Appendix B. Soils Field Testing Results are included in Appendix C. The Inventory Logs for geosynthetics are included in Appendix D. The Manufacturer's Quality Control Certificates are included in Appendix E. Conformance Test Results are included in Appendix F. Subgrade Acceptance Certificates are included in Appendix G. Geomembrane Installation logs for the Secondary Layer and Primary Layer are included in Appendices H and I, respectively. The Florida JetClean Report for leachate collection line cleaning verification is included in Appendix J. Daily Field Monitoring Reports of construction activities are included in Appendix K. Project Photos of major construction activities are included Appendix L. Record drawings for Moisture/Density Test Locations, Top of Subgrade As-Built, Secondary Layer 60 Mil HDPE As-Built, Primary Layer 60 Mil HDPE As-Built, Top of Protective Cover Sand As-Built, and the Final Topographic As-Built are included in the Project Figures section of this report.

2 PROJECT DESCRIPTION

2.1 General

The JED facility is located in eastern Osceola County, Florida, west of highway U.S. 441, approximately 6.5 miles south of Holopaw. The landfill facility is connected to highway U.S. 441 by a 2.86-mile paved access road, which was constructed as part of the overall project site development.

The JED facility site comprises a total of approximately 2,179 acres. The landfill footprint at final build-out is approximately 360 acres and consists of a total of 23 landfill cells that provide available waste capacity for approximately 30 years. Cell 10 is the third cell to be constructed as part of the Phase 3 development with a footprint of approximately 11.5 acres. This report primarily addresses the CQA activities performed during construction of Cell 10.

2.2 Construction Activities

This certification report pertains to CQA monitoring and testing activities performed for construction of Cell 10. The construction of Cell 10 included earthwork, liner system installation, and leachate collection system construction as indicated in the Cell 10 Construction Drawings prepared for the construction of Cell 10. The Cell 10 design incorporates a double-liner system and other engineering controls that meet or exceed the requirements of Chapter 62-701, FAC. The Cell 10 liner system consists of the following components (from top to bottom):

- minimum 24-in thick liner protective soil layer;
- primary geocomposite drainage layer, consisting of a high-density polyethylene (HDPE) geonet with a needle-punched, non-woven geotextile heat bonded to each side, hereafter referred to as primary geocomposite;
- primary liner, consisting of a 60-mil thick textured HDPE geomembrane;
- primary geosynthetic clay liner (GCL) within the sump area consisting of an internally reinforced composite, composed of granular sodium bentonite encapsulated between a needle-punched non-woven geotextile and a woven geotextile;
- secondary geocomposite drainage layer, consisting of a HDPE geonet with a needle-punched, non-woven geotextile heat bonded to each side, hereafter referred to as secondary geocomposite;
- secondary liner, consisting of a 60-mil thick textured HDPE geomembrane;
- secondary GCL consisting of an internally reinforced composite, composed of granular sodium bentonite encapsulated between a needle-punched non-woven geotextile and a woven geotextile; and
- minimum 6-in thick prepared liner subbase.

The Cell 10 leachate collection system consists of the following components:

- one 6-in nominal diameter HDPE perforated leachate collection pipe surrounded by gravel aggregate and non-woven geotextile filter fabric installed along the cell floor as part of the primary leachate collection system;
- one 4-in nominal diameter HDPE perforated leachate collection pipe surrounded by gravel aggregate and non-woven geotextile filter fabric installed within the cell as part of the secondary leak detection system;
- two 24-in nominal diameter HDPE primary sump risers and associated sections of 24-in nominal diameter HDPE perforated leachate sump pipes;
- one 24-in nominal diameter HDPE secondary sump riser and associated section of 24-in nominal diameter HDPE perforated leachate sump pipe; and
- leachate pumps, piping, valves, and system controls.

3 CONSTRUCTION QUALITY ASSURANCE PROGRAM

3.1 General

The scope of CQA monitoring, testing, and documentation services performed by Brantley during the construction of Cell 10 at the JED facility included review of documents, field CQA operations, and preparation of this final certification report which includes record drawings for the liner system. These activities are described in the following sections of this report.

Brantley provided the CQA monitoring, testing, and documentation for this project. Geosyntec Consultants, Inc. provided the original design and construction drawings. A list of personnel involved in construction of Cell 10 at the JED facility is included in Appendix A of this report.

Earthwork activities associated with the Cell 10 construction commenced on March 3, 2104. The liner system installation in Cell 10 commenced on April 21, 2104. Protective soil layer placement in Cell 10 commenced on May 9, 2014. Construction of Cell 10 (described in this certification report) was substantially completed on July 11, 2014.

3.2 Related Documents

The CQA activities conducted by Brantley were intended to satisfy the requirements of the following documents:

- Solid Waste Construction Permit No. SC49-019726-023;
- Technical Specifications, Appendix J of the Major Modification Application for Vertical Expansion of the J.E.D. Solid Waste Management Facility (Phases 1 through 3), prepared and submitted by Geosyntec in September 2007;
- Construction Quality Assurance (CQA) Plan, Appendix K of the Major Modification Application for Vertical Expansion of the J.E.D. Solid Waste Management Facility (Phases 1 through 3), prepared and submitted by Geosyntec in September 2007;
- Construction drawings titled J.E.D. Solid Waste Management Facility, St. Cloud, Florida, Cell 10 Construction, dated December 2013, prepared by Geosyntec.

All of the above documents are collectively referred to in this certification report as the CQA Documents. During construction, minor deviations were made to these documents to include clarifications to the intent of the design and to accommodate existing site conditions or preferred construction techniques. However, no substantial changes were made to the CQA Documents.

3.3 Field CQA Operations

The CQA activities performed by Brantley personnel during the Cell 10 construction are listed in the following subsections.

Earthwork:

- collected samples of soils used as general fill to construct the subgrade and liner subbase in Cell 10 for testing at an off-site geotechnical laboratory;
- collected samples of soils used for protective soil layer for testing at the off-site geotechnical laboratory;
- reviewed and evaluated geotechnical laboratory test results to ensure compliance with the requirements of the CQA Documents;
- monitored placement, grading, and compaction of earthwork related construction activities;
- tested in-situ density, moisture content, and percent compaction of earthwork related construction activities to ensure compliance with the requirements of the CQA Documents;
- notified Contractor of areas that need additional compaction based on failing in-situ tests and re-testing these areas to ensure compliance with the requirements of the CQA Documents; and
- monitored anchorage of the geosynthetics in the perimeter anchor trenches.

Geosynthetics:

- monitored delivery, storage, and tracked the inventory of geosynthetic materials delivered for the project;
- coordinated the collection of geosynthetic conformance samples from in-plant sources or delivered rolls and forwarded samples to an off-site geosynthetics testing laboratory;
- collected and reviewed geosynthetic manufacturers' quality control (MQC) certification documents and geosynthetic laboratory conformance test results to verify compliance with the requirements of the CQA Documents;
- monitored installation of geosynthetic materials in Cell 10 including trial seams, production seaming, nondestructive testing, and repair operations; and
- performed destructive testing of geomembrane seams at the minimum frequency required by the CQA Documents.

Leachate Collection System:

- reviewed quality control (QC) documents of materials used in the leachate collection system, geotechnical laboratory conformance test results on aggregate samples, and geosynthetic laboratory conformance test results on geotextile filter/separator fabric samples to verify compliance with the requirements of the CQA Documents; and

- monitored construction of the leachate collection system in Cell 10.

Miscellaneous Activities:

- monitored pressure cleaning and video inspection of the Cell 10 leachate collection system piping; and
- monitored installation of sump risers, concrete surface pads, leachate pumps, leachate piping and system controls.

During construction activities involving monitoring and/or testing, the observations made and results obtained by Brantley CQA personnel were compared with the requirements of the CQA Documents. In the event of deficiencies in construction practices and/or materials, the construction manager and the appropriate Contractor were notified to take appropriate corrective actions. The corrective actions were monitored and/or tested by CQA personnel to confirm compliance with the requirements of the CQA Documents.

3.4 Certification Report and Record Drawings

Record drawings for Cell 10 liner subbase, primary and secondary geomembrane panel layouts, liner protective soil cover, and the leachate collection and removal system piping, and this CQA certification report were prepared as the final task of the CQA program for construction of Cell 10. The record drawings are included in the Project Figures section of this report. This certification report summarizes the CQA activities performed by Brantley.

During construction of Cell 10, CQA monitoring and testing activities were documented by CQA personnel in Daily Field Reports found in Appendix K of this report. QC certificates for the geosynthetics, other construction materials, and surveyor's data were provided to Brantley for review. These and other construction-related documents are maintained by Omni and Brantley, and will be made available for FDEP review upon request. Results of CQA monitoring and testing activities that are critical with respect to the satisfactory performance of Cell 10 at the JED facility and protection of the surrounding environment have been summarized in a tabular form in this certification report.

3.5 Project Personnel

Major personnel or representatives of the firms involved in the project are as follows:

Owner:	Omni Waste of Osceola County, LLC
	Mike Kaiser, Regional Engineer
	Dave Collins, Site Supervisor

CQA Consultant:	Brantley Engineering, LLC.
	Allan Brantley, PE, Engineer of Record/CQA Project Manager
	Kevin Lesley, CQA Site Manager Chris Johnson, GRI Certified CQA Liner Inspector
Earthwork Contractor:	RCS Excavation, Inc., Lake Placid, FL
	A.J. Smith, Project Manager
	Mike Rowley, Soils Superintendent
Geosynthetics Installer:	Comanco Environmental Corp., Plant City, FL
	Clayton Lung, Project Manager
	Jorge Barrantes, Geosynthetics Superintendent
Surveyor:	Peavey Surveying, Fort Meade, FL
	Deborah L. Peavey, PSM
Geotechnical Laboratories:	Excel Geotechnical Testing, Roswell, GA
	Nader Rad, Ph.D., P.E., Project Manager
Geosynthetics Laboratory:	TRI/Environmental, Inc., Anaheim, CA
	Christian Sebastian, Project Manager

4 CQA – EARTHWORK

4.1 General

Brantley monitored earthwork related to the Cell 10 construction and other miscellaneous construction activities. Earthwork activities related to Cell 10 included construction of the perimeter berm on the north side of Cell 10, construction of intercell berms on the east and south sides, construction of subgrade and 6-inch thick liner subbase, installation of the protective soil layer, and anchorage of the geosynthetic components of the double-composite liner system.

The materials used to construct Cell 10 included general fill and protective soil. General fill was used to construct the perimeter berm, intercell berms, subgrade and 6-inch thick liner subbase in Cell 10, and to anchor the geosynthetics. Protective soil was used for the minimum 2-ft thick protective soil layer over the geosynthetic liner system.

CQA personnel observed the earthwork related construction activities and tested the soils to confirm that the material properties conformed to the CQA Documents, maximum lift thicknesses were not exceeded, and compaction requirements were met. During construction, geotechnical soil tests were performed at off-site geotechnical laboratories under the supervision of Dr. Nader S. Rad, P.E. The off-site geotechnical laboratory utilized was Excel Geotechnical Testing (EGT), Roswell, Georgia.

4.2 Soil Source and Requirements

The general fill and protective layer soils were obtained from the borrow area located on the neighboring Bronson Family property (Bronson Borrow Area) west of the landfill. Representative samples of general fill and protective layer soils were obtained and tested to verify conformance with specified material requirements in the CQA Documents. The geotechnical tests were performed to confirm that the following requirements were met for the general fill and protective layer soils:

- *General Fill:* classified as SW, SP, SW-SM, SW-SC, SP-SM, SP-SC, SM, or SC in accordance with the Unified Soil Classification System (USCS) per ASTM D 2487 and was relatively free of debris, foreign objects, large rock fragments, organic matter, and other deleterious materials. Additionally, general fill used as liner subbase in Cell 10 was free of sharp materials or materials larger than 0.5 inches.
- *Protective Layer Soils:* classified as SW, SP, SW-SM, SW-SC, SP-SM, or SP-SC in accordance with the USCS; had maximum particle size of 0.5 inches; typically had fines content of less than 10 percent; and were relatively homogeneous soils free of deleterious materials. Regardless of the classification, protective layer soil was required to exhibit a hydraulic conductivity no less than 1.0×10^{-3} cm/sec when tested in accordance with ASTM D 2434.

A description of the geotechnical tests performed on placed materials and results of these tests are presented below.

4.3 CQA Monitoring and Testing

Brantley's CQA personnel monitored the placement and/or compaction of soils as described in Section 3. Brantley had personnel on site on a full-time basis during completion of major earthwork activities.

As part of the CQA activities, geotechnical testing was performed on the soils used for the construction of Cell 10. Testing was performed at an off-site geotechnical laboratory (Section 3.5).

The following geotechnical tests were performed:

- in-situ nuclear moisture/density tests on compacted lifts of general fill (the tests were performed in accordance with ASTM D 2922 for density and ASTM D 3017 for moisture content);
- in-situ density tests using the drive cylinder method (ASTM D 2937) to compare to the density tests results obtained using the nuclear gauge;
- moisture content tests on general fill in accordance with ASTM D 2216;
- standard Proctor compaction tests on general fill in accordance with ASTM D 698;
- grain-size analysis or fines content determination in accordance with ASTM D 422, ASTM C 136, or ASTM D 1140;
- hydraulic conductivity tests on the protective layer soils in accordance with ASTM D 2434; and
- interface friction tests, as discussed in the CQA Documents.

Brantley supplied one Humboldt Model #HS-5001SD nuclear gauge (Serial No. 6638) that was used to perform the moisture/density tests. The gauge was calibrated daily prior to use by the "standard count" method. These counts were recorded on a standard count log. The in-situ density tests using the drive cylinder method (ASTM D 2937) were performed periodically and compared with the density test results obtained using the nuclear gauge to ensure that the gauge was functioning properly.

4.4 General Fill

CQA personnel monitored the excavation (from the Bronson Borrow Area), placement, and compaction of general fill, which was used to construct the Cell 10 perimeter berm, intercell berms, subgrade, 6-in thick liner subbase, and anchorage of geosynthetics. CQA personnel assessed existing subgrade to confirm that unsuitable materials were removed. General fill-related activities performed by the Contractor consisted of the following:

- proof rolled subgrade to detect soft or loose zones using articulated off-road dump trucks;
- excavated and hauled general fill from Bronson Borrow Area using tracked excavators and articulated off-road dump trucks, respectively;
- placed and spread general fill in relatively thin lifts using bulldozers;
- compacted general fill using smooth drum rollers;
- scarified the surface of each compacted lift using tracks of a bulldozer prior to placement and compaction of subsequent lifts; and
- surveyed the limits and elevations of the compacted general fill (As-built survey drawings from the surveyor are included in the Project Figures section of this report.

General fill was required to be compacted to at least 95 percent of the corresponding standard Proctor (ASTM D 698) maximum dry unit weight. The tests performed on compacted general fill materials are discussed below. The CQA laboratory reports for the general fill samples are included in Appendix B-Section 1.

4.4.1 Standard Proctor Tests

Standard Proctor tests were performed to evaluate the percent compaction from the measured in-situ densities of compacted general fill. Standard Proctor tests were required to be performed at a minimum frequency of 1 test per 25,000 cubic yards (cyd) of compacted general fill.

Eight (8) standard Proctor tests were performed during construction for approximately 150,000 cyd of compacted general fill placed as part of the Cell 10 construction. The laboratory results are provided in Appendix B-Section 1. The actual CQA test frequency of 1 test per 18,750 cyd (approx.) of compacted general fill exceeds the minimum testing frequency required by the CQA Documents.

4.4.2 Density and Percent Compaction

In-situ nuclear moisture/density tests were required to be performed at a frequency of 5 tests per acre per lift for earthwork performed using general fill (equivalent to approximately 1 test per 320 cyd). If the density test failed to meet the minimum compaction requirements, the Contractor reworked and re-compacted the area surrounding the failure and the area was retested by CQA personnel. The procedure was repeated until satisfactory moisture/density test results were obtained at each test location.

Approximately 150,000 cyd of general fill were used to construct Cell 10. The in-situ nuclear moisture/density tests performed to evaluate the compaction of general fill in Cell 10 are presented in Appendix C. A total of 563 nuclear moisture/density tests were performed, which correspond to a CQA test frequency of 1 test per 266 cyd (approx.) of compacted general fill which exceeds the minimum testing frequency required by the CQA Documents. Moisture/Density Test Locations are presented in the Project Figures section of this report.

4.4.3 Grain Size Analyses and USCS Classification

Grain-size distribution analyses (ASTM D 422) were performed to evaluate the USCS classification (ASTM D 2487) of general fill materials used to construct Cell 10. Grain size distribution analyses and USCS classification were required to be performed at a minimum frequency of 1 test per 10,000 cyd of compacted general fill.

Twenty (20) grain size distribution analyses and USCS classification were performed during construction for approximately 150,000 cyd of compacted general fill placed as part of the Cell 10 construction. The actual CQA test frequency of 1 test per 7,500 cyd (approx.) of compacted general fill meets the minimum testing frequency required by the CQA Documents. The grain size distribution analyses and USCS classification performed during construction of Cell 10 are presented in Appendix B-Section 2. As noted, the general fill materials used to construct Cell 10 are classified as SP, SM, or SP-SM in accordance with the USCS classification.

4.4.4 Drive Cylinder Tests

In-situ moisture/densities were measured using the drive cylinder method (ASTM D 2937) periodically to verify the moisture/density test results obtained using the nuclear gauge. Forty (40) moisture/densities were measured using the drive cylinder method for the general fill used to construct Cell 10 and are presented in Appendix C. A drive cylinder was collected for approximately every 14 nuclear density tests performed, meeting the minimum testing frequency required by the CQA Documents. As noted, the densities measured using the two methods were in general agreement.

4.4.5 Anchorage of Geosynthetics

Brantley CQA personnel periodically monitored the method of anchorage for the geosynthetic materials along the perimeter berm (on north side of Cell 10) and the intercell berms between Cell 10 and future Cells 11 and 13. Along the west sides of Cell 10, each layer of geosynthetics was tied into the respective layer of geosynthetics from Cell 9. The construction sequence for the anchor trenches was as follows:

- a 2-ft deep by 2-ft wide (minimum) trench was excavated approximately 2 feet from the inside crest of perimeter berm and 6 feet from the inside crest of the intercell berms;
- the geosynthetic components were then placed in and depending upon the material, across the bottom of the anchor trench and ballasted with sandbags; and
- the anchor trench was backfilled with general fill and compacted.

A small, low ground pressure, tracked excavator, hand shovels and brooms were used to carefully remove the existing protective cover soil from an approximate 7-ft wide swath along the length of the west sides of Cell 10 where the geosynthetic layers of the adjacent existing Cell 9 were to be tied into. When the Installer was ready to deploy the secondary GCL along the tie-in area, the following tie-in activities were performed: (i) the existing primary geosynthetic components (primary geocomposite and primary geomembrane) and the secondary geocomposite were cut open and folded back to expose the secondary liner, and (ii) the similar geosynthetic components from Cell 10 were overlapped, fastened, or welded to the existing adjacent geosynthetic components as shown in Detail E3 on Sheet 7 of 18 of the Construction Drawings and as described in Section 5.

4.5 <u>Protective Soil Layer</u>

Protective soil was used to cover the geosynthetic components of the liner system in Cell 10. The minimum thickness of the protective soil layer atop the geosynthetic components of the liner system in Cell 10 was 2 feet.

Sandy soils from the Bronson Borrow Area were used as protective soil. CQA personnel monitored the placement of the protective soil in Cell 10. The construction sequence of protective soil layer was as follows: (i) articulated dump trucks hauled the sandy soils from Bronson Borrow Area to Cell 10, and (ii) the sandy soils were placed and spread using low ground pressure bulldozers.

During placement of the protective soil, CQA personnel monitored the Contractor's activities such that the risk of damage to the underlying geosynthetics was minimized. CQA personnel also confirmed that at least a 2-ft thick layer of sandy soils was maintained over the geosynthetics where the Contractor operated the dozer equipment. A minimum 3-ft thick layer of sandy soils was maintained where the articulated off-road dump trucks operated. Brantley also reviewed the certified survey for the protective cover soil layer, submitted by the Contractor, to ensure compliance with the CQA Documents.

Grain-size distribution analyses (ASTM D 422), soil classification in accordance with USCS (ASTM D 2487), and hydraulic conductivity (ASTM D 2434) tests were performed on samples of protective soil at an off-site geotechnical laboratory. Grain-size distribution analyses, soil classification, and hydraulic conductivity tests were performed at a minimum frequency of 1 test per 5,000 cyd of in-place protective soil.

A total of approximately 38,500 cyd of protective soil was placed in Cell 10. Eight (8) grain-size distribution analyses (and USCS classification) and hydraulic conductivity tests were performed on the protective layer soils placed in Cell 10. The CQA laboratory reports for the protective soil samples are included in Appendix B-Section 2. The actual CQA test frequencies of 1 test per 4,812 cyd (approx.) for grain-size distribution analyses, USCS classification, and hydraulic conductivity met the minimum testing frequencies required by the CQA Documents. As noted, the measured hydraulic conductivities of protective soil exceeded the minimum hydraulic conductivity of 1.0×10^{-3} cm/sec required by the CQA Documents.

5 CQA – GEOSYNTHETICS

5.1 General

Brantley monitored the installation of the geosynthetic components of the double composite liner system in Cell 10, as described in Section 2. At times, several liner system installation operations were conducted simultaneously during Cell 10 construction. When this occurred, the on-site CQA personnel monitored the operations that were considered most critical to the performance of the liner system.

5.2 CQA of Geosynthetic Clay Liner

5.2.1 Conformance Testing and Documentation

A geosynthetic clay liner (GCL) was used in construction of the secondary liner system, and primary liner system within the sump area in Cell 10. Bentomat ST GCL, manufactured by Colloid Environmental Technologies Company (CETCO) was used for the project. Conformance samples of the GCL were collected (from the rolls produced for the project) by TRI, which coordinated with the manufacturer to collect the CQA samples at CETCO's manufacturing plant. TRI also performed the CQA conformance testing in accordance with the CQA Documents on the samples of the GCL collected.

The MQC certificates and test results, and the CQA conformance test results were reviewed by CQA personnel and were found to be in compliance with the CQA Documents. The GCL MQC certificates have been included in Appendix E-Section 1.

A total of nine (9) CQA conformance samples were tested for approximately 558,000 square feet (ft^2) of GCL delivered to the site for installation in Cell 10. The actual CQA test frequency of 1 test per 186,000 ft^2 of GCL exceeded the minimum testing frequency of 1 test per 200,000 ft^2 required by the CQA Documents. As a minimum, one conformance sample was tested during CQA from each lot of GCL supplied for the project. The CQA laboratory test results for the GCL conformance samples have been included in Appendix F-Section 1.

The hydraulic conductivity of GCL was tested using deionized water as the permeant fluid during MQC and CQA testing. Comparison studies using deionized water and leachate from the JED facility were performed previously for Cells 1 and 4. It was determined that the measured hydraulic conductivity of GCL using leachate as the permeant fluid was less than the measured hydraulic conductivity of GCL using deionized water as the permeant fluid, i.e., it is conservative to measure the hydraulic conductivity of GCL using deionized water.

5.2.2 Field Monitoring Activities

5.2.2.1 Delivery and On-Site Storage

Upon delivery, GCL rolls were unloaded in an area located south of the Cell 10 construction area (i.e., in future Cell 13 footprint), stacked on an elevated soil berm, and covered with plastic tarps. The rolls were typically transported on site by an off-road forklift equipped with a stinger bar. CQA personnel periodically monitored the Installer's delivery, unloading, and storage procedures and observed that the GCL was handled in an appropriate manner. The CQA personnel also compared the roll numbers of the GCL rolls delivered to the manufacturer's bill of lading. An inventory of the rolls delivered for the project was maintained by the CQA personnel. This inventory also includes the rolls that were approved for installation based on MQC and CQA test results and the rolls that were used during construction. Only approved rolls were incorporated into the work. The Inventory Log for the GCL material is presented in Appendix D-Section 1.

5.2.2.2 Deployment

Prior to GCL deployment, the Installer signed a certificate of acceptance for the liner subbase, which is included in Appendix G. The GCL rolls were lifted using a stinger bar attached to a skid steer w/forklift attachment. The rolls were deployed by inserting a spreader bar attached to a low-ground pressure, track-mounted skid steer vehicle and unrolled. Panels were re-positioned as necessary using laborers.

CQA personnel monitored the deployment of the GCL rolls. During deployment, the CQA personnel checked for the following:

- manufacturing defects;
- damage that may have occurred during shipment, storage, and handling; and
- damage resulting from installation activities.

If any materials were observed to be damaged, the Installer was notified and the damaged materials were either discarded or repaired. CQA personnel observed repair locations to verify conformance with the requirements of the CQA Documents.

CQA personnel also periodically monitored the deployment of the GCL as well as its condition after installation to ensure that the Installer followed the following procedures:

- the GCL was unrolled and placed in a manner which kept the GCL in sufficient tension to avoid excessive wrinkling and was securely anchored in the anchor trench or ballasted with sand bags;
- the rolls were deployed with the woven geotextile in contact with the geomembrane;
- adjacent GCL panels were overlapped a minimum of 6 inches along the length of the panels and 12 inches along the width of the panels and granular bentonite was added between overlap along the width of panels and repaired areas;
- measures were taken to keep the GCL free of contamination and protected from premature hydration; and
- geomembrane installation immediately followed installation of the GCL.

Any observed holes or tears in the GCL were repaired by the Installer by placing a patch of the same material over the hole or tear and at a distance of at least 1 foot beyond the edges of the hole or tear. Granular bentonite was added around the damaged area prior to overlaying the patch material. In areas where premature hydration of the GCL was detected, the GCL was removed and replaced with new material.

5.3 <u>CQA of Textured Geomembrane</u>

5.3.1 Conformance Testing and Documentation

A 60-mil textured HDPE geomembrane was installed as primary and secondary liners in Cell 10. The 60-mil textured geomembrane, Micro Spike double sided HD, was supplied by AGRU America, Inc., (Agru). Conformance samples of textured geomembrane were collected (from the rolls produced for the project) by TRI, which coordinated with the manufacturer to collect the CQA samples at Agru's manufacturing plant. TRI also performed the CQA conformance testing in accordance with the CQA Documents on the samples of textured geomembrane collected.

The MQC certificates and test results and the CQA conformance test results were reviewed by CQA personnel and were found to be in compliance with the CQA Documents. The geomembrane MQC certificates and conformance test results are included in Appendices E and F, Section 2, respectively.

A total of thirteen (13) CQA conformance samples were tested for approximately 1,103,425 ft^2 of textured geomembrane delivered to the site for installation in Cell 10. The actual CQA test frequency of 1 test per 84,878 ft^2 for the textured geomembrane exceeded the minimum frequency of 1 test per 100,000 ft^2 required by the CQA Documents. As a minimum, one conformance sample was tested during CQA from each resin lot supplied for the project. The CQA laboratory test results for the geomembrane conformance samples have been included in Appendix F-Section 2.

5.3.2 Field Monitoring Activities

5.3.2.1 <u>Delivery and On-Site Storage</u>

Upon delivery to the site, geomembrane rolls were stored in an area located south of the Cell 10 construction area (i.e., future Cell 13 footprint) and stacked on an elevated soil berm. The rolls were typically transported by an off-road forklift with a spreader bar attachment or using the nylon slings which were attached to each roll. CQA personnel periodically monitored the Installer's delivery, unloading, and storage procedures to ensure that the material was handled in an appropriate manner. CQA personnel also compared the roll numbers of the geomembrane rolls delivered to the manufacturer's bill of lading. An inventory of the rolls delivered for the project was maintained by the CQA personnel. This inventory also includes the rolls approved for installation based on MQC and CQA test results and the rolls used during construction. Only approved rolls were incorporated into the work. The Inventory Log for the geomembrane is presented in Appendix D-Section 2.

5.3.2.2 Deployment

The geomembrane rolls were lifted using a spreader bar attached to a track-mounted skid steer vehicle with forklift attachment. The panels were deployed by unrolling the geomembrane rolls using the low-ground pressure, track-mounted skid steer vehicle with forklift attachment. The individual panels were re-positioned as necessary using laborers.

CQA personnel monitored the deployment of each geomembrane panel. During deployment, the CQA personnel checked for the following:

- manufacturing defects;
- damage that may have occurred during shipment, storage, and handling; and
- damage resulting from installation activities, including damage as a consequence of panel placement, seaming operations, or weather.

If any materials were observed to be damaged or deficient, the Installer was notified and the damaged materials were either discarded or repaired. CQA personnel observed and documented the repair locations to verify compliance with the CQA Documents. Details of the geomembrane panel deployment were recorded by CQA personnel on panel deployment logs, which are included in Appendices H and I, Section 1, for Secondary and Primary respectively.

5.3.2.3 Trial Seams

Prior to production seaming, the Installer prepared geomembrane trial seams for each piece of seaming equipment to be used. Additional trial seams were prepared approximately every five hours or when field conditions changed. CQA personnel evaluated the trial seams as follows:

- trial seams were welded under similar conditions as production seaming;
- test strips were cut from the trial seams at random locations with a die press;
- five (5) test strips were tested using a field tensiometer and compared to the passing criteria for the tests, which were as follows:

  Fusion

  - *Peel tests - a minimum bonded seam strength of 91 lb/in (inside/outside); and*
  - *Shear test - a minimum bonded seam strength of 120 lb/in.*

  Extrusion

  - *Peel test - a minimum bonded seam strength of 78 lb/in; and*
  - *Shear test - a minimum bonded seam strength of 120 lb/in.*

If trial welds failed, the machine or welding process was adjusted and a new trial seam was prepared. The new sample was tested to ensure compliance with the above strength requirements. The procedure was repeated, as needed, until passing results were obtained.

Trial seam samples were not archived. Details of the trial seams, including the trial seam test results, are included in Appendices H and I, Section 2, for Secondary and Primary, respectively.

5.3.2.4 Production Seams

Geomembrane production seaming operations were monitored by CQA personnel. The majority of the geomembrane production seams were fabricated using double-track fusion welders. Seam repairs were made using hand-held extrusion welders. Rub sheets were periodically used during production seaming to provide a clean surface to weld over. During or after fabrication, the geomembrane seams were visually examined for workmanship and continuity. Geomembrane fusion seaming logs are included in Appendices H and I, Section 3 for Secondary and Primary, respectively. Geomembrane extrusion seaming logs are included in Appendices H and I, Section 4 for Secondary and Primary, respectively.

5.3.3 Nondestructive Seam Testing

5.3.3.1 Scope

Nondestructive testing of geomembrane seams was monitored by CQA personnel. All geomembrane seams were nondestructively tested for continuity by the Installer using the air pressure procedure for double-track fusion seams and the vacuum-box test procedure for extrusion welded seams. Failed air pressure seams, if applicable, were capped and then retested using vacuum-box test methods after determining the failed seam length. Leaks identified using the vacuum-box method were repaired and retested as described in Section 5.3.5.

5.3.3.2 Air Pressure Testing

Accessible double-track fusion seams were nondestructively tested using the air pressure test. The procedure used by the Installer for air pressure testing was as follows:

- visually observed the integrity of the annulus of the section of seam being tested and isolated the section by sealing the ends using heat and pressure;
- inserted the needle of the pressure test apparatus into the annulus at one end of the seam;
- inflated the annulus to a gauge pressure between 25-30 psi with an air pump and maintained the gauge pressure for at least 5 minutes;
- repaired faulty areas in accordance with Section 5.3.5 if the pressure loss exceeded 3 psi or if the pressure did not stabilize; and

- confirmed airflow through the entire annulus by releasing the air from the seam at the opposite end from where the needle was inserted.

5.3.3.3 *Vacuum-Box Testing*

The vacuum-box was used by the Installer to nondestructively test extrusion seams and repairs. The procedure used by the Installer for vacuum testing was as follows:

- wetted a strip of seam with a soapy solution;
- placed the vacuum-box assembly over the wetted area, closed the bleed valve and opened the vacuum valve;
- forced the box onto the sheet until vacuum was observed;
- examined the seam through the viewing window for a period of approximately 20 seconds for the occurrence of air bubbles;
- removed the assembly and continued the process over the entire length of the seam; and
- recorded the location of any leaks.

Nondestructive seam air pressure test results are presented in Appendices H and I, Section 6 for Secondary and Primary, respectively. Nondestructive vacuum box test results are presented in Appendices H and I, Section 5 for Secondary and Primary, respectively. If nondestructive testing indicated that repairs were necessary, repairs were made in accordance with procedures presented in Section 5.3.5. All repairs were tested using the vacuum-box test procedure.

5.3.4 Destructive Seam Sample Testing

5.3.4.1 *Scope*

CQA personnel identified and collected geomembrane seam samples for destructive testing in accordance with the CQA Documents. These samples were tested at an off-site geosynthetics laboratory. For a destructive seam sample to be considered as passing, the seam strength criteria described in Section 5.3.2.3 had to be met for at least four out of the five test specimens obtained from the sample. Additionally, if one non-FTB failure was observed, the average of the five test specimens had to meet the specified strength criterion.

5.3.4.2 *Sampling Procedures*

Prior to the removal of the full seam sample, two geomembrane test strips were taken by the Installer from either end of the proposed destructive sample. Each strip was peel-tested in the field. If the peel samples exhibited passing results, the adjacent destructive seam sample was removed and tested. At each destructive seam sample location, a test sample measuring approximately 12 inches across the seam and 42 inches along the seam was obtained. The sample was divided into three pieces and distributed to: (i) the off-site geosynthetics laboratory for testing, (ii) the Installer, and (iii) the Owner as an archive sample.

5.3.4.3 Test Results

Laboratory testing of geomembrane seam samples was performed in accordance with the CQA Documents. For destructive seam testing, five 1-in wide test specimens were removed from the destructive seam sample using a die press. Five test specimens were peel-tested for adhesion strength using a calibrated tensiometer. For fusion seams, peel tests were performed on both the bottom (inside track) and top (outside track) edges. Additionally, five specimens were tested for shear strength. The seam acceptance/rejection criteria described in Sections 5.3.2.3 and 5.3.4.1 were used to evaluate the destructive seam samples.

The CQA laboratory destructive test results for the secondary and primary liner have been included in Appendices H and I, Section 7 respectively. For the primary liner installed in Cell 10, fifty seven (57) destructive seam samples were tested for a total fusion seam length of 26,015 linear ft. (approx.). This corresponds to an approximate sample frequency of 1 per 456 lf of fusion seam. Three (3) destructive seam samples were tested for a total extrusion seam length of 1,057 linear ft. (approx.). This corresponds to an approximate sample frequency of 1 per 352 lf of extrusion seam. For secondary liner installed in Cell 10, fifty three (53) destructive seam samples were tested for a total fusion seam length of 25,202 linear feet (approx.). This corresponds to an approximate sample frequency of 1 per 475 lf of seam. Three (3) destructive seam samples were tested for a total extrusion seam length of 1,035 linear ft. (approx.). This corresponds to an approximate sample frequency of 1 per 345 lf of extrusion seam. The actual destructive seam test frequencies exceeded the minimum frequency of 1 per 500 lf of production seams required by the CQA Documents.

A total of 110 destructive fusion seam samples and 6 destructive extrusion seam samples were tested during the installation of the geomembrane liners. Seams identified by a failing destructive seam sample were tracked in both directions (i.e., seam welded before “B” and after “A” the location of the failing destructive sample) in accordance with the CQA Documents until passing destructive seam samples were achieved. The section of the seam between passing destructive seam samples was capped. There were no failing destructive seam samples for this project.

5.3.5 Geomembrane Repairs

The repair procedures presented in this subsection were used by the Installer to patch holes and tears, spot-extrude impact damage or other minor defects, and for grinding and extrusion welding small sections of failed fusion seams (if the exposed edge was accessible). In the cases where patches or caps were used to repair the damaged geomembrane (i.e., small holes, tears, or on seams which failed nondestructive or destructive testing), an approximately 12-in. wide capping strip was used.

During the repair or panel tie-in operations, the following procedures were implemented:

- technicians and seaming equipment used were required to pass trial welds;
- patches or caps extended at least 6 in. beyond the edge of the defect and all corners were rounded; and
- repairs were tested using vacuum box and visually observed for continuity.

Repair summary logs prepared by Brantley during CQA activities are included in Appendices H and I, Section 5 for secondary and primary liner, respectively. Record drawings illustrating layout of panels, location of seams, destructive samples, and repairs are included in the Project Figures section of this report.

5.4 CQA of Secondary Geocomposite

5.4.1 Conformance Testing and Documentation

The secondary geocomposite used was Transnet 270-2-8 manufactured by SKAPS. Secondary geocomposite conformance samples were collected (from the rolls produced for the project) by TRI, which coordinated with the manufacturer to collect the CQA samples at the SKAPS' manufacturing plant. TRI also performed the CQA conformance testing on the samples of the secondary geocomposite collected.

The MQC certificates and test results and the CQA conformance test results were reviewed by CQA personnel and were found to be in compliance with the CQA Documents. The results of the MQC and CQA conformance tests results for the 178 rolls (498,400 ft^2) produced for the project are provided in Appendices E and F, Section 3, respectively.

A total of three (3) CQA conformance samples were tested for approximately 498,400 ft^2 of secondary geocomposite delivered to the site for installation in Cell 10. The actual CQA test frequency of 1 test per 166,133 ft^2 of the secondary geocomposite meets the minimum frequency of 1 test per 200,000 ft^2 required by the CQA Documents for transmissivity, ply adhesion, mass per unit area, grab strength, and trapezoidal tear strength. Note that both sides of the geotextile component were tested for mass per unit area, grab strength, and trapezoidal tear strength. In addition, two (2) of these three (3) samples were tested for apparent opening size and permittivity. The actual CQA test frequency of 1 test per 249,200 ft^2 of the secondary geocomposite meets the minimum frequency of 1 test per 500,000 ft^2 required by the CQA Documents for apparent opening size and permittivity. A minimum of one conformance sample was tested during CQA from each geocomposite lot.

The transmissivity of the secondary geocomposite was measured under compressive stresses of 500 psf for 24 hours and 15,000 psf for 100 hours. The tests were performed with the secondary geocomposite sandwiched between a GCL (Bentomat ST) and a 60-mil HDPE textured geomembrane. The transmissivity of the secondary geocomposite reported is the minimum transmissivity measured during the 24 and 100-hour tests.

The CQA laboratory test results for the secondary geocomposite conformance samples have been included in Appendix F-Section 3.

5.4.2 Field Monitoring Activities

5.4.2.1 Delivery and On-Site Storage

Upon delivery to the site, secondary geocomposite rolls were stored in an area located south of the Cell 10 construction area (i.e., future Cell 13 footprint) and stacked on an elevated soil berm. The rolls were typically transported by an off-road forklift. CQA personnel periodically monitored the Installer's delivery, unloading, and storage procedures to ensure that the material was handled in an appropriate manner.

CQA personnel also compared the roll numbers of the secondary geocomposite rolls delivered to the Manufacturer's bill of lading. An inventory of the rolls delivered for the project was maintained by the CQA personnel. This inventory also includes the rolls that were approved for installation based on MQC and CQA test results and the rolls that were used during construction of Cell 10. Only approved rolls were incorporated into the work. The Inventory Log for the secondary geocomposite is presented in Appendix D-Section 3.

5.4.2.2 Deployment

CQA personnel monitored the deployment of the secondary geocomposite for manufacturing defects, damage that may have occurred during shipment, storage, and handling, and damage resulting from installation activities. If the materials were observed to be damaged, the Installer was notified and the damaged materials were either discarded or repaired. CQA personnel observed repair locations to verify conformance with the CQA Documents.

CQA personnel periodically monitored the deployment of the secondary geocomposite, as well as its condition after installation, to confirm that the Installer took measures to:

- securely anchor the geocomposite in the anchor trench or ballast it with sand bags;
- unroll the geocomposite down the slope (i.e., rolls were aligned perpendicular to the leachate leak detection corridor) in a manner that kept the panel in sufficient tension to avoid excessive wrinkling;
- avoid entrapment of dust, stones, or other objects that would damage or clog the geocomposite;
- avoid damaging the underlying geomembrane during deployment;
- overlap the bottom geotextile edges;
- secure the geonet component of adjacent geocomposite panels with nylon fasteners, installed along the panel at maximum 5-ft spacing on slopes greater than 10 percent and 10-ft spacing on the cell floor, and at 1-ft spacing on end seams; and
- overlap and continuously sew the upper geotextile edges.

Any observed holes in the geotextile component of the secondary geocomposite were repaired by placing a patch of non-woven geotextile over the hole that extended at least one foot beyond the edge of the hole. These patches were continuously thermally bonded to the undamaged portion of the geocomposite. This method was also used along the tie-in at the toe of the slope and along trimmed panels. Any observed holes or tears in the geonet component of the composite were repaired by the Installer by placing a patch of the same material over or under the hole or tear, at least 2-ft beyond the edges of the hole or tear. These patches were secured using nylon fasteners, followed by thermal bonding of the uppermost geotextile of the patch to the undamaged portion of the geocomposite.

5.5 CQA of Primary Geocomposite

5.5.1 Conformance Testing and Documentation

The primary geocomposite used was Transnet 330-2-8 manufactured by SKAPS Industry (SKAPS). The primary geocomposite conformance samples were collected by TRI, which coordinated with the manufacturer to collect the CQA samples at the SKAPS' manufacturing plant in Commerce, Georgia. TRI also performed the CQA conformance testing on the samples of primary geocomposite collected.

The MQC certificates and test results and the CQA conformance test results were reviewed by CQA personnel and found to be in compliance with the CQA Documents. The MQC and CQA conformance test results for 224 rolls (564,480 ft^2) of primary geocomposite are provided in Appendices E and F, Section 3, respectively.

A total of three (3) CQA conformance samples were tested for approximately 564,480 ft^2 of primary geocomposite delivered to the site for installation in Cell 10. The actual CQA test frequency of 1 test per 188,160 ft^2 of the primary geocomposite meets the minimum frequency of 1 test per 200,000 ft^2 required by the CQA Documents for transmissivity, ply adhesion, mass per unit area, grab strength, and trapezoidal tear strength. Note that both sides of the geotextile component were tested for mass per unit area, grab strength, and trapezoidal tear strength. In addition, two (2) of these three (3) samples were tested for apparent opening size and permittivity. The actual CQA test frequency of 1 test per 282,240 ft^2 of the primary geocomposite meets the minimum frequency of 1 test per 500,000 ft^2 required by the CQA Documents for apparent opening size and permittivity. A minimum of one conformance sample was tested during CQA from each geocomposite lot.

The transmissivity of the primary geocomposite was measured under compressive stresses of 500 psf for a period of 24 hours, and 15,000 psf for a period of 100 hours. The tests were performed with the primary geocomposite sandwiched between 60-mil textured geomembrane and the soil actually used as part of the protective soil layer. The transmissivity of the primary geocomposite reported is the minimum transmissivity measured during the 24 and 100-hour tests.

The CQA laboratory test results for the primary geocomposite conformance samples have been included in Appendix F-Section 3.

5.5.2 Field Monitoring Activities

5.5.2.1 Delivery and On-Site Storage

Upon delivery to the site, primary geocomposite rolls were stored in an area located south of the Cell 10 construction area (i.e., future Cell 13 footprint) and stacked on an elevated soil berm. The rolls were typically transported by an off-road forklift. CQA personnel periodically monitored the Installer's delivery, unloading, and storage procedures to ensure that the material was handled in an appropriate manner.

CQA personnel also compared the roll numbers of the primary geocomposite rolls delivered to the manufacturer’s bill of lading. An inventory of the rolls delivered for the project was maintained by the CQA personnel. This inventory also includes the rolls that were approved for installation based on MQC and CQA test results and the rolls that were used during construction. Only approved rolls were incorporated into the work. The Inventory Log for the primary geocomposite is presented in Appendix D-Section 3.

5.5.2.2 Deployment

CQA personnel monitored the deployment of the primary geocomposite for manufacturing defects, damage that may have occurred during shipment, storage, and handling, and damage resulting from installation activities. If the materials were observed to be damaged, the Installer was notified and the damaged materials were either discarded or repaired. CQA personnel observed repair locations to verify conformance with the CQA Documents.

CQA personnel periodically monitored the deployment of the primary geocomposite, as well as its condition after installation, to confirm that the Installer took measures to:

- securely ballast the geocomposite with sand bags;
- unroll the geocomposite down the slope (i.e., rolls were aligned perpendicular to the slope contours) in a manner that kept the panel in sufficient tension to avoid excessive wrinkling;
- avoid entrapment of dust, stones, or other objects that would damage or clog the geocomposite;
- avoid damaging the underlying geomembrane during deployment;
- overlap the bottom geotextile edges;
- secure the geonet component of adjacent geocomposite panels with nylon fasteners, installed on a maximum 5-ft spacing on slopes greater than 10 percent and 10-ft on the cell floor and at 1-ft spacing on end seams; and
- overlap and continuously sew the upper geotextile edges.

Any observed holes in the geotextile component of the primary geocomposite were repaired by placing a patch of non-woven geotextile over the hole that extended at least one foot beyond the edge of the hole. These patches were continuously thermally bonded to the undamaged portion of the geocomposite. This method was also used along the tie-in at the toe of the slope and along trimmed panels. Any observed holes or tears in the geonet component of the composite were repaired by the Installer by placing a patch of the same material over or under the hole or tear, at least 2-ft beyond the edges of the hole or tear. These patches were secured using nylon fasteners, followed by thermal bonding of the uppermost geotextile of the patch to the undamaged portion of the geocomposite.

5.6 CQA of Non-Woven Geotextile

5.6.1 Conformance Testing and Documentation

A non-woven geotextile was used as filter fabric to surround the aggregate in the leachate collection and leak detection system corridors and as a separator in the Cell 10 leachate sump. The GT180 8-oz/yd^2, needle-punched, non-woven geotextile was manufactured by SKAPS.

The CQA conformance sample for the non-woven geotextile were collected by TRI, which coordinated with the manufacturer to collect the CQA samples at the SKAPS' manufacturing plant in Commerce, Georgia. TRI performed the CQA conformance testing on the sample of the non-woven geotextile collected.

The MQC certificates and test results and the CQA conformance test results were reviewed by CQA personnel and were found to be in compliance with the CQA Documents. The results of the MQC and CQA conformance tests are presented in Appendices E and F, Section 4, respectively.

One (1) CQA conformance sample was tested for approximately 62,100 ft^2 (six rolls) of the non-woven geotextile delivered to the site for installation in Cell 10. The actual CQA test frequency of 1 test per 62,100 ft^2 of non-woven geotextile exceeded the minimum testing frequency of 1 test per 100,000 ft^2 required by the CQA Documents for mass per unit area, grab strength, trapezoidal tear strength, puncture resistance, and static puncture strength. In addition, this sample was also tested for apparent opening size and permittivity. The actual CQA test frequency of 1 test per 62,100 ft^2 of non-woven geotextile exceeded the minimum frequency of 1 test per 200,000 ft^2 required by the CQA Documents for apparent opening size and permittivity. The CQA laboratory test results for the geotextile conformance sample have been included in Appendix F-Section 4 of this report.

5.6.2 Field Monitoring Activities

5.6.2.1 Delivery and On-Site Storage

Upon delivery to the site, non-woven geotextile rolls were stored in an area located south of the Cell 10 construction area (i.e., future Cell 13 footprint) and stacked on an elevated soil berm. The rolls were typically transported by an off-road forklift. CQA personnel periodically monitored the Installer's delivery, unloading, and storage procedures to ensure that the material was handled in an appropriate manner.

CQA personnel also compared the roll numbers of the geotextile rolls delivered to the manufacturer's bill of lading. An inventory of the rolls delivered for the project was maintained by the CQA personnel. This inventory also includes the rolls that were approved for installation based on MQC and CQA test results and the rolls that were used during construction. Only approved rolls were incorporated into the work. The Inventory Log for the geotextile is presented in Appendix D-Section 4.

5.6.2.2 Deployment

CQA personnel monitored the deployment of the non-woven geotextile rolls for manufacturing defects; damage that may have occurred during shipment, storage, and handling; and damage resulting from installation activities. If any materials were observed to be damaged, the Installer was notified and the damaged materials were either discarded or repaired. CQA personnel observed repair locations to verify conformance with the requirements of the CQA Documents.

After deployment of the geotextile, CQA personnel observed that the Installer overlapped geotextile panels end-to-end a minimum of 24 inches and continuously sewed the 6-in overlap.

5.7 Interface Friction Testing

As discussed in Section 2, the liner system in Cell 10 consists (from top to bottom) of the protective soil layer, primary geocomposite, primary geomembrane liner, secondary geocomposite, secondary geomembrane liner, secondary GCL and prepared subbase. Tests were performed in accordance with the CQA Documents to evaluate the interface shear strength for the various components of the liner system and the internal strength of the GCL. All tests for interface shear strength and the internal strength of the GCL were performed by TRI.

The interface shear and the internal strength tests were performed as part of CQA testing. The tests were performed using samples of geosynthetics collected from rolls that were actually installed in Cell 10. The soils for the protective soil layer and liner subbase were obtained from the Bronson Borrow Area and were similar to the sandy soils used in construction. The following rolls of geosynthetics were used for the CQA interface shear and the internal strength tests:

- GCL – Roll #761
- Textured geomembrane – Roll #G14A097093
- Primary geocomposite – Roll #57871020001

- Secondary geocomposite – Roll #57871010001

The interfaces between the various components of the liner system and the internal strength of the GCL were tested at normal stresses of 5,000, 10,000, and 15,000 psf. Peak (at small displacement) and residual (at large displacements) shear strengths were measured at each normal stress. The interface shear tests were conducted under wetted/saturated conditions. GCL was soaked and consolidated prior to testing. The following liner system interfaces were tested:

- Protective soil layer / primary geocomposite / textured geomembrane / secondary geocomposite
- Textured geomembrane / secondary geocomposite / textured geomembrane / GCL (non-woven side down) / subbase soil
- Internal strength of the GCL

The peak interface shear strength of the GCL and components was measured at an effective friction angle of 20.8^o (Case 1) and 18.3^o (Case 2) which exceeds the minimum CQA Document requirements of 11.0^o. The large displacement interface shear strength was measured at an effective angle of 11.6^o (Case 1) and 8.7^o (Case 2) which exceeds the minimum CQA Document requirements of 6.1^o.

The peak internal shear strength of the GCL was measured at an effective friction angle of 22.6^o which exceeds the minimum CQA Document requirements of 11.0^o. The large displacement internal shear strength was measured at an effective angle of 16.8^o which exceeds the minimum CQA Document requirements of 6.5^o.

As noted, the measured peak and residual shear strengths exceeded the minimum specification requirements. The CQA laboratory interface test results have been included in Appendix F-Section 5 of this report.

6 CQA – LEACHATE COLLECTION AND REMOVAL SYSTEM

6.1 General

This section includes CQA activities performed during construction of the leachate collection and removal system in Cell 10 and a leachate header pipe installed between Cell 10 sump risers and the existing leachate transmission line manhole MH-10, as shown in the construction drawings.

The leachate collection system in Cell 10 consists of a primary and a secondary leachate collection system and sumps. The primary leachate collection system included a 6-in diameter SDR 11 HDPE perforated leachate collection pipe surrounded by gravel aggregate and geotextile filter fabric. The secondary system was the same as the primary, except a 4-in SDR 11 HDPE perforated pipe was used.

For the primary and secondary leachate collection systems, the leachate collection pipe was provided with two rows of ½-inch perforations in the bottom 1/3 of the pipe section. Granular drainage materials meeting the requirements of #57 stone (per ASTM D 448) was used as the gravel aggregate. An 8-oz/yd^2 needle-punched, non-woven geotextile was used as the filter fabric.

Two (2) cleanouts (one for the primary system and one for the secondary system) were installed along the inside slope of the perimeter berm from the sump in Cell 10 to maintain the leachate collection system piping. The primary cleanout was constructed using 6-in diameter SDR 11 HDPE pipe and fitted with a blind flange. The secondary cleanout was constructed similarly, but with 4-in diameter pipe.

The Cell 10 sump included gravel beds covered with geotextile separator fabric and three sump upslope risers. The gravel beds for the primary and secondary sumps were separated by the primary liner system. Granular drainage materials meeting the requirements for #4 stone (per ASTM D 448) were used in the drainage beds. The primary drainage bed was separated from the overlying liner protective layer by an 8-oz/yd^2 needle-punched, non-woven geotextile separator fabric. Two primary and one secondary sump risers were installed in the Cell 10 sump. The sump risers were constructed using 24-in diameter SDR 32.5 HDPE pipe and included a perforated cap at the sump end and a bolted flanged top lid. The horizontal section (or collection segment) of the sump riser pipes were perforated to allow leachate to flow into the pipe.

The Cell 10 sump area also included a primary GCL extending along the toe of the perimeter berm and approximately 50 feet outward from the toe.

Leachate from Cell 10 will be collected in the leachate collection system in the central leachate corridors, and will gravity flow to the Cell 10 sump. Leachate will be pumped from the sump risers through the leachate transmission line to the leachate storage area. To control the pumping and transfer of leachate, a sump control panel was installed as part of the leachate system in Cell 10.

Brantley's CQA personnel monitored the construction of the leachate collection system within Cell 10 and the leachate transmission header line from Cell 10 to the existing leachate transmission line manhole (MH-10). The field monitoring and testing activities performed by the CQA personnel during construction of the leachate collection system and the leachate transmission line are discussed below. After construction of the leachate collection system was complete, the primary collection pipes were pressured cleaned and video inspected by Florida JetClean, of Lutz, Florida. A report from Florida JetClean verifying the system to be free flowing and not obstructed is included in Appendix J of this report.

6.2 HDPE Pipe

All pipes used in the construction of the leachate collection system were SDR 11 HDPE pipes except for the sump risers, which were constructed using SDR 32.5 HDPE pipes. The MQC certificates for the HDPE pipes were reviewed by the CQA personnel and were found to be in compliance with the requirements of the CQA Documents.

HDPE pipe sections were joined using butt-fusion welding and electro fusion coupler techniques. CQA personnel monitored the butt-fusion welding techniques to ensure that industry-accepted procedures were used during construction. CQA personnel also verified the diameter of and perforation details (size, number of rows, orientation) for the different pipes used in the leachate collection system.

6.3 Granular Drainage Materials

Granular drainage materials meeting the requirements of #57 stone (per ASTM D 448) were used in Cell 10 primary and secondary leachate collection systems. Granular drainage materials meeting the requirements of #4 stone (per ASTM D 448) were used in the Cell 10 leachate sump area. The #4 and #57 granular drainage materials were supplied by Conrad Yelvington Distributors, Inc. out of Orlando, Florida.

The QC certificates and test results were reviewed by CQA personnel and were found to be in compliance with the CQA Documents. The hydraulic conductivity (per ASTM D 2434) of the #57 stone was measured to be 15 cm/sec, which exceeded the CQA Documents requirement of 1 cm/sec. The hydraulic conductivity (per ASTM D 2434) of the #4 stone was measured to be 22 cm/sec, which exceeded the CQA Documents' requirement of 10 cm/sec. Carbonate content tests (per ASTM D 3042) were performed on the #57 and #4 stone granular drainage materials during the QC testing. The #57 and #4 stone used in construction of the leachate collection system were found to be almost insoluble (less than 1 percent soluble) to 6N hydrochloric acid. The results of the MQC and CQA conformance tests are presented in Appendix E-Section 5 and Appendix B-Section 3, respectively.

CQA personnel monitored the placement of the granular drainage material to ensure: (i) the underlying geosynthetics were not damaged; (ii) the perforated pipes were properly surrounded by the drainage materials and the geotextile; and (iii) the drainage materials were placed in accordance with the requirements of the CQA Documents.

6.4 Pressure Testing

The leachate header pipe installed between the Cell 10 sump and the existing leachate transmission manhole MH-10 was pressure tested to detect any leaks or defective pipe joints. The hydrostatic pressure testing was performed by filling the leachate transmission line segment and pressurizing it. The hydrostatic pressure of 130 psi was maintained for at least 1 hour after an initial 3 hour expansion phase. No drop in the hydrostatic pressure was observed during the 1 hour test period.

6.5 Sump Pumps and Control Panel

Leachate collected in the leachate sumps will be extracted and pumped to the leachate storage area by two 5-hp electric EPG model WSDPT 46-2 SurePumps located in the primary sump risers and one 1.5-hp electric EPG model WSDPT 12-2 SurePump located in the secondary sump riser. The pumps are controlled by a control panel located at the Cell 10 sump near the top of the sump risers. The sump pumps and the associated control panel were supplied by EPG Companies, Inc., (EPG), Rogers, Minnesota.

This facility is currently waiting on Duke Energy to install the power pole to supply power to the above mentioned pumps and controls. The following tests will be performed to confirm proper operation of the pumps and controls. Once this is completed, a final certification letter from Absolute Water, Inc. will be submitted to verify functionality in a separate transmittal from this report.

- Sump pumps will be tested in place by flooding the Cell 10 sump. Each pump will be connected to a piping assembly containing a pressure gauge, meter valve, and a flow meter. The pumps will be turned on and the pressure and flow rate of each pump will be recorded. The pressure and flow rate data for each pump will be compared to the pump curves provided by EPG.
- Transducer settings will be checked to confirm that the pumps and alarms are functioning and activating correctly.
- The installed system components will be visually checked for compliance with the requirements set forth in the project documents.

7 CQA – OTHER CONSTRUCTION ACTIVITIES

7.1 Overview

Brantley provided CQA monitoring, testing and documentation for miscellaneous activities associated with the development and ongoing operation of the JED facility. The CQA activities associated with the construction of the Cell 10 not previously discussed herein include the installation of a storm water drainage structure and a geomembrane flap installed along the Cell 10 perimeter berm and intercell berm to minimize methane gas migration and to temporarily restrict the cross flow of storm water into the Cell 10 area.

7.2 Storm Water Drainage Structure

Three storm water drainage structures (Structure A – 30” and Structures B&C – 24”) were installed in the perimeter berm on the north side of Cell 10 in accordance with the CQA Documents. The pre-cast concrete storm water drainage structures were manufactured by American Concrete Industries, Inc., in Fort Pierce, Florida. The shop drawing supplied by the manufacturer was reviewed by the CQA personnel and were found to be in compliance with the CQA Documents.

7.3 Geomembrane Flap at Intercell Berm

A 60-mil HDPE geomembrane flap (approximately 6 feet wide) was installed along the Cell 10/13 intercell berm, the Cell 10/11 intercell berm, and the Cell 10 perimeter berm. The geomembrane flap was extrusion welded to the 60-mil primary geomembrane, brought up through the protective cover, and extended back toward the cell on top of the protective cover approximately 3-4 feet. This geomembrane flap is intended to minimize methane gas migration. The primary geocomposite drainage layer was terminated approximately 3 feet below the crest of the slope with the end wrapped with a geotextile and heat tacked to the geocomposite. The exposed geomembrane flap was held in place with sandbags.

7.4 Landfill Gas System

Two landfill gas side-slope risers were installed on the north side slope of Cell 10 and connected at the toe of slope creating a U-Shape. These risers will be connected to the lower tier horizontal gas collectors to facilitate condensate drainage and will be installed at a future date as waste filling occurs in Cell 10. Each riser consisted of approximately 25 feet of eight-inch diameter HDPE solid pipe. These pipes were installed down the slope with a 45 degree elbow placed approximately 5-feet from the toe, extended to the toe of slope with additional solid pipe, then another 45 degree elbow placed at the toe of slope, extended along the toe with an additional 15-foot section of eight-inch solid pipe. Connected to the solid pipe is approximately 160 linear feet of eight-inch HDPE perforated pipe (embedded in gravel to facilitate condensate drainage and wrapped in geotextile fabric) which extends through the sump area towards the east. A similar riser is connected at the end of the perforated pipe and extends back up the slope. Each riser pipe was installed within the 24-inch layer of liner protective soil.

8 SUMMARY

Observation of the construction of Cell 10 at the JED facility was performed by Brantley during the period of March 3, 2014 and July 11, 2014. During this time, CQA personnel monitored the installation of the following components:

- earthwork (Cell 10 subgrade, liner subbase, intercell berms, sump area, protective soil layer, and miscellaneous earthwork);
- geosynthetics in Cell 10; and
- leachate management system (leachate collection and removal system and tie into the existing leachate transmission system).

During construction of the above components, CQA personnel verified that performance and conformance testing was performed at the frequencies required by the CQA Documents and that the installation met or exceeded the requirements of the CQA Documents. CQA personnel also verified that conditions or materials identified as not conforming to the CQA Plan were replaced, repaired, and/or retested, as described in this report.

The results of the CQA activities undertaken by Brantley as described in this report indicate that Cell 10 was constructed in general accordance with the CQA Documents and the solid waste permit issued for the JED facility.

Allan Brantley, Florida P.E. #68030
Certifying Engineer-of-Record

ALLAN S. BRANTLEY
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STATE OF
FLORIDA
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PROJECT FIGURES

Figure 1

Asbuilt Top of Subgrade

Figure 2

Asbuilt Top of Subgrade and Top of Protective Cover

Control Point Table

Figure 3

Asbuilt Leak Detection System

Figure 4
Asbuilt Leachate Collection System

Figure 5
Asbuilt Top of Protective Cover

Figure 6

Cell 10 Secondary Layer 60 Mil HDPE As-built

Figure 7
Cell 10 Primary Layer 60 Mil HDPE As-built

Figure 8

Moisture/Density Test Locations

(Lifts 1 thru 14)

LIST OF APPENDICIES

APPENDIX A
Listing of CQA Monitoring and Installation Personnel

Section 1
Brantley Engineering, LLC

Section 2
Comanco Environmental Corporation

APPENDIX B

Pre-Construction Soils Laboratory Testing Results

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General Fill

Section 2
Protective Cover

Section 3
#4 Stone and #57 Stone

APPENDIX C
Soils Field Testing Results

Section 1
General Fill Density Summary and Field Tests

APPENDIX D
Inventory Log

Section 1

GCL

Section 2
HDPE Geomembrane

Section 3
Drainage Geocomposite

Section 4
Geotextile

APPENDIX E
Manufacturer’s Quality Control Certificates

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GCL

Section 2
HDPE Geomembrane

Section 3
Drainage Geocomposite

Section 4
Geotextile

Section 5
#4 Stone and #57 Stone

APPENDIX F

Conformance Test Results

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GCL

Section 2
HDPE Geomembrane

Section 3
Drainage Geocomposite

Section 4
Geotextile

Section 5

Interface Friction Test

APPENDIX G
Subgrade Acceptance Certificates

APPENDIX H
Geomembrane Installation
(Secondary Layer)

Section 1

Geomembrane Panel Deployment Log

Section 2
Geomembrane Trial Seam Log

Section 3
Geomembrane Fusion Seaming Log

Section 4

Geomembrane Extrusion Seaming Log

Section 5

Geomembrane Defect, Repair, and Vacuum Test Log

Section 6

Geomembrane Non-Destructive Pressure Test Log

Section 7

Geomembrane Destructive Samples Laboratory Results

APPENDIX I
Geomembrane Installation
(Primary Layer)

Section 1

Geomembrane Panel Deployment Log

Section 2
Geomembrane Trial Seam Log

Section 3
Geomembrane Fusion Seaming Log

Section 4
Geomembrane Extrusion Seaming Log

Section 5

Geomembrane Defect, Repair, and Vacuum Test Log

Section 6

Geomembrane Non-Destructive Pressure Test Log

Section 7
Geomembrane Destructive Samples Laboratory Results

APPENDIX J
Florida JetClean Report

APPENDIX K
Daily Field Monitoring Reports

APPENDIX L
Project Photos