# SQUAW GULCH VALLEY LEACH FACILITY
# PHASE 2A PART 2
# RECORD OF CONSTRUCTION REPORT

**Prepared for:**
**Cripple Creek & Victor Gold Mining Company**
**P.O. Box 191**
**Victor, CO 80860**

**Prepared by:**
**NewFields Mining Design & Technical Services**
**9400 Station Street, Suite 300**
**Lone Tree, Colorado 80124**

**NewFields Job No. 475.0106.032**
**October 29, 2019** ***(Revision 2)***

NewFields
Perspective. Vision. Solutions.

## TABLE OF CONTENTS



**ISSUED FOR CONSTRUCTION DRAWINGS**

| | |
|---|---|
| A0 | COVER SHEET |
| A10 | PROJECT SITE PLAN VIEW |
| A15 | PROJECT MATERIAL STOCKPILE AREAS |
| A20 | EXISTING SITE CONDITIONS |
| A30 | HISTORIC UNDERGROUND WORKINGS |
| A32 | TABLE OF HISTORIC UNDERGROUND WORKINGS SHEET 1 OF 3 |
| A34 | TABLE OF HISTORIC UNDERGROUND WORKINGS SHEET 2 OF 3 |
| A36 | TABLE OF HISTORIC UNDERGROUND WORKINGS SHEET 3 OF 3 |
| A38 | UNDERGROUND WORKING REMEDIATION TYPICAL DETAILS |
| A40 | PHASE 2A GRADING PLAN |
| A42 | PHASE 2A PERIMETER ACCESS ROAD PLAN AND PROFILE |
| A43 | PHASE 2A PERIMETER ACCESS ROAD SECTIONS AND DETAILS |
| A44 | PHASE 2B GRADING PLAN |
| A46 | PHASE 2A SQUAW GULCH GRADING PLAN ISOPACH |
| A48 | PHASE 2B SQUAW GULCH GRADING PLAN ISOPACH |
| A50 | OVERALL LINER LIMITS |
| A60 | VALLEY LEACH FACILITY SECTIONS AND DETAILS SHEET 1 OF 2 |
| A62 | VALLEY LEACH FACILITY SECTIONS AND DETAILS SHEET 2 OF 2 |
| A64 | UNDERDRAIN DETAIL SHEET |
| A68 | LEAK DETECTION & EROSION CONTROL DETAILS |
| A70 | PHASE 2A HIGH VOLUME SOLUTION CONCENTRATION PIPING LAYOUT |
| A72 | PHASE 2B HIGH VOLUME SOLUTION CONCENTRATION PIPING LAYOUT |
| A74 | HIGH VOLUME SOLUTION COLLECTION SYSTEM DETAILS |

## RECORD OF CONSTRUCTION DRAWINGS

- Sheet No. 1 of 4 — SOIL LINER FILL AS-BUILT 1 OF 4
- Sheet No. 2 of 4 — SOIL LINER FILL AS-BUILT 2 OF 4
- Sheet No. 3 of 4 — SOIL LINER FILL AS-BUILT 3 OF 4
- Sheet No. 4 of 4 — SOIL LINER FILL AS-BUILT 4 OF 4
- Sheet No. 1 of 4 — LEAK DETECTION TRENCH AS-BUILT
- Sheet No. 1 of 4 — HIGH VOLUME COLLECTION PIPE AS-BUILT 1 OF 4
- Sheet No. 2 of 4 — HIGH VOLUME COLLECTION PIPE AS-BUILT 2 OF 4
- Sheet No. 3 of 4 — HIGH VOLUME COLLECTION PIPE AS-BUILT 3 OF 4
- Sheet No. 4 of 4 — HIGH VOLUME COLLECTION PIPE AS-BUILT 4 OF 4
- DRAWING NO. 10 — GEOMEMBRANE PANEL LAYOUT AS-BUILT
- DRAWING NO. 11 — DRAIN COVER FILL AS-BUILT ISOPACH

## LIST OF TABLES



## LIST OF FIGURES



## LIST OF APPENDICES

## 1. INTRODUCTION

NewFields Mining Design & Technical Services (NewFields) was commissioned by the Cripple Creek & Victor Gold Mining Company (CC&V), which is owned and managed by Newmont Goldcorp, to provide Construction Quality Assurance and Quality Control (QA/QC) for the construction of the Squaw Gulch Valley Leach Facility (VLF) Phase 2 project. The project is located in Teller County, Colorado, just east of the city of Cripple Creek. The Squaw Gulch VLF is included in the Cresson Project, which is a gold mining and ore processing facility comprised of surface mines, crushers, lined VLFs, gold recovery plants, and associated infrastructure. The Cresson project was designed and constructed to meet or exceed the requirements established by C.R.S. §34 32 101 et seq. and regulations promulgated there under by the Mined Land Reclamation Board (MLRB). The work associated with the Cresson Project is being performed under specific criteria established in Amendment No. 10 of Permit Number M-1980-244, as approved by the MLRB.

This Record of Construction (ROC) report documents the QA/QC services for Squaw Gulch VLF Project through Phase 2A Part 2. The majority of the earthworks for the Squaw Gulch VLF Phase 2 facility extending to the subgrade below the Soil Liner Fill (SLF) was constructed simultaneously with the Squaw Gulch VLF Phase 1. Additional work activity, including leak detection installation, SLF placement, and geomembrane installation, was performed simultaneously with Phase 2A Part 1 construction. The following ROC reports should be referenced for Phase 2 documentation that was completed concurrently with Phase 1 and Phase 2A Part 1:

*"Squaw Gulch VLF Pregnant Solution Storage Area Project Final Report*," submitted by AMEC in November 2014

*"Squaw Gulch VLF Phase 1 (9,450' to 9,500' Bench) Final Report*," submitted by AMEC in October 2015

*"Squaw Gulch VLF Phase 1 (9,550-foot Elevation Bench to Completed Areas Outlined on Figure 2) Final Report*," submitted by AMEC in January 2016

"Squaw Gulch Valley Leach Facility Phase 1 Completion Record of Construction Report," submitted by NewFields in October 2016

"Squaw Gulch Valley Leach Facility Phase 2A Part 1 Record of Construction Report," submitted by NewFields in July 2019

The attached Figures 1 and 2 present the general site location and the Squaw Gulch VLF Phases, and the Phase 2A Part 2 certification limits.

## 1.1. Project Description

The Squaw Gulch VLF is located north of the current Arequa VLF in an area referred to as Squaw Gulch and is referred to as the Squaw Gulch VLF as part of the Mine Life Extension 2 Project. This area encompasses Squaw, Anaconda, and Swede Gulches. The Squaw Gulch VLF Phase 2A Part 2 area is a continuation of construction. Construction associated with this certification report was completed in September, 2019.

The majority of the earthworks construction to the extent of the finished subgrade elevation below the Soil Liner Fill (SLF) was performed concurrently with the Squaw Gulch VLF Phase 1 work prior to 2019. All work performed on Phase 2A Part 2 prior to 2019 is presented in the previously submitted certification report submitted in July, 2019. The Squaw Gulch VLF Phase 2A Part 2 area was constructed placing SLF, overlain with an 80 mil Linear Low Density Polyethylene (LLDPE) double sided micro-spike (DSMS) geomembrane, and covered with Drain Cover Fill (DCF). Construction within this area was completed on September 24, 2019. The Squaw Gulch VLF Phase 2A grading plan and typical VLF cross sections are shown on Drawings A40 and A60/A62 in the Issued for Construction (IFC) drawing set, respectively.

## 1.2. Parties Involved

Work performed during the Squaw Gulch VLF Phase 2A Part 2 project was completed by several parties. Responsible parties involved in the project are listed below:

Project management was provided by CC&V. Messrs. Steve Blaskovich, Jeff Gaul, and John Shiflett represented CC&V as the Construction Manager and Construction Superintendents, respectively.

Tezak Heavy Equipment Co., Inc. (Tezak) was contracted by CC&V as the general contractor responsible for all construction activities after January 2019 for the Phase 2A project.

Edward-James Surveying, Inc. (EJS) performed surveying for all construction activities performed by Tezak.

Tetra Tech, formerly known as American Environmental Group, Ltd. (AEG), was subcontracted by Tezak to perform the Phase 2A geomembrane installation.

NewFields provided field engineering and construction QA/QC testing and inspection for the Phase 2A project. A Staff Schedule of NewFields personnel is presented in Appendix A.

Foresight West Surveying, Inc. (Foresight) performed third party surveying.

Agru America Inc. (Agru) manufactured and delivered geomembrane materials.

Skaps Industries manufactured and delivered all the geotextile materials.

Tensar International Corporation manufactured and delivered all geogrid materials.

Texas Research International, Inc. (TRI) was subcontracted by NewFields to perform third party conformance testing during the geosynthetics manufacturing.

### 1.3. Construction Quality Assurance (CQA) / Construction Quality Control (CQC)

CC&V contracted NewFields to perform all CQA and CQC activities for the remainder of the Squaw Gulch VLF Phase 2A Part 2 project. All CQA records of testing are presented in the Tables and Appendices attached to this report.

### 1.4. Design Drawings and Technical Specifications

The Phase 2A Part 2 Squaw Gulch VLF was constructed in general accordance with the Design Drawings and Technical Specifications from the report titled "*Cripple Creek & Victor Gold Mining Company, Squaw Gulch Valley Leach Facility Design,"* issued by AMEC, September 1, 2011. NewFields developed updated issued for construction drawings dated September 2018 and the Technical Specifications were updated in August 2016. The IFC Drawings and ROC Drawings are attached to this document. Survey for the Squaw Gulch VLF Phase 2A Part 2 ROC drawings was performed by EJS and Foresight. Copies of the Surveyor's Professional Licenses are presented in Appendix B. The Technical Specifications are presented in Appendix C and the earthwork material specifications are summarized in Table 1. Any deviations from the IFC drawings or project Technical Specifications are discussed in Section 4 of this report.

### 1.5. Use of this Report

This report has been prepared exclusively for Cripple Creek & Victor Gold Mining Company. No third party, other than the design team (NewFields), shall be entitled to rely on any information, conclusions, opinions, or other information contained herein without the express written consent of CC&V. Any third party that does rely on any information, conclusions, opinions, or other information contained herein without the express written consent of CC&V understands and acknowledges that NewFields is not liable for any claim arising out of such use.

## 2. SQUAW GULCH VLF CONSTRUCTION ACTIVITIES

Tezak performed construction activities during the Squaw Gulch VLF project, excluding geomembrane installation.

Equipment used to perform these activities is listed below:

CAT 14G Motor Grader

CAT D6 Low Ground Pressure (LGP) Dozer

CAT D6 LGP Dozers equipped with Global Positioning System (GPS)

CAT D8 Dozer

| | |
|---|---|
| CAT D10 Dozer | CAT 330 Excavator |
| CAT 259 Skid steer | CAT336 Excavator w/ Roller Attachment |
| CAT 279 Skid steer | CAT 345 Excavator |
| CAT IT28 Loader | John Deere 470 Excavator |
| CAT 966 Loader | John Deere 35 Excavator |
| CAT 988 Loader | CAT 730 Haul Trucks |
| John Deere 744k Loader | Volvo A30 Haul Truck |
| Komatsu PC78MR-6 | CAT 740 Haul Trucks |
| CAT CS56 Smooth Drum Compactor | Edge TRT622 Trommel |
| CAT CP56 Sheepsfoot Drum Compactor | Tandem Axle Water Trucks |
| CAT CS76 Smooth Drum Compactor | Broce 350 Series Sweeper |
| CAT 320 Excavator | CAT 740 Water Truck |
| CAT 329 Excavator | CAT 773 Water Wagon |

## 2.1. Clearing and Grubbing

The footprint of the Phase 2A Part 2 Squaw Gulch VLF was stripped of all deleterious materials. Any soil containing vegetation was removed and placed in several site topsoil stockpiles designated by CC&V. All cleared areas were inspected by the CQA Monitor to ensure that all deleterious material was removed prior to further construction activities.

## 2.2. Site Grading

Approximately 130,140 cy of Structural Fill (SF) material was used to grade the site within the limits of Squaw Gulch VLF Phase 2A. Prior to SF placement, the existing subgrade was scarified to a depth of 6 inches, moisture conditioned, and compacted, as required. The SF was then placed in 2-foot thick loose lifts, moisture conditioned as required, and compacted using a 12-ton vibratory sheepsfoot drum compactor. The entire surface of each lift was compacted with a minimum of four passes in accordance with the developed method specifications. The development of the method specifications is described in Appendix D. All subgrade preparation and SF placement associated with site grading was monitored by the CQA Monitor to ensure that it met the project Technical Specifications.

## 2.3. Subgrade Preparation

The subgrade was prepared and inspected prior to SLF placement. The exposed subgrade surface was moisture conditioned and compacted using a 12-ton sheepsfoot drum vibratory compactor

where needed. Compaction of the subgrade was performed in accordance with the applicable developed method specifications, presented in Appendix D, for a 12-ton vibratory sheepsfoot drum compactor. The CQA Monitor inspected and approved the finished subgrade surface prior to SLF placement.

## 2.4. Leak Detection Trench

Approximately 387 linear feet of leak detection trench was constructed within the Squaw Gulch VLF Phase 2A Part 2 limits in accordance with the project Technical Specifications. The Phase 2A Part 2 leak detection trench is presented in the Leak Detection Trench As-built record of construction drawing.

Detail N on IFC Drawing A68 shows the typical leak detection trench section. Per Detail N, a minimum one foot by one-foot trench was excavated and lined with 40 mil smooth LLDPE geomembrane. The geomembrane was installed in long strips with a 5-foot overlap and was overlain by a 12 oz/yd$^2$ non-woven geotextile. A 4-inch diameter perforated corrugated polyethylene pipe (CPeP) was then placed in the trench. The trench was backfilled with Leak Detection Fill (LDF) and the geotextile was wrapped around the fill with a minimum 1-foot overlap. A minimum slope of 0.5 percent was maintained along the entire length of the trench. The CQA Monitor observed all leak detection trench installation to date.

The Squaw Gulch VLF Phase 2A Part 2 leak detection trench was constructed by installing approximately 1,935 square feet of 40 mil smooth LLDPE geomembrane, 1,935 square feet of 12 oz/yd$^2$ non-woven geotextile, 387 linear feet of 4-inch CPeP and 14 cy of LDF.

## 2.5. Soil Liner Fill

Approximately 64,430 cy of SLF was placed within the Squaw Gulch VLF Phase 2A Part 2 area. The as-built SLF surface is presented in Soil Liner Fill As-Built record of construction drawings.

Materials from the Cameron borrow and WHEX pit were processed through a custom-designed rotary mill and screen in order to remove oversized rock and uniformly condition the material. After processing, the SLF was stockpiled in designated stockpiles around the site.

The contractor used 30- and 40-ton articulated haul trucks to haul SLF from the local stockpiles to the Squaw Gulch VLF Phase 2A Part 2 footprint. The material was spread using LGP dozers equipped with GPS, and moisture conditioned in place by tandem-axel water trucks and laborers. A 12- and 19-ton smooth drum vibratory compactor, track-mounted skid steer with roller attachment, and excavator with smooth drum roller attachment were utilized to compact the SLF to a minimum thickness of 12 inches. The specified minimum density was 95 percent of the

maximum dry density at minus 2 percent to plus 3 percent of optimum moisture content as determined by American Society for Testing and Materials (ASTM) D698.

Laboratory testing, moisture content verification, nuclear density testing, depth verification, and visual inspection of the SLF were performed by the CQA Monitor prior to approval for geomembrane deployment. If deficient areas of the SLF were encountered, the area was reworked and retested until the area was compliant with the project Technical Specifications. All SLF was inspected and approved by the CQA Monitor, CC&V, Tezak, and Tetra Tech prior to geomembrane deployment. SLF acceptance is discussed further in Section 3.2.3 and Section 3.4.2. SLF acceptance forms are provided in Appendix E.

## 2.6. Geomembrane

Tetra Tech installed approximately 1,739,843 square feet of 80 mil LLDPE DSMS geomembrane within the Squaw Gulch VLF Phase 2A Part 2 area as shown on Record Drawing No. 10. The edge of geomembrane along the eastern end of the project limits, which will tie in with future construction phases, was protected by burying it within the SLF.

Forklifts were used to transport and deploy the geomembrane panels parallel to the slopes to minimize stress on seams. Double-wedge fusion welding was the primary method of geomembrane seaming. Extrusion welding methods were used to perform tie-in seaming, defect repairs, and detail activities. Continuity conformance of fusion welded seams was performed using pressure testing methods, while extrusion welded seams and repairs were non-destructively tested using vacuum testing methods. Destructive testing was performed for both seaming types. The CQA Monitor observed and documented all geomembrane installation and repair activities.

## 2.7. Anchor Trench

The geomembrane was anchored at the limits of Phase 2A Part 2 area in a minimum 2-foot wide and 3-foot deep anchor trench. Once non-destructive testing and repairs were completed and approved, the anchor trench was backfilled by Tezak in accordance with the project Technical Specifications. The backfill material was placed in 12-inch thick lifts and compacted by a smooth drum vibratory compactor. In areas where future geomembrane installation would cover the anchor trench, SLF was used to backfill the top 12 inches of the anchor trench.

## 2.8. High Volume Solution Collection System (HVSCS) Piping

High Volume Collection Pipe As-Built record of construction drawings present the as-built layouts of the HVSCS piping installed within the Squaw Gulch VLF Phase 2A Part 2 area. IFC Drawings A70 and A74 present the HVSCS layout and detail, respectively.

All HVSCS piping was installed on approved geomembrane and kept in place during DCF placement. Approximately 24,349 linear feet of 4-inch diameter perforated CPeP, 1,089 linear feet of 8-inch diameter perforated CPeP, 3,900 linear feet of 12-inch diameter perforated CPeP, and 454 linear feet of 15-inch diameter perforated CPeP was installed.

## 2.9. Drain Cover Fill

Approximately 128,860 cy of DCF was placed within the Squaw Gulch VLF Phase 2A Part 2 area in accordance with the project Technical Specifications. Crushed overburden material from the Cresson Project was processed between September 2013 and November 2014. All oversized material was removed from the overburden by screening the material over a vibrating 1 ½ inch screen. After processing, the DCF was stockpiled north of the Squaw Gulch VLF in an area designated by CC&V.

Tezak used 30- and 40-ton articulated haul trucks to haul DCF from the stockpile to the Squaw Gulch VLF Phase 2A Part 2 footprint. The DCF was placed in a 2-foot lift on approved geomembrane by LGP dozers. The DCF as-built boundary is shown on Record Drawing No. 11.

Haul routes consisted of 4-foot lifts that were spread into 2-foot lifts upon finish grading the area. All DCF was placed in an uphill direction on slopes steeper than 4H:1V using dozers with GPS capability.

A CQA Monitor was present during all DCF placement activities to verify that the DCF was placed in accordance with the project Technical Specifications and that no damage to the geomembrane occurred. If any damage to the geomembrane was noted, work activities were paused, and the damage was repaired prior to resuming DCF placement. The DCF As-Built Isopach is shown on Record Drawing No. 11.

## 2.10. Miscellaneous

After geomembrane was approved and DCF was placed within the eastern end of the project, a mine haul truck mistakenly drove approximately 1,300 feet into the project limits before it was stopped. The haul truck was guided back out along its path with the assistance of a spotter. The extents of the haul truck's path were surveyed and a buffer was added to cover approximately one and a half times the width of the haul truck. All geomembrane within this designated area was removed and replaced. The CQA Monitor observed both the removal of DCF from the surface and the exposure of geomembrane. As the geomembrane within the designated area was removed, the underlying SLF was inspected, tested, and re-approved prior to replacing with new geomembrane. All geomembrane installation within this area was documented and is included in Appendix J. The CQA Monitor then observed the replacement of DCF over the geomembrane.

## 3. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC activities were performed by the CQA Monitor for all shifts during the Squaw Gulch VLF project. An office and field laboratory was used to organize data and perform necessary laboratory testing onsite. QA/QC activities performed included: monitoring all aspects of construction, inspection and approval of all project components, laboratory testing of soils and geomembrane, field testing of soils and geomembrane, documentation of construction and QA/QC activities.

Daily and weekly construction progress reports were generated and submitted to CC&V and the Engineer of Record (EOR). The weekly construction progress reports are presented in Appendix F. Photographs of construction activities were taken by the CQA Monitor throughout the Squaw Gulch VLF Phase 2A. Photographs of key construction elements are presented in Appendix G. All testing and inspections were performed in accordance with the Technical Specifications presented in Appendix C.

### 3.1. Testing Standards

The CQA Monitor completed the earthwork laboratory testing in an on-site soils laboratory to verify that all earthwork construction materials met the project Technical Specifications. Geomembrane and geotextile samples were sent to a third-party laboratory to verify that the material properties met the project technical specifications. All testing was performed in accordance with these American Society of Testing and Materials (ASTM) standards.

#### 3.1.1. Earthworks Testing Standards

- Particle size analysis (ASTM C117, C136, D1140, D6913)
- Atterberg limits (ASTM D4318)
- Laboratory moisture/density relationship (ASTM D698)
- Moisture Content (ASTM D2216)
- Flexible Wall Permeability (ASTM D5084, Method D)
- Density of soil in place by nuclear method (ASTM D6938)
- Soil Classification (ASTM D2488)

#### 3.1.2. Geomembrane Testing Standards

- Thickness (ASTM D5199/D5994)
- Density (ASTM D792, Method B)
- Carbon Black Content (ASTM D4218)

- Carbon Black Dispersion (ASTM D5596)
- Tensile Properties (ASTM D6693)
- Ultimate Elongation (ASTM D6693)
- Puncture Strength (ASTM D4833)
- Peel and Shear Strength (ASTM D6392)

#### 3.1.3. Geotextile Testing Standards

- Mass per Unit Area (ASTM D5261)
- Puncture Resistance (ASTM D4833)
- CBR Puncture (ASTM D6241)
- Apparent Opening Size (ASTM D4751)

### 3.2. Earthworks Construction Quality Assurance

All earthwork activities for the Squaw Gulch VLF Phase 2A Part 2 project were performed in accordance with the design drawings and project specifications as discussed in Section 2. The CQA Monitor observed, documented, and performed testing during material placement. This included; ensuring the proper materials were placed, fills were free of deleterious materials, lift placement was performed uniformly and on a firm and unyielding underlying layer, haulage traffic was spread across fill surfaces when practical, moisture conditioning was performed uniformly with acceptable moisture content, the proper method specification was used when applicable, and specified densities were achieved during field testing. Earthworks laboratory and field testing and frequencies are summarized in Table 2.

The CQA Monitor checked ambient temperatures and logged the daily high and low temperatures, maximum wind speeds and amount of precipitation in Table 3. If earthwork activities were performed while the ambient temperature was below 32°F, fill temperatures were monitored by the CQA Monitor to ensure no frozen material was placed. Ambient and fill temperatures are presented in Table 4.

#### 3.2.1. Structural Fill

Squaw Gulch VLF Phase 2A was constructed by placing 130,140 cy of SF. The particle size distribution and Atterberg limits testing frequencies were one sample for every 50,000 cy. A minimum of three SF samples were required to be tested for particle size and Atterberg limits based on the quantity of material placed. A total of four SF samples were tested with passing results. SF laboratory testing is summarized in Table 5 and individual test results are presented in Appendix H.1.

No laboratory compaction testing was performed on the SF placed within the Squaw Gulch VLF Phase 2 area, as all SF material contained more than 30 percent retained on the ¾-inch sieve. Density was achieved by placing the material in accordance with the method compaction specifications presented in Appendix D.

### 3.2.2. Leak Detection Fill

The Squaw Gulch VLF Phase 2A Part 2 area was constructed by placing 14 cy of LDF. The particle size distribution and Atterberg limits testing frequencies were one sample for every 10,000 cy. One LDF sample was required to be tested for particle size and Atterberg limits. One LDF sample was tested with passing results. LDF laboratory testing is summarized in Table 6 and individual test results are presented in Appendix H.2.

### 3.2.3. Soil Liner Fill

The Squaw Gulch VLF Phase 2A Part 2 area was constructed by placing 64,430 cy of SLF. The particle size distribution, Atterberg limits, laboratory compaction, and permeability testing frequencies were one sample for every 4,000 cy. A minimum of 17 SLF record samples were required to be tested for particle size distribution, Atterberg limits, laboratory compaction, and permeability testing. A total of 20 SLF record samples were tested with passing results. SLF laboratory testing is summarized in Table 7 and individual test results are presented in Appendix H.3.

The nuclear density/moisture testing frequency for SLF is one test for every 500 cy. A minimum of 129 SLF nuclear density/moisture tests were required. A total of 171 SLF nuclear density/moisture tests were performed with passing results. The depth check frequency for SLF is two checks for every acre. A minimum of 80 SLF depth checks were required. A total of 110 SLF depth checks were performed with passing results. SLF nuclear density/moisture testing and SLF depth checks are presented in Tables 9 and 10, respectively.

### 3.2.4. Drain Cover Fill

The Squaw Gulch VLF Phase 2A Part 2 area was constructed by placing 128,860 cy of DCF. The particle size distribution and Atterberg limits testing frequencies were one sample for every 20,000 cy. A minimum of six DCF samples were required to be tested for particle size and Atterberg limits. A total of seven DCF samples were tested, all the samples had either passing results or where approved for use by the certifying engineer. DCF laboratory testing is summarized in Table 8 and individual test results are presented in Appendix H.4.

## 3.3. Geosynthetics Quality Control Submittals

The CQA Monitor reviewed and approved all geosynthetic QC submittals, including geomembrane installation personnel résumés, geomembrane roll QC certificates, geomembrane resin QC certificates, welding rod QC certificates, and geotextile QC certificates. The CQA Monitor tracked all geomembrane delivered to site in the site inventory. The site inventory, for all geomembrane used within the Phase 2A Part 2 area, is presented in Appendix I.1.

### 3.3.1. Geomembrane Installation Personnel Resumes

Tetra Tech submitted the resumes of all installation personnel prior to construction or repair activities within the Squaw Gulch VLF Phase 2A Part 2 area. The CQA Monitor verified that the Installation Superintendent, Master Seamer and QC Inspector possessed the installation experience required by the project Technical Specifications. Geomembrane installation personnel resumes for all crews that performed work on the Squaw Gulch VLF Phase 2A Part 2 area are presented in Appendix I.2.

### 3.3.2. Geomembrane Roll QC Certificates

The Squaw Gulch VLF Phase 2A Part 2 geomembrane was manufactured by AGRU America. Manufacturing Roll QC certificates were submitted for every roll of geomembrane (approximately one every 9,000 square feet), exceeding the required minimum frequency of one per 50,000 square feet of geomembrane. The roll QC certificates were reviewed by the CQA Monitor, ensuring all geomembrane materials met or exceeded the project Technical Specifications. The roll QC certificates for all geomembrane used within the Phase 2A Part 2 area are presented in Appendix I.3. Geomembrane roll QC Certificates were provided for all 40 mil and 80 mil rolls installed within Phase 2A Part 2.

### 3.3.3. Geomembrane Resin QC Certificates

AGRU America manufactured the geomembrane for the Squaw Gulch Phase 2A Part 2 VLF by using LLDPE polymer raw material (resin). Chevron Phillips Chemical Company provided resin QC certificates at a rate of one per rail car shipment. The resin QC certificates were reviewed by the CQA Monitor, ensuring all materials met or exceeded the project Technical Specifications. It is important to note that the Oven-Aging, UV-Aging, 2% Secant and Multi-Axial Tensile testing is considered formulation testing and is only completed when a resin formula has changed to ensure that the resin/additive formula is adequate. The resin QC certificates for all geomembrane used within the Phase 2A Part 2 area are presented in Appendix I.4.

### 3.3.4. Geomembrane Welding Rod QC Certificates

AGRU America manufactured the extrusion welding rod for the Squaw Gulch Phase 2A Part 2 VLF from various resin lots. The CQA Monitor reviewed and verified that all welding rod QC certificates that were provided by Chevron Phillips Chemical Company met the project Technical Specifications and was manufactured using the same type of resin. The welding rod QC certificates are presented in Appendix I.5.

### 3.3.5. Geotextile QC Certificates

Skaps Industries manufactured the 12 oz/yd$^2$ non-woven geotextile that was used to construct the underdrain systems and leak detection trenches. The CQA Monitor verified that the geotextile QC certificates, presented in Appendix I.6, met the project Technical Specifications.

## 3.4. Geomembrane Construction Quality Assurance

CQA performed on installed LLDPE geomembrane consisted of visual observations of panel deployment, double-wedge fusion seaming, extrusion seaming, extrusion welded repairs, non-destructive testing, and destructive testing. Fusion welded seams were non-destructively tested for continuity using pressure testing methods. Extrusion welds were non-destructively tested using vacuum testing methods. Fusion and extrusion welding methods were also tested destructively. All field sampling and testing was performed by Tetra Tech and observed by the CQA Monitor. Visual observations of field seams and panels were routinely made to inspect the seam for squeeze-out, melt, over-grind, and overlap. Defects and/or failed seams were marked and repaired in accordance with the specified repair procedures.

Welding machines were continually inspected for proper operation, settings and condition by performing trial welds prior to actual geomembrane installation. Logs of the trial welds, panels, seams, continuity testing, repairs, and destructive testing were maintained by both the contractor and the CQA Monitor on a daily basis. The CQA Monitor's geomembrane installation logs are presented in Appendix J.

All geomembrane installation for the Squaw Gulch VLF project was performed in accordance with design drawings and project specifications. Record Drawing No. 10 shows panel locations, seams, and destructive test locations.

### 3.4.1. Geomembrane Third Party Conformance Testing

Third party conformance test samples for geomembrane were obtained at a rate of one test for every 150,000 square feet, and at least one test for each resin lot. Samples were

tested by TRI in Anaheim, CA. All conformance test results were reviewed by a NewFields representative and met the Technical Specifications. Third party conformance test results are presented for 40mil and 80mil geomembranes in Appendix K.1 and K.2, respectively.

### 3.4.2. Geomembrane Panel Deployment

The SLF surface was inspected by the CQA monitor prior to geomembrane deployment, ensuring the surface was free of any protruding rock greater that 0.75" or irregularities (rutting, ridges, indentations, etc.) greater than 0.5". The SLF surface was approved by Tetra Tech, Tezak, CC&V, and the CQA Monitor prior to and during deployment each day. SLF acceptance forms are presented in Appendix E. During geomembrane panel deployment the CQA Monitor logged the dimensions of each panel, the roll number used for each panel, and measured the thickness of the panel edges. Roll numbers were checked against the site inventory to ensure only approved geomembrane was deployed. The Geomembrane Panel Deployment Summary is presented in Appendix J.1.

### 3.4.3. Geomembrane Fusion Seaming

Double-wedge fusion welding was the primary method of geomembrane seaming for the Squaw Gulch VLF Phase 2A Part 2 project. Prior to fusion welding activities, trial welds were performed for each welding machine and welding technician combination for each type of geomembrane. The fusion welding trial seam logs are presented in Appendix J.2.1. The weld was inspected constantly for insufficient overlap, burnouts, or any other damage caused during the welding process. The CQA Monitor logged the welding machine and welding technician combination, the length of the seam, the direction the seam was welded, time of seaming, the welding machine temperature, and the welding machine speed. Destructive test samples were marked during fusion seaming and are discussed further in Section 3.4.5. Continuity conformance of the seam was also performed using pressure testing methods and is discussed further in Section 3.4.6. The Geomembrane Fusion Welding Summary is presented in Appendix J.3.

### 3.4.4. Geomembrane Extrusion Seaming

At each construction bench, the deployed geomembrane was tied-into the previously placed geomembrane, overlapping a minimum of two feet. The tie-in was welded using extrusion welding methods. Any damage caused to the existing geomembrane, at the Phase 1 tie-in as it was exposed, was repaired by extending the overlap of new liner or by completely covering the damaged area with a patch. Prior to extrusion seaming activities, trial welds were performed for each welding machine and welding technician combination for each type of geomembrane. The trial seam logs are presented in Appendix J.2.2. As extrusion seaming was performed, proper techniques were verified

including welding angle, grinding, and weld/welding rod cleanliness. The CQA Monitor logged the welding machine and welding technician combination, the length of the seam, the direction the seam was welded, time of seaming, the pre-heat temperature, and the welding temperature. Destructive test samples were marked during extrusion seaming and testing is discussed further in Section 3.4.5. All extrusion welded seams were vacuum tested and is discussed further in Section 3.4.7. The Geomembrane Extrusion Welding Summary is presented in Appendix J.4.

### 3.4.5. Geomembrane Destructive Testing

During welding activities destructive test samples were marked for every 500 linear feet of seam for each welding type and each welding machine/welding technician combination. A 24-inch long by 12-inch wide sample was cut from the seam centered on the seam lengthwise. The sample was then cut in two halves. One half was archived by the CQA Monitor to be tested later, if necessary. Ten 1-inch coupons were then cut from the remaining sample half. Five coupons were tested for shear strength and five coupons were tested for peel strength using a tensiometer. The different failure types and test codes for fusion and extrusion destructive testing are presented on Figures 3 and 4, respectively. All destructive testing was performed by Tetra Tech in the presence of the CQA Monitor. Five fusion and two extrusion destructive tests failed within the Squaw Gulch Phase 2A Part 2 area and the extent of the failure was delineated by obtaining samples before and after the failed sample. Once the failing area was identified, that portion of the seam was capped. Fusion and Extrusion Destructive Testing Summaries are presented in Appendix J.5.1 and Appendix J.5.2, respectively, and the tensiometer certifications are presented in Appendix L.

### 3.4.6. Geomembrane Pressure Testing

Pressure testing was performed to ensure all fusion welded seams had continuity throughout their entire length. The ends of the seam were sealed and the air channel in the seam was pressurized using a small air compressor to a minimum of 30 pounds per square inch (psi), for a minimum of five minutes. A pressure gauge and needle were used to monitor the air pressure in the seam. If the pressure dropped less than 3 psi, the opposite end of the seam from the pressure gauge was cut. If the needle dropped, continuity was confirmed throughout entire seam length and the test was considered "passing." If a pressure drop of more than 3 psi occurred or the continuity was not proven, smaller sections of the seam were tested to delineate the failing section of the seam. All failing seams or portions of seams were repaired, and vacuum tested. The Geomembrane Seam Pressure Testing Summary is presented in Appendix J.6.

### 3.4.7. Geomembrane Defects and Repairs

The CQA Monitor constantly inspected the geomembrane for defects from the time it was deployed until it was covered with DCF. A defect is defined as any item in which a repair is necessary to create a continuously sealed geomembrane layer. All defects were marked with a defect number by the CQA Monitor. Repairs were performed using the extrusion welding method and patches extended at least 6 inches beyond the defect in all directions. All repairs were assigned a repair number and cross checked with defect numbers to ensure that all defects were repaired.

All repairs and extrusion welded seams were non-destructively tested using a vacuum box. The area being tested was covered in soapy water and the vacuum box was sealed to the geomembrane. A vacuum was pulled over the area for at least 10 seconds and if no bubbles were present, the test passed. If bubbles were present, the area failed and was marked as a defect. The repair process would then be repeated for the failing vacuum test. Vacuum tests overlapped each other by a minimum of 3 inches. The Geomembrane Defect/Repair Summary, including vacuum testing logs, is presented in Appendix J.7.

### 3.4.8. Geomembrane Acceptance

Prior to DCF placement, the geomembrane was accepted by Tetra Tech, Tezak, CC&V, and the CQA Monitor. All CQA logs and survey data were thoroughly reviewed ensuring that all aspects of the geomembrane installation were performed in accordance with project Technical Specifications. Geomembrane Acceptance Forms are presented in Appendix J.8.

## 4. PROJECT DEVIATIONS

Throughout construction, the following deviations from the Design and IFC Drawings were approved by the Engineer of Record:

- Several localized grading, underdrain alignment and HVSCS alignment changes were made throughout construction in order to better accommodate the actual site conditions. The grading changes were minor and such are not highlighted in the Record of Construction Drawings.
- IFC Drawings A60 and A62 indicated that a fusion weld should be used between the phased geomembrane connections; however, the use of extrusion welding was also approved.
- The Engineer of Record accepted the substitution of the CBR Puncture Value test (ASTM D6241) for the Puncture Value test (ASTM D4833) as reported/tested on the geotextile manufacturing certification sheets.

- The Engineer of Record accepted the use of DCF that did not meet the gradation and/or Plasticity Index criteria stated in the Technical Specifications. The minor deviations in material properties didn't impact the design intent of the DCF.

## 5. ENGINEER'S OPINION

Based on the construction activities observed, testing performed, and inspections completed, NewFields certifies that the project was constructed in general accordance with the approved IFC Drawings and Technical Specifications.

# FINAL CERTIFICATION

## SQUAW GULCH VALLEY LEACH FACILITY PROJECT
## QUALITY ASSURANCE
## PHASE 2A PART 2 VLF COMPLETION AREA
## TELLER COUNTY, COLORADO

I, Jay N. Janney-Moore, a registered professional engineer in the State of Colorado, hereby certify that the construction of the Squaw Gulch Valley Leach Facility Phase 2A Part 2 VLF Completion Area, as outlined in Figure 2, was completed in compliance with the drawings and project Technical Specifications approved as part of Permit Number M-1980-244, Amendment No. 10 as well as subsequent changes approved by the Office of Mined Land Reclamation.

**NewFields Mining Design & Technical Services,**


Jay N. Janney-Moore, PE

CO PE No. 37571