

Texas Custodial Trust

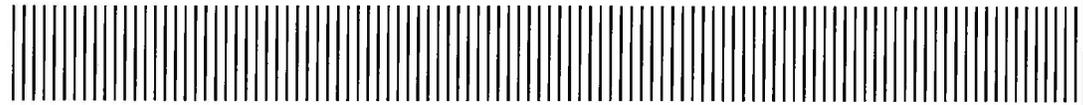
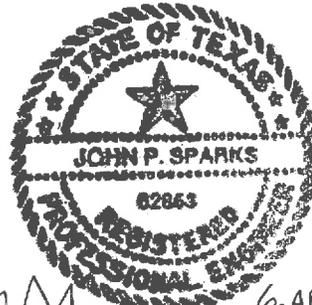
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**Construction Quality Assurance Report
Category I Landfill – Cell 3 Cover System
Reconstruction**

**Former ASARCO Smelter Site,
El Paso, Texas**

MALCOLM PIRNIE F-979

April 2015



Report Prepared for Project Navigator, LTD (Trustee) By:

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Acronyms

AEG	American Environmental Group, Ltd.
AMEC	American Environmental & Infrastructure, Inc.
CAT I	Category I
CES	ARCADIS Construction and Environmental Services Group
CQA	Construction Quality Assurance
CY	cubic yards
GCL	geosynthetic clay liner
GSE	GSE Lining Technology, LLC
HDPE	high-density polyethylene
I-10	Interstate 10
Land-Mark	Land-Mark Professional Surveying, Inc.
LLDPE	linear low-density polyethylene
QC	Quality Control
SF	square feet
Site	Former ASARCO Smelter Site
Trust	Texas Custodial Trust
T	ton
TRI	TRI Environmental, Inc.

1. Introduction

1.1. Objective

This construction quality assurance (CQA) report has been developed on behalf of the Texas Custodial Trust (Trust) to summarize the monitoring and testing program conducted by Malcolm Pirnie, Inc. during reconstruction of the cover system for the Category I (CAT I) Landfill - Cell 3 Cover System Reconstruction at the Former ASARCO Smelter Site (Site) located in El Paso, Texas.

This report was prepared for the Trust by Mr. Steve Richey (CQA Manager), Ms. Rachel Jennings (Liner CQA Engineer) and reviewed by Scott Brown (Project Manager) and John Sparks, P.E. (Engineer of Record).

1.2. Project Description

The Site is located within the limits of El Paso, Texas. The main smelter site occupied an area of approximately 120 acres bounded by U.S. Interstate Highway 10 (I-10) on the east and U.S. Highway 85 (Paisano Drive) on the west as shown in the Site Vicinity Map (see Figure 1).

As part of the remediation activities and construction activities at the site, Cell 3 (formerly Pond 6) was completed in 2008 for use as a Category I landfill. In order to meet the long term requirements of the site, Pond 6 required partial redesign and reconstruction.

Malcolm Pirnie designed and prepared the Design Drawings (see Appendix A) for the new Cell 3 cover system and served as the Project Manager for the construction project. The ARCADIS Construction & Environmental Services group (CES) served as the General Contractor and completed earthwork activities for the project and American Environmental Group, Ltd. (AEG) of Richfield, Ohio installed the geosynthetic components of the cover system. Field and laboratory testing of soils was conducted by AMEC Environment & Infrastructure (AMEC), Inc. of El Paso, Texas. Laboratory testing of geosynthetic materials for conformance analysis was conducted by TRI Environmental, Inc. (TRI) of Austin, Texas. CQA surveying was completed by Land-Mark Professional Surveying, Inc. (Land-Mark) of El Paso, Texas. Malcolm Pirnie performed CQA monitoring, data review, field documentation and prepared this report.

Cell 3 cover reconstruction included the following:

- Removal of existing sandy clay cover.
- Removal of the existing temporary cover system from bottom to top, geosynthetic clay liner (GCL), 40 mil textured linear low-density polyethylene (LLDPE) geomembrane, and double sided geocomposite.

- Repair of HDPE baseliner geosynthetic materials from damage caused from cover removal.
- Excavation of Category I material to approximate elevation 3,787 feet. The Category I material was disposed in Cell 4.
- Placement of 18-inch-thick foundation layer.
- Installation of permanent cover system from bottom to top, GCL, 40 mil LLDPE geomembrane, nonwoven geotextile.
- Placement of 18-inch-thick layer of clean 1-inch minus soil cover material.

1.3. Report Organization

This CQA Report is organized as follows:

- Design clarifications and changes are presented in Section 2.
- An overview of the construction activities and a description of the CQA monitoring and testing activities performed during placement of the prepared foundation (18-inch-thick subgrade layer beneath the geosynthetic components of the cover system) are provided in Section 3.
- An overview of the construction activities and a description of the CQA monitoring and testing activities performed during placement of the soil cover material (18-inch-thick layer over the geosynthetic components of the cover system) are provided in Section 3.
- An overview of repair activities and description of the CQA monitoring and testing activities performed on the existing Cell 3 baseliner is presented in Section 4.
- An overview of the construction activities and a description of the CQA monitoring and testing activities performed during installation of the GCL are provided in Section 5.
- An overview of the construction activities and a description of the CQA monitoring and testing activities performed during installation of the LLDPE geomembrane are provided in Section 5.
- An overview of the construction activities and a description of the CQA monitoring and testing activities performed during installation of the nonwoven geotextile are provided in Section 5.
- A summary and conclusions of the CQA monitoring and testing activities performed by Malcolm Pirnie are presented in Section 6.

Documentation presenting the results of the CQA monitoring and testing activities performed by Malcolm Pirnie for the cover system is contained in the appendices to this report. The appendices are organized as follows:

- Design drawings/October 10, 2013 letter to TCEQ are presented in Appendix A.

- Design changes/clarifications/February 6, 2014 letter to TCEQ is presented in Appendix B.
- Representative photographic documentation of construction activities is provided in Appendix C.
- Material laboratory test results for structural fill soils, used for the foundation layer, final cover, and cover system anchor trench are provided in Appendix D.
- Geosynthetics installers' resumes are presented in Appendix E.
- Installer's Certificate of Soil Surface Acceptance is presented in Appendix F.
- Documentation associated with the GCL is provided in Appendices G and H:
 - the manufacturer's quality control (QC) documentation
 - conformance test results
- Documentation associated with the 60 mil high-density polyethylene (HDPE) geomembrane is provided in Appendices I and J:
 - the manufacturer's QC documentation
 - CQA documentation
- Documentation associated with the 40-mil LLDPE geomembrane is provided in Appendices K through M:
 - the manufacturer's QC documentation
 - conformance test results
 - CQA documentation
- Documentation associated with the nonwoven geotextile is provided in Appendices N and O:
 - the manufacturer's QC documentation
 - conformance test results
- Record drawings prepared and sealed by the CQA professional land surveyor showing the elevations of the top of subgrade and top of the prepared subgrade for thickness verification and the geomembrane panel layout for the cover system are presented in Appendix P.

1.4. Scope of Services

The scope of CQA monitoring, testing and field documentation services performed by Malcolm Pirnie during construction of the cover system for Cell 3 included the technical review of preconstruction test results, implementation of field CQA operations, technical review of field documentation, and preparation of this report. These activities were documented to satisfy the following project documents:

- “*Cell 3 Cover System, Former Smelter Site, El Paso, Texas*”, prepared by Malcolm Pirnie, 3 sheets, September 2013 and 1 sheet, January 2014 (Design Drawings) (see Appendix A and B)

- “*Material Specifications and Construction Quality Assurance Plan, Rev. 2*”, prepared for the Category I Landfill - Cell 4 by Geosyntec, January 2013; specifically Section 7-Geomembranes, Section 8-Geotextiles, Section 10-Geosynthetic Clay Liners, Section 11-CQA Surveying, Section 12-CQA Documentation (Specifications)

The following activities were performed as part of Malcolm Pirnie’s CQA services:

- Collecting samples of onsite soils and offsite soils for laboratory testing.
- Reviewing laboratory test results to verify that the soils for the new cover system met the requirements of the Design Drawings and Specifications.
- Monitoring construction of structural fill and preparation of the subgrade surface prior to installation of the GCL.
- Testing the in-situ moisture/unit weight (i.e., field moisture/density testing) of the compacted structural fill to verify that values were within the required range and met the requirements of the Design Drawings.
- Monitoring excavation of the perimeter anchor trench prior to placement of geosynthetics and subsequent backfilling of the anchor trench following the placement of geosynthetics.
- Reviewing manufacturer QC documentation and conformance test documentation for the geosynthetics (i.e., GCL, geomembrane, and nonwoven geotextile) to verify that they met the requirements of the CQA Plan.
- Tracking the geosynthetics rolls delivered to the site.
- Visually inspecting the geosynthetics rolls stored at the site to verify that the rolls had not been damaged during transportation and that the rolls were being stored in a manner that protected them from dirt, debris, and damage.
- Monitoring the deployment and seaming of GCL panels.
- Monitoring the deployment and seaming of geomembrane panels and marking damaged locations for repair.
- Monitoring geomembrane trial seaming operations and field testing of trial seams at the beginning of each seaming period.
- Monitoring geomembrane production seaming operations, including cleaning of the seam prior to welding.
- Monitoring nondestructive testing of geomembrane seams.
- Selecting geomembrane seam destructive sample locations, monitoring sample collection, monitoring field testing of seam samples, forwarding destructive samples to the offsite geosynthetics laboratory, and reviewing laboratory test results.
- Monitoring performance of geomembrane repairs and testing of the repairs.

- Monitoring placement of nonwoven geotextile.
- Monitoring sewing of nonwoven geotextile and marking locations for repair; and reviewing survey data (prepared subgrade elevations and thickness and geomembrane panel layout, including repair and destructive sample locations) provided by the CQA surveyor.

2. Design Changes & Clarifications

Three design changes and one design clarification was described in the February 6, 2014 letter to TCEQ and approved by TCEQ on February 19, 2014 (both letters presented in Appendix B). They include the following:

- Design Changes:
 1. The GCL material, Bentomat CLT, was replaced with Bentomat DN. Bentomat DN is the same material that was used for the baseliner system of Cell 3.
 2. The cover system was extended beyond and below the 3,788 feet elevation and terminated in a new anchor trench located approximately 3 feet outboard of the existing cover system anchor trench. As a result of the original Cell 3 cover system geosynthetics being removed, the Category I anchor trench was reused for the new cover system geosynthetics as shown in the cross-section depicted in Figure 2. This design change is more fully discussed in Section 3.1.
 3. The original Cell 3 cover included a double-sided geocomposite which was replaced with a 12 oz. nonwoven geotextile for the Cell 3 reconstruction. The reason for replacement of the geocomposite was because Cell 3 was originally designed to temporarily convey any infiltrating precipitation to a perimeter drain at the toe of Cell 3. The perimeter drain was no longer needed as part of the overall site drainage system due to future plans for a final soil cover system. Cell 3 will be covered with additional soil preventing infiltration and have other surface drainage components managing runoff in this area. The nonwoven geotextile will cushion and protect the geomembrane liner from potential damage during installation of the overlying soil cover material.
- Design Clarification No. 1 - The 18-inch-thick foundation layer was comprised of select unscreened material from the East Borrow Source and due diligence was taken during excavation and placement to minimize the amount of rock that exceeds 1-inch in size. After the first 12-inch-thick lift was placed and compacted with a smooth drum compactor, the surface was inspected to determine methodology was acceptable to continue for the final 6-inch-thick lift. The material was deemed acceptable and was used for the subsequent 6-inch-thick lift. The surface was inspected by the field engineer and approved prior to commencing GCL installation.

3. Earthwork Quality Assurance

3.1. Overview of Construction and CQA Activities

Construction activities commenced on October 19, 2013 with removal of the existing clean sandy clay cover. The sandy clay cover was removed, stockpiled and eventually transported to Cell 4 for use as interim cover and a small portion was used for the second lift of the Cell 3 foundation layer. The original Cell 3 cover system geosynthetics were removed. The Category I anchor trench was reused for the new cover system geosynthetics as shown in the cross-section depicted in Figure 2. On November 5, 2013, Category I material excavation and hauling to Cell 4 began. The Category I material was excavated to an elevation of approximately 3,787 feet as shown in the Design Drawings (see Appendix A). The Category I material was graded to achieve a crown along the center portion of the cell. Clean soil was excavated and transported from the East Borrow Source along with a small portion of the former Cell 3 cover material and placed as the foundation layer. In conformance with the Design Drawings, two lifts of foundation layer material were moisture conditioned and compacted to a minimum 90 percent relative compaction. The surface of the foundation layer was inspected and rocks that exceeded 1-inch size were removed and replaced with compacted one-inch minus material.

Malcolm Pirnie personnel provided monitoring and documentation of the foundation fill placement. Fill soils were placed and compacted in horizontal lifts. In general, the soil was transported to the work area in 40-ton (T) articulated haul trucks and was spread by a dozer in approximately 6-inch- to 12-inch-thick loose lifts. Moisture was added utilizing water trucks as needed during placement. Compaction of the soil within each lift was accomplished utilizing a Cat CS56 pad foot compactor and loaded 40T haul trucks.

The soil was compacted to minimum 90 percent of its Modified Proctor maximum dry unit weight at moisture contents at -2 to +2 percent of the Modified Proctor optimum moisture content. The degree of compaction and moisture content were verified in the field at various locations by AMEC. Verification was achieved using a nuclear density gauge, as described in Section 3.4.

After the foundation layer was installed and approved, the GCL, geomembrane and geotextile layers were installed (see Section 5). The 12 oz. nonwoven geotextile was covered by two lifts of 3/8-inch minus material imported from Jobe Materials, L.P. which conformed to the 1-inch minus requirement in the Design Drawings. The two lifts of soil cover were track-packed with a dozer as required in the Design Drawings.

Land-Mark surveyed the top of the soil layers (foundation layer and soil cover material), at designated control points, to verify that the required cover thicknesses were achieved within a tolerance of ± 0.1 feet. A sealed record drawing prepared by Land-Mark is provided in Appendix P.

3.2. Material Testing

Structural fill materials used for the foundation layer, cover material, and cover system anchor trench were sampled by Malcolm Pirnie and tested by an AMEC. The laboratory testing included particle size analysis, Modified Proctor, moisture content, and Atterberg limits. The laboratory test results are summarized in Table 1 and test reports for the collected samples are included in Appendix D.

3.3. Field Monitoring Activities

As part of the field monitoring program, Malcolm Pirnie observed the following construction activities:

- Existing cover system removal
- Grading of waste subgrade
- Soil layer placement and compaction

3.4. Field Soil Testing Activities

As part of the CQA activities, AMEC performed in-situ moisture/density tests on compacted lifts of soil fill (foundation layer and anchor trench). The tests were performed in accordance with ASTM D6938. Results of the field moisture/density tests are summarized in Table 2.

The soils used for the foundation layer were compacted to minimum 90 percent of maximum dry density at -2 to +2 percent of optimum moisture content, as determined by Modified Proctor test results. The anchor trench backfill was compacted to minimum 90 percent of maximum dry density.

The degree of compaction and moisture content were verified in the field at various locations by AMEC using a nuclear density gauge. A total of 15 passing field moisture/density tests were performed on the approximately 4,500 cubic yards (CY) of foundation material and a total of six passing field moisture/density tests were performed on the approximately 160 CY of anchor trench backfill. The number of completed field moisture/density tests exceeds the one test per 1,000 CY frequency specified in the Specifications.

4. Repair Activities

While removing the temporary Cell 3 cover material, the excavator bucket punctured the existing baseliner 60-mil HDPE geomembrane in 29 locations along the existing perimeter anchor trench, beyond the slope crest of the baseliner. In three of the 29 locations, the GCL was also punctured. Repairs to the geomembrane and GCL components of the Cell 3 baseliner system were completed on April 7 and 8, 2014.

AEG completed the repairs in accordance with the Specifications. Resumes of AEG's repair crew are provided in Appendix E. Construction oversight and CQA observation activities were performed by Malcolm Pirnie representatives Bill Sabatka and Rachel Jennings.

In areas where the GCL needed repair, the puncture in the overlying geomembrane was widened to evaluate the damage to the GCL. A piece of GCL was placed over the location to measure and ensure a minimum 1-foot overlap beyond the edge of the GCL puncture in all directions. The GCL was then inserted beneath the geomembrane opening and spread flat.

The GCL material used for the repair was manufactured by CETCO® of Hoffman Estates, Illinois. Manufacturing quality control documentation and conformance test results for the GCL material are provided in Appendices G and H, respectively.

Prior to extrusion welding the geomembrane repairs, AEG prepared trial seams in accordance with the Specifications. The trial seams were field tested by AEG in the presence of Malcolm Pirnie using a field tensiometer to ensure that the resulting peel and shear strength values met or exceeded the requirements listed in the Specifications. Results of the trial seam testing of the 60 mil HDPE geomembrane are presented in Appendix J.

Geomembrane repairs were performed by placing a piece of 60 mil HDPE geomembrane over the repair location to measure and ensure a minimum overlap of 6 inches beyond the edge of the defect. The geomembrane repair was then temporarily heat bonded over the geomembrane puncture to hold the repair in place. The edges of the repair and the existing geomembrane were cleaned by mechanical abrasion and inspected for moisture and excess debris in accordance with the Specifications. The perimeter of the repair was then sealed to the existing geomembrane with an extrusion weld.

Geomembrane repairs were non-destructively tested by AEG and monitored by Malcolm Pirnie, using a vacuum box. Results of the non-destructive testing performed during the repair of the baseliner system geomembrane are presented in Appendix J.

The 60-mil geomembrane material used for the repairs was manufactured by GSE Lining Technology, LLC. (GSE) of Houston, Texas. Manufacturing quality control documentation for the 60 mil HDPE geomembrane is provided in Appendix I.

The locations of the baseliner system geomembrane repairs are included in Appendix P.

Representative photographic documentation of the repairs to the baseliner geomembrane is provided in Appendix C.

5. Cover System Geosynthetics Quality Assurance

5.1. Overview of Construction and CQA Activities

The cover system for Cell 3 consists of the following components, from bottom to top:

- 18-inch-thick prepared foundation;
- reinforced GCL with a hydraulic conductivity $\leq 5 \times 10^{-9}$ cm/s;
- 40-mil-thick textured LLDPE geomembrane;
- 12 oz. nonwoven geotextile; and
- 18-inch-thick soil cover material.

The cover system geosynthetics were installed by AEG from April 7, 2014 through April 11, 2014. As a result of the existing Cell 3 cover system geosynthetics being entirely removed, its anchor trench location was reused for the new cover system geosynthetics.

Details regarding geosynthetic material testing and installation is provided below in Sections 5.2 and 5.3.

5.2. Manufacturer Quality Control and Conformance Testing

5.2.1. Geosynthetic Clay Liner

The GCL used for Cell 3 was manufactured by CETCO® of Hoffman Estates, Illinois. A total of 43 GCL rolls were delivered to site for the project. Each roll of GCL measured approximately 14.5 feet wide by 150 feet long. Thus, the total area of the delivered rolls was approximately 93,525 square feet (SF). It should be noted that approximately nine rolls of GCL were not used during cover construction due to the use of the existing cover system anchor trench location. Results of the manufacturer's QC testing and the conformance testing for the GCL rolls are provided in Appendices G and H, respectively.

Based on the Specifications, GCL conformance testing was to be performed at a frequency of one sample per 250,000 SF (with minimum one per lot). Malcolm Pirnie obtained and shipped two GCL samples to TRI for conformance testing. Based on the conformance test results, both samples met the specified testing values provided in the Specifications. Per the required test frequency and quantity of material delivered to the site and due to the material being produced from two lots, two conformance tests were required. Therefore, the number of conformance tests performed on the GCL met the requirements of the Specifications.

Based on the results of the manufacturer QC documentation and the conformance tests, the GCL rolls used to construct the Cell 3 cover system met the requirements of the Specifications.

5.2.2. LLDPE Geomembrane

The 40-mil textured LLDPE geomembrane used for the cover system of Cell 3 was manufactured by AGRU America of Georgetown, South Carolina. A total of six rolls of 40 mil textured LLDPE geomembrane were delivered to site and all but half of one roll was used for the project. Each roll of geomembrane measured approximately 23 feet wide by 710 feet long. Thus, the total area of the delivered rolls was approximately 97,980 SF. Results of the manufacturer's QC testing and the conformance testing for the geomembrane rolls are provided in Appendices K and L, respectively.

Based on the Specifications, geomembrane conformance testing was to be performed at a frequency of one sample per 100,000 SF (with minimum one per lot). Malcolm Pirnie obtained and shipped one geomembrane sample to TRI for conformance testing. Based on the conformance test results, the sample met the specified testing values provided in the Specifications. Per the required test frequency and quantity of material delivered to the site, only one conformance test was required. Therefore, the number of conformance tests performed on the geomembrane met the requirements of the Specifications. Interface shear strength testing (LLDPE/GCL) was also performed as required by the Specifications as part of the conformance testing process.

Based on the results of the manufacturer QC documentation and the conformance tests, the geomembrane rolls used to construct the Cell 3 cover system met the requirements of the Specifications with the exception of one of two interface shear strength tests using a normal stress of 300 psf which achieved a Corrected Large Displacement Shear Stress of 126 psf (required is 140 psf). The other two normal stress tests for the same sample, performed at 5,000 and 10,000 psf, exceeded the required minimum "Peak" and "Large Displacement" shear strengths of the Specifications. Since the Cell 3 cover system will be covered by a clean soil cover/cap having a total approximate thickness of 4 feet, Malcolm Pirnie does not consider the one failed interface shear strength test, performed at normal stress of 300 psf, to have a significant impact to overall stability.

5.2.3. Nonwoven Geotextile

The 12 oz. nonwoven geotextile used for the cover system of Cell 3 was manufactured by GSE of Houston, Texas. A total of 19 rolls of 12 oz. nonwoven geotextile were delivered to the site. It should be noted that approximately six rolls of geotextile were not used during cover construction due to the use of the existing cover system anchor trench location. Each roll of geotextile measured approximately 15 feet wide by 400 feet long. Thus, the total area of the delivered rolls was approximately 114,000 SF. Results of the manufacturer's QC testing and the conformance testing for the geotextile are provided in Appendices N and O, respectively.

Based on the Specifications, geotextile conformance testing was to be performed at a frequency of one sample per 250,000 SF (with minimum one per lot). Malcolm Pirnie obtained and shipped one geotextile sample to TRI for conformance testing. Based on the conformance test results, the sample met the specified testing values provided in the Specifications. Per the required test frequency and quantity of material delivered to the site, only one conformance test was required. Therefore, the number of conformance tests performed on the geotextile met the requirements of the Specifications.

Based on the results of the manufacturer QC documentation and the conformance tests, the geotextile rolls used to construct the Cell 3 cover system met the requirements of the Specifications.

5.3. Cover System Geosynthetics Installation

Upon delivery to the site, the geosynthetic materials were unloaded at a designated covered, concrete area near Cell 3 and stacked two rolls high. Malcolm Pirnie performed an inventory of all delivered geosynthetic materials to verify that the roll numbers matched the approved manufacturer's QC documentation.

Prior to installation of geosynthetics over the prepared subgrade, the surface of the subgrade was inspected by AEG and Malcolm Pirnie to confirm that it was smooth and uniform, and free of irregularities, dimples, loose soil, or abrupt changes in grade. The prepared subgrade was smooth drum rolled by CES and surveyed by Land-Mark. A "Certificate of Soil Surface Acceptance" was signed by AEG and Malcolm Pirnie and is provided in Appendix F.

The following sections provide additional information related to the installation of the Cell 3 cover system geosynthetics.

5.3.1. Geosynthetic Clay Liner

Installation of GCL over the prepared subgrade began on April 7, 2014. A forklift with a spreader bar was used to transport rolls of GCL to the work area.

GCL was deployed along the plateau and the sideslopes of Cell 3 by positioning the roll over the anchor trench on one side of the cell and using a Skidsteer positioned on the opposite side of the cell with a winch system attached to the material, pulling the GCL off the roll and across the cell with the aid of several laborers. Adjacent GCL panels were overlapped a minimum of 6 inches along longitudinal seams and a minimum 12 inches along transverse seams in accordance with manufacturer's specifications.

Supplemental bentonite was applied along the length of transverse seams in accordance with the manufacturer's recommendations. All GCL seams were heat bonded to hold the GCL in place when deploying the overlying LLDPE geomembrane. GCL seams were monitored by Malcolm Pirnie for workmanship and continuity.

Sand bags were used temporarily to secure the GCL along the sideslopes and plateau area of the cell and were removed prior to placement of the overlying LLDPE geomembrane.

5.3.2. Geomembrane

Installation of the 40-mil textured LLDPE geomembrane began on April 8, 2014. A forklift with a spreader bar was used to transport rolls of geomembrane to the work area. Occasionally, rolls of geomembrane were temporarily stored adjacent to the construction area prior to deployment.

Geomembrane was deployed along the plateau and the sideslopes of Cell 3 by positioning the roll over the anchor trench on one side of the cell and using a Skidsteer positioned on the opposite side of the cell with a winch system attached to the material pulling the geomembrane material off the roll and across the cell with the aid of several laborers. After the panels were placed, they were overlapped in accordance with the Specifications. The Panel Placement Log is provided in Appendix M.

Prior to production seaming, AEG prepared trial seams, in accordance with the Specifications for each combination of seaming equipment and operator used during the work period. The trial seams were field tested by AEG in the presence of Malcolm Pirnie using a field tensiometer to confirm that the resulting peel and shear strength values met or exceeded the requirements listed in the Specifications. Results of the trial seam testing of the 40-mil LLDPE geomembrane are documented in the Trial Seam Log provided in Appendix M.

Following Malcolm Pirnie's approval of the trial seams, AEG inspected and verified that the geomembrane overlap areas were clean and free of moisture, dust, dirt, and debris of any kind. Once cleaned, production seams were fabricated using double-track fusion welders. Seaming operations were monitored by Malcolm Pirnie for workmanship and continuity. The integrity of double-track fusion seams were evaluated in the field by air pressure testing the seams in accordance with the Specifications and ASTM D5820. All non-destructive testing was performed by AEG and monitored by Malcolm Pirnie. The Production Seaming Log, which includes the results of the air pressure testing, is provided in Appendix M.

Destructive samples were obtained in accordance with the Specifications to further evaluate the integrity of the field seams. Based on the total production seam length of 3,509 feet and a minimum sample frequency of one per 500 linear feet per welder, the required number of destructive samples was approximately eight. Consistent with the required frequency provided in the Specifications, Malcolm Pirnie identified eight destructive sample locations. Each destructive sample was divided into three specimen and utilized as follows:

- One specimen was field tested by AEG for peel and shear strength using a calibrated field tensiometer.
- One specimen was archived by Malcolm Pirnie.
- One specimen was sent to TRI to be independently tested for peel and shear strength.

Passing results were obtained from all eight destructive samples designated as DS-1 through DS-8. The field and laboratory destructive test results are documented in the Destructive Test Log provided in Appendix M.

Geomembrane repairs were performed at intersections of three or more panels, seam destructive sample locations, and where geomembrane defects were identified. Repair activities included placing a piece of 40 mil LLDPE geomembrane over the repair location and ensuring a minimum overlap of 6 inches beyond the edge of the defect. The geomembrane repair was then temporarily heat bonded over the geomembrane puncture to hold the repair in place. The edges of the repair and the existing geomembrane were cleaned by mechanical abrasion and inspected for moisture and excess debris in accordance with the Specifications. The perimeter of the repair was then sealed to the existing geomembrane with an extrusion weld. In cases where large wrinkles developed, the geomembrane was cut along the ridge of the wrinkle to achieve a flat overlap and the cut area was temporarily heat bonded, cleaned and sealed with an extrusion weld. Extrusion welds were also used to repair minor irregularities or surface flaws. The integrity of the extrusion welded repairs was evaluated in the field by vacuum box testing the weld in accordance with the Specifications and ASTM D 5641. All non-destructive testing was performed by AEG and monitored by Malcolm Pirnie. Geomembrane repair locations and nondestructive testing of the repairs are documented on the Repair Summary Log provided in Appendix M.

After the geomembrane was deployed, seamed, tested, repaired, and found to meet the requirements of the Specifications, Land-Mark surveyed the geomembrane and created a record drawing. This drawing, which is provided in Appendix P, includes the geomembrane panels, destructive sample locations, and repair locations documented by Malcolm Pirnie.

Sand bags were used temporarily to secure the geomembrane along the sideslopes and plateau area of the cell and were removed prior to placement of the overlying nonwoven geotextile.

5.3.3. Nonwoven Geotextile

Installation of the 12 oz. nonwoven geotextile by AEG began on April 9, 2014 and was completed on April 11, 2014. A forklift with a spreader bar was used to transport rolls of the material to the work area.

Nonwoven geotextile was deployed along the plateau and the sideslopes of Cell 3 by positioning the roll over the anchor trench on one side of the cell and using a Skidsteer positioned on the opposite side of the cell with a winch system attached to the material pulling the geotextile off the roll and across the cell with the aid of several laborers. Adjacent geotextile panels were overlapped a minimum of 12 inches in both machine and transverse directions in accordance with manufacturer's recommendations. All geotextile seams were sewn together using polyester thread, a flat "prayer" seam and one row of stitching. Geotextile seams were monitored by Malcolm Pirnie for workmanship and continuity.

Sand bags were used to temporarily secure the geotextile along the sideslopes and plateau area of the cell and were removed prior to placement of the overlying cover materials.

6. Conclusion

The reconstruction of the cover system for the Category I Landfill - Cell 3 at the Site in El Paso, Texas observations and testing occurred from October 19, 2013 to June 5, 2014. Malcolm Pirnie provided CQA during construction activities. This report documents the CQA activities conducted by Malcolm Pirnie during reconstruction of the Cell 3 cover system.

Based on the results of the monitoring and testing program conducted by Malcolm Pirnie, the new Cell 3 cover system was constructed in general accordance with the requirements of the Specifications, Design Drawings, and standard of practice.