

Grants Reclamation Project EP-1 Geotechnical Investigation Report



Prepared for:
Homestake Mining Company of California

Prepared by:
Stantec Consulting Services Inc.



May 7, 2019

Document Review and Revision Record

Rev.	Description	Author		Quality Check		Independent Review	
0	For Client Review	M. Kapp	1/22/2019	J. Cumbers	2/12/2019	M. Davis	2/27/2019
1	Updated based on review comments	M. Kapp/ S. Downey	5/7/2019	J. Cumbers	5/7/2019	M. Davis	5/7/2019

Table of Contents

EXECUTIVE SUMMARY	I
ABBREVIATIONS	III
1 INTRODUCTION.....	1.1
1.1 PURPOSE.....	1.1
1.2 REPORT BACKGROUND.....	1.1
1.3 REPORT OBJECTIVES AND SCOPE.....	1.1
2 DRILLING AND SAMPLING CONDUCTED.....	2.1
2.1 DRILLING ACTIVITIES	2.1
2.2 SAMPLING ACTIVITIES.....	2.1
2.3 FIELD OBSERVATIONS	2.2
3 SUBSURFACE CONDITIONS	3.1
3.1 SITE GEOLOGY	3.1
3.2 EP-1 SUBSURFACE CONDITIONS.....	3.1
3.3 GROUNDWATER CONDITIONS	3.1
3.4 SITE SEISMICITY	3.2
3.4.1 Liquefaction Screening Evaluation	3.2
4 GEOTECHNICAL LABORATORY TEST RESULTS	4.1
5 MATERIAL PROPERTIES EVALUATION	5.1
5.1 STABILITY MODEL MATERIAL PROPERTIES	5.1
5.1.1 EP-1 Design Properties.....	5.1
5.2 GEOTECHNICAL INVESTIGATION PROPERTIES	5.2
5.2.1 Type A Structural Fill (Sandy Tailings)	5.2
5.2.2 In-Place Tailings.....	5.3
5.2.3 Natural Ground (Alluvium).....	5.3
6 CONCLUSIONS.....	6.1
7 REFERENCES.....	7.1

LIST OF TABLES

Table 1 Summary of Completed Boreholes.....	2.1
Table 2 Liquefaction Susceptibility based on Geotechnical Properties	3.5
Table 3 Summary of Geotechnical Laboratory Results.....	4.2
Table 4 Design Material Property Values Summary	5.2
Table 5 Type A Structural Fill (Sandy Tailings) Property Values Comparison	5.2
Table 6 In-place Tailings Property Values Comparison	5.3
Table 7 Natural Ground Property Values Comparison.....	5.3

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION REPORT

LIST OF FIGURES

Figure 1 Soil Boring and Well Locations

LIST OF APPENDICES

APPENDIX A	BORING LOGS, SAMPLE PHOTOS, AND DAILY FIELD LOGS.....	A.1
	Boring Logs.....	A.2
	Sample Photos.....	A.3
	Daily Field Logs	A.4
APPENDIX B	LABORATORY DATA	B.1

Executive Summary

Introduction

This Geotechnical Investigation Report was prepared on behalf of Homestake Mining Company of California (HMC) as part of the Evaporation Pond 1 (EP-1) relining project. Because the EP-1 liner exceeded its design lifespan, the liner must be replaced if EP-1 is to continue to be used effectively. This report presents information collected during the geotechnical drilling and field sampling specific to EP-1 at the Grants Reclamation Project (GRP) site. The appendices include field notes, boring logs, photo log, and laboratory testing results. Information presented in this report will be used to evaluate the relining suitability of EP-1, as well as collect data on the current state of the underlying tailings of the Small Tailings Pile (STP).

Site Description

The GRP site is located approximately 4.5 miles north of the Village of Milan, Cibola County, New Mexico. The site consists of two uranium mill tailings piles, a groundwater extraction and injection system, a reverse osmosis water treatment system, two lined collection ponds, three lined evaporation ponds for disposal of contaminated groundwater, administrative buildings, and associated equipment and structures. The combined area of the site is approximately 1,085 acres.

EP-1 is on the STP at 35° 14' N latitude and 107° 52' W longitude, with a nominal site elevation of 6,583 feet above mean sea level (amsl). EP-1 was designed and constructed in 1990 (New Mexico Office of the State Engineer Dam Permit Number 3700). It was constructed on top of the STP, which was constructed above the surrounding natural grade. The pond has a composite liner consisting of 50-mil polyester fabric sheets coated with Deery Oil No. 6 asphaltic emulsion. EP-1 has no internal leak detection system.

Geotechnical Investigation

The field work for the geotechnical investigation took place in September 2018, following HMC approval of the Work Plan for EP-1 Geotechnical Characterization (Stantec, 2018a). Drilling and sampling were conducted to characterize the subsurface materials and conditions within and underneath the EP-1 dam (i.e. north, south, east, and west embankments). The objective of the field investigation was to collect samples of the EP-1 dam fill and underlying tailings materials for geotechnical characterization and use the data for verification of design properties and if necessary, updates to the EP-1 design.

Conclusions

The subsurface profile consists of between 2 and 4 feet below ground surface (bgs) of gravel-sand-clay fill mixture along the EP-1 dam crest, underlain by silty or clayey fine sand tailings to approximately 25 feet bgs, and natural silty or clayey fine sand to the extent of the boring depths. Modified California Sample (MCS) blow counts of 3 to 94 blows per foot (bpf) indicate soil consistency ranging between very loose and very dense. MCS blow counts ranged from 10 to 47 bpf (median of 15 bpf, for 5 tests) in the underlying alluvium, and ranged from 3 to 94 bpf (median of 36 bpf, for 60 tests) in the tailings. Retrieved samples ranged between dry and moist, but Stantec did not encounter groundwater during drilling activities.

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION REPORT

Sample test results show EP-1 dam having subsurface material types of fat and lean clay, clayey sand, silty sand, and lean clay-silt for structural fill type A (sandy tailings) and in-place tailings samples. Water content ranges between 5 and 21.7 percent for structural fill type A (sandy tailings) and in-place tailings samples with dry unit weights ranging between 88 and 110 pounds per cubic foot (pcf). Specific gravity ranges between 2.64 and 2.68 for structural fill type A (sandy tailings) and in-place tailings samples. Plasticity index (PI) ranges between non-plastic and 42 percent for structural fill type A (sandy tailings) and in-place tailings samples and soil strength results show drained strength friction angles of 31.5 and 38.7 degrees. Water contents of the natural alluvium samples were between 8.5 and 12.3 percent with dry unit weights between 85 and 106 pcf. Specific gravity of one alluvium sample was 2.68. The plasticity index (PI) of one alluvium sample was 7 percent with a drained strength friction angle of 33.6 degrees.

Based on a material properties evaluation described in Section 4.1, Stantec finds the design property values used for the slope stability modeling during the EP-1 Feasibility Study (Stantec, 2018b) acceptable.

Based on liquefaction susceptibility screening of the tailings samples collected from beneath the EP-1 embankments, two of eleven laboratory samples were identified as liquefaction-susceptible material types. The two susceptible samples were collected from 10-12 feet bgs, which is at least 23 feet above the STP static groundwater level (HMC and Hydro-Engineering, 2018).

Based on requirements in NUREG Guide 3.11 (NRC, 2008) Section C.2.f., Stantec recommends CPT characterization of the STP profile and installation of piezometers to further confirm the presence, or limits, of susceptible layers and the phreatic surface. The NUREG states that evaluation of liquefaction potential should include laboratory testing, in situ testing, and comparisons to similar soil deposits. The pseudo-static analysis conducted for the EP-1 Feasibility Study (Stantec, 2018b) should be revisited after completing additional characterization of the profile. Stantec recommends completing the CPT characterization concurrently with the LTP CPT investigation.

May 7, 2019

Abbreviations

amsl	above mean sea level
bgs	below ground surface
bpf	blows per foot
CPT	cone penetration test
HMC	Homestake Mining Company of California
LL	Liquid limit
LTP	Large Tailings Pile
MCS	Modified California sample(r)
NSHM	National Seismic Hazard Maps
NMOSE	New Mexico Office of the State Engineer
pcf	pounds per cubic foot
PGA	peak ground acceleration
PI	plasticity index
STP	Small Tailings Pile
TM	technical memorandum
USGS	US Geological Survey

Introduction
May 7, 2019

1 INTRODUCTION

1.1 PURPOSE

This Geotechnical Investigation Report was prepared on behalf of Homestake Mining Company of California (HMC) as part of the Evaporation Pond 1 (EP-1) relining project. Because the EP-1 liner exceeded its design lifespan, the liner must be replaced if EP-1 is to continue to be used effectively. This report presents information collected during the geotechnical drilling and field sampling specific to Evaporation Pond 1 (EP-1) at Grants Reclamation Project site. The geotechnical data for the pond embankment tailings, the STP in general, and alluvium (natural ground) beneath the STP will be used for verification of design properties and updates to the EP-1 design.

This report summarizes the geotechnical investigation and sampling conducted at the Grants Reclamation site specific to EP-1. The field work for the EP-1 relining project investigation was completed in accordance with the HMC-approved work plan (Stantec, 2018a).

1.2 REPORT BACKGROUND

As part of the EP-1 Relining Feasibility Study (Stantec, 2018b), Stantec and HMC determined additional geotechnical characterization data was necessary to confirm existing data and the material properties used for stability modeling in the liner system design. The proposed Relining Design includes placement of a double-liner with leak detection system on top of the existing liner system. Due to limited available STP and EP-1 geotechnical data, Stantec developed a work plan to obtain data necessary to complete the design (Stantec, 2018a).

1.3 REPORT OBJECTIVES AND SCOPE

The objective of the geotechnical investigation was to obtain additional data required to further evaluate the EP-1 dam (i.e. north, east, south, and west embankments) and underlying tailings materials for geotechnical characterization. Stantec conducted drilling and sampling to characterize the subsurface materials and conditions within and underneath the EP-1 dam. Laboratory samples underwent analytical screening and geotechnical testing to evaluate their geotechnical properties. Objectives of the geotechnical characterization were to collect current geotechnical data for materials of the pond embankments, the STP, and beneath the STP and use this data for verification of design properties and updates to the EP-1 Re-lining Design. This report contains an evaluation of soil properties of EP-1 dam and underlying materials. Specifically, this report presents the following information:

- A summary of the investigation and sampling conducted
- The results of the investigation – boring logs and laboratory data
- Verification of design geotechnical properties used in the EP-1 Re-lining Design

The report contents include the following:

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION REPORT

Introduction
May 7, 2019

- Section 1 – Introduction
- Section 2 – Drilling and Sampling Conducted
- Section 3 – Subsurface Conditions
- Section 4 – Geotechnical Laboratory Test Results
- Section 5 – Material Properties Evaluation
- Section 6 – Conclusions
- Section 7 – References

The appendices include laboratory data reports, field and drilling logs, and field photographs documenting the investigation and sampling activities at the EP-1 dam.

Drilling and Sampling
May 7, 2019

2 DRILLING AND SAMPLING

2.1 DRILLING ACTIVITIES

Stantec conducted the EP-1 geotechnical investigation September 17 to September 19, 2018. Field activities consisted of drilling and soil sampling conducted by Cascade Drilling and Technical Services LP (Cascade) under contract to HMC. Cascade used a CME-85 truck-mounted drill rig and 7.25-inch-diameter hollow stem auger to complete the drilling portion of the field activities. Upon completion of each borehole, Cascade backfilled each with cuttings. No drilling fluid was used.

Cascade conducted drilling activities generally in accordance with the work plan (Stantec, 2018a). There was a minor change to the S-3 drilling location (a move of 24 feet to the west) due to a buried electrical cable. Borehole depths were reduced during the investigation from depths proposed in the work plan at E-2, W-2, and N-1 based on field interpretation of the transition from tailings to native soils. Figure 1 shows borehole locations. Table 1 summarizes the completed boreholes.

Table 1 Summary of Completed Boreholes

Boring ID	Northing ¹	Easting ¹	Surface Elevation (ft) ¹	Depth of Borehole (ft bgs) ²
E-1	1542183.8	492695.3	6603	20.5
E-2	1541757.1	492682.9		31.5
E-3	1541332.1	492669.9		20.5
S-1	1541232.7	492421.6		20.5
S-2	1541304.6	491875.7		36.5
S-3	1541377.0	491303.9		20.5
W-1	1541597.0	491285.4		20.5
W-2	1541884.8	491507.4		20.5
W-3	1542171.3	491730.4		20.5
N-1	1542265.1	492139.9		20.5

Note:

1. New Mexico West Zone State Plane Grid NAVD88
2. bgs = below ground surface, ft = feet

2.2 SAMPLING ACTIVITIES

A Stantec geotechnical engineer supervised sampling activities along the EP-1 dam crest. Cascade conducted penetration tests with a 2.5-inch Modified California sampler driven by a 140-pound auto-hammer falling 30 inches to complete the geotechnical sampling activities.

Cascade drilled ten boreholes along the crest of the EP-1 dam, one borehole on the north embankment, and three boreholes each on the east, south, and west embankments. Borehole depths ranged between

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION REPORT

Drilling and Sampling
May 7, 2019

20 and 37 feet below ground surface (bgs), with a total of 232 feet drilled. At each borehole location, one MCS test was conducted within the upper five feet bgs and another five feet after. Between 10 and 20 feet bgs, Stantec conducted MCS tests at 2.5-foot intervals, and at five-foot intervals from 20 feet to total depth. Stantec collected 72, 2.5-inch diameter by 4-inch long, brass liner sample sleeves for off-site laboratory testing. Samples were sealed with plastic caps and stored in a 5-gallon bucket while on-site. All 72 samples were packaged to limit disturbance and shipped to an off-site laboratory as a UN 2910 excepted package.

2.3 FIELD OBSERVATIONS

The subsurface profile consists of between 2 and 4 feet bgs of gravel-sand-clay fill mixture along the crest of EP-1 dam, underlain by silty or clayey fine sand tailings to approximately 25 feet bgs, and natural silty or clayey fine sand to the extent of the boring depths. MCS blow counts ranged from 3 to 94 in the tailings indicating very loose to very dense consistency. Blow counts in the natural soil ranged from 10 to 47 indicating a loose to medium dense consistency. The materials encountered were similar to materials described in the 1990 Design Brief (AKG, 1990) and correlate with material properties used for the EP-1 relining design. Free water was not encountered in the boreholes completed for this investigation.

Subsurface Conditions
May 7, 2019

3 SUBSURFACE CONDITIONS

3.1 SITE GEOLOGY

The site is in the southeastern part of the Colorado Plateau physiographic province and is mostly on the south flank of the San Juan Basin. This region experienced a minor degree of structural deformation (regional folding and block uplift) associated with formation of the Zuni Uplift, which is characterized by a northwest-trending anticline composed of Precambrian crystalline basement rocks overlain by Permian to Jurassic sedimentary rocks. These sedimentary rocks were uplifted during the Laramide Orogeny near the end of the Late Cretaceous through the Eocene, approximately 80 to 40 million years before present (Arcadis, 2013). Bedrock units at the site consist of the Glorieta Sandstone (Early Permian), San Andres Limestone (Early Permian), and Chinle Formation (Late Triassic). As a result of Laramide deformation, these bedrock units have a shallow northeastern dip direction of approximately 3 to 10 degrees (Kelley, 1967).

The surficial soils underlying the site consist of clay underlain by silty sand to sand with silt to varying depths. The clay is low in plasticity, whereas the silty sand was non-plastic (CH2M, 2018). Geologic logs from wells installed on site indicate the alluvium thickness underneath the main area of the site (the location of the Large Tailings Pile [LTP]) is up to 100 feet thick (CH2M, 2018). The alluvial aquifer consists of discontinuous layers of clay, silt, and sand.

3.2 EP-1 SUBSURFACE CONDITIONS

Cascade drilled boreholes along the EP-1 dam to characterize subsurface soil conditions. The boreholes extended below the designed base elevation of EP-1.

The borings were predominantly in tailings (referred to as “Structural Fill Type A (Sandy Tailings)” and “In-Place Tailings” in AKG, 1990 and Stantec, 2018a), with an estimated 1.5 to 3.5 feet of soil fill overlying the tailings. The soil fill consists of silty sand with gravel, clayey sand, or clayey gravel. The tailings generally consist of silty sands with lenses of sandy clay and clay at depths below 13 feet. Below approximately 25 feet, the alluvium soils (referred to as “Natural Ground” in AKG, 1990 and Stantec, 2018a) generally consist of sandy clay or clay with sand.

As discussed above, Stantec encountered fill at each borehole location. Stantec did not conduct drive samples in the fill. MCS blow counts for tailings between 5 and 25 feet bgs in tailings generally indicated very loose to very dense consistency (3 to 88 bpf). Between 25 to 36 feet bgs in Natural Ground, MCS blow counts indicated a consistency ranging between loose and medium dense (10 to 47 bpf). Sample material at each boring was generally moist.

3.3 GROUNDWATER CONDITIONS

While some retrieved samples were moist, Stantec did not encounter groundwater during EP-1 drilling activities. For reference, monitoring wells previously installed in the alluvium downstream of EP-1 (wells

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION REPORT

Subsurface Conditions
May 7, 2019

C10, C12, and K7) showed a water level between elevations of 6,541 and 6,569 feet (NAVD88) in 2017 (HMC and Hydro-Engineering, 2018). The deepest boring location drilled was S-2, reaching an elevation of approximately 6,565 feet (NAVD88). Figure 1 shows these well locations.

3.4 SITE SEISMICITY

The following is excerpted from Stantec's review memo of the Grants Reclamation PFS Fault Study for Seismic Design to Support Detail Design Draft Technical Memorandum (TM) prepared by Jacobs and submitted to Barrick in April 2018 (Jacobs, 2018). Stantec's memo is included as Appendix A.1 in the EP-1 Feasibility Study (Stantec, 2018b).

The TM discussed two M5.0 earthquakes, one that occurred in the Rio Grande Rift near the New Mexico-Colorado border in 2005, and one that occurred about 110 miles northwest of Albuquerque in 1976 (and approximately 80 miles from the project site). Stantec identified a M_w 5.3 earthquake that occurred in 2011 in the same region as the 2005 earthquake and a m_b (body wave magnitude) 5.0 earthquake that occurred in 1973 approximately 6 miles from the project site. While most of the seismic activity in the region can be attributed to the Rio Grande Rift, the project site is not located within the rift and seismicity closer to the site provides more of an indication of the seismic hazard at the site due to background earthquakes.

Jacobs' seismic hazard study was performed using the Uniform Hazard Tool available on the US Geological Survey (USGS) website. In the study, both the 2008 and 2014 USGS National Seismic Hazard Maps (NSHM) were evaluated for the 2,475-year return period. Jacob used a site condition of 760 m/s (Site Class B/C) in the evaluation. The resulting peak ground acceleration (PGA) from the 2008 and 2014 NSHM was 0.14 and 0.13 g, respectively, indicating a slight decrease in PGA from the 2008 and 2014 NSHM models.

Stantec selected the resulting PGA from the 2014 NSHM of 0.13 g as the predicted PGA for the geotechnical design basis. Stantec chose the base (i.e., bedrock) ground motions (Site Class B) from the USGS data for the project site, based on coordinates of 35.25° N latitude, 107.52° W longitude. Following Section 20.4 of ASCE (2010), the average penetration resistance for the upper 100 feet of the site was estimated to be between 15 and 50 bpf (CH2M, 2018), classifying the site as Site Class D for shallow foundations. The predicted PGA value was converted from Site Class B/C to Site Class D using Table 11.8-1 from ASCE (2010) (shown in Figure 1). Given a PGA value of 0.128 g, interpolation results in a F_{PGA} of 1.54. The resulting Site Class D PGA used in the geotechnical design is 0.20 g ($=1.54 \times 0.128$). Stantec used two-thirds of the predicted peak ground acceleration, 0.13 g ($=0.20 \times 2/3$) as the pseudo-static coefficient in the pseudo-static stability analysis for the EP-1 Feasibility Study (Stantec, 2018b).

3.4.1 Liquefaction Screening Evaluation

Earthquakes can commonly induce liquefaction within saturated granular materials of low relative density. Liquefaction is most common in poorly-graded sand and silty sand deposits, though it has been known to occur in other material types. Conditions susceptible to liquefaction generally occur in areas where

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION REPORT

Subsurface Conditions
May 7, 2019

accumulated material is composed of low-density granular material with near-surface groundwater. Although less common, sites without groundwater or substantial thickness of saturated soils can also sustain earthquake-induced damages; including ground-rupture, flow slides and settlement.

NRC Regulatory Guide 3.11 (2008) states that if three or more of the following indicate liquefaction is likely, then "... a more rigorous analysis of the liquefaction potential at a facility is required": (1) geologic age and origin, (2) fines content and plasticity index (PI), (3) saturation, (4) depth below ground surface, and (5) soil penetration and resistance.

- 1) *Geologic age and origin*: the tailings fill and fluvial foundation have a greater potential for liquefaction than older deposits
- 2) *Fines content and PI*: To identify specific materials considered susceptible for the purposes of this screening evaluation, non-plastic materials with a fines content less than 15 percent or materials with water content to liquid limit ratios of 0.85 or greater (exceeds NUREG 3.11, which limits at a ratio of 0.9) were identified (see below).
- 3) *Saturation*: Stantec did not encounter groundwater or saturated materials during drilling at EP-1. Drilling reached a maximum depth of 6,565 feet (NAVD88). Water levels from nearby monitoring wells located in alluvium on the north and south ends downstream of EP-1 show groundwater levels between 6,541 and 6,569 feet (NAVD88) as mentioned in Section 3.3.
- 4) *Depth*: The materials of concern for EP-1 are in the STP (above original ground) or within 50 feet of the original ground surface.
- 5) *Soil penetration and resistance* was not considered quantitatively for liquefaction screening based on NMOSE guidance not to convert blow counts for the California sampler to Standard Penetration Test values. However, uncorrected MCS blow counts of 51 bpf or less (very loose to medium dense material) are considered potentially susceptible based on the NRC screening criteria and 44 of the 65 drive samples from the investigation fall into this category. MCS blow counts ranged from 10 to 47 bpf (median of 15 bpf, for 5 tests) in the underlying alluvium, and ranged from 3 to 94 bpf (median of 36 bpf, for 60 tests) in the tailings.

In the case of the STP, conditions 1, 4 and 5 are typically met for the profile so the materials were further evaluated using the laboratory data and the Bray and Sancio (2006) criteria. The criteria state a soils PI is a better indicator of susceptibility than weight of clay-size particles. Soils were identified as "susceptible" or "moderately susceptible" to liquefaction according to the guidelines outlined in Bray and Sancio (2006), which state that a soil deposit is considered to be susceptible to liquefaction if the ratio of the water content (w_c) to liquid limit (LL) is greater than or equal to 0.85 ($w_c/LL \geq 0.85$), and the soil PI is less than or equal to 12 ($PI \leq 12$). Soils with $12 < PI \leq 20$ and $w_c/LL \geq 0.8$ may be moderately susceptible to liquefaction. Soils with $PI > 20$ are considered too clayey to liquefy.

Eight samples were tested for Atterberg limits and eight were tested for gradation. Two of the eight samples are non-plastic. The six remaining samples show a plasticity index range between 5 and 42

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION REPORT

Subsurface Conditions
May 7, 2019

percent, with a water content to liquid limit ratio range between 0.37 and 0.95. Of the eight samples tested for gradation only one sample (E-1-10A) had less than 15 percent fines (14.3%). The remaining samples had fines contents between 26 and 60 percent. Table 2 summarizes liquefaction susceptibility criteria of the samples with plasticity.

Excluding the use of the blow counts for consideration, and although saturated conditions were not encountered, two samples tested in the laboratory exhibit properties of liquefaction susceptibility. Because two samples were identified as potentially susceptible within the profile, and the MCS blow counts generally indicate very loose to medium dense materials within and below the STP, Stantec recommends additional characterization to identify thicknesses of specific layers susceptible to liquefaction. Further characterization using Cone Penetration Testing (CPT) should be completed in conjunction with the planned liquefaction characterization for the LTP.

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION REPORT

Subsurface Conditions
May 7, 2019

Table 2 Liquefaction Susceptibility based on Geotechnical Properties

Sample	Sample Depth (ft)	Modified California Sampler Blow Counts (bpf)	Water Content (by mass, %)	Fines Content (% silt and clay)	Plasticity Index (%)	Liquid Limit (%)	Water Content to Liquid Limit Ratio (w_c/LL)	Liquefaction Susceptibility	Comments
W-3-17.5A	19.0	10	19.4	44.2	NP		-	Not susceptible	
E-1-10A	11.5	13	5.0	14.3	NP		-	Susceptible	Fines content < 15%
E-2-17.5A	19.0	9	20.0	59.8	10	29	0.69	Not susceptible	
E-2-25A	26.5	10	8.5	57.5	-		-	Not susceptible	
S-2-17.5B	18.5	61	19.8	45.8	9	24	0.83	Not susceptible	
W-2-15A	16.5	3	12.3	-	8	28	0.44	Not susceptible	
W-1-17.5A	19.0	19	21.7	-	42	59	0.37	Not susceptible	
S-2-30A	31.5	15	12.3	26.2	7	25	0.49	Not susceptible	
S-1-15B	16.5	63	11.5	35.9	-		-	Not susceptible	
N-1-10A	11.5	4	20.9	-	5	22	0.95	Susceptible	$w_c/LL \geq 0.85$ and $PI \leq 12$
S-1-17.5B	19.0	47	15.6	38.3	-		-	Not susceptible	

Geotechnical Laboratory Testing Results
May 7, 2019

4 GEOTECHNICAL LABORATORY TESTING RESULTS

Advanced Terra Testing (ATT) in Lakewood, CO conducted the geotechnical laboratory testing on the samples. Due to the radioactivity of the tailings material, analytical testing of the soil samples was required before ATT could receive them. Hazen Research Laboratories in Golden, CO conducted gross gamma, thorium, and uranium testing for ATT. Geotechnical laboratory testing included sieve analysis, Atterberg limits, moisture and density, specific gravity, triaxial strength (consolidated undrained with pore water pressure), and direct shear strength. Table 3 summarizes geotechnical laboratory testing results. Appendix C includes results as received from ATT.

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION REPORT

Geotechnical Laboratory Testing Results
May 7, 2019

Table 3 Summary of Geotechnical Laboratory Testing Results

Borehole	Sample	Sample Type ⁽¹⁾	Material Type ⁽²⁾	Sample Depth Interval (ft)		USCS ⁽³⁾	Water Content (by mass, %)	Dry Unit Weight (pcf)	Specific Gravity	Atterberg Limits (%) ⁽⁴⁾			USCS % Sand	% Passing No. 200 Sieve (fines)	Triaxial Shear Strength Consolidated Undrained (peak friction angle (φ', degrees), cohesion (psf))	Direct Shear Strength, peak (ultimate) friction angle (φ', degrees), cohesion (psf))
										LL	PL	PI				
W-3	W-3-17.5A	CA	tailings	18.5	19.0	SC	19.4	93.7	2.66	NP			55.8	44.2		
E-1	E-1-10A	CA	sandy tailings	11.0	11.5	SM	5.0	94.6	2.65	NP			85.7	14.3		
E-2	E-2-17.5A	CA	tailings	18.5	19.0	CL	20.0	88.0	2.64	29	19	10	40.2	59.8		
E-2	E-2-25A	CA	alluvium	26.0	26.5	CL	8.5	85.5					42.5	57.5		
S-2	S-2-17.5B	CA	tailings	18.0	18.5	CL	19.8	104.9	2.67	24	15	9	53.2	45.8		
W-2	W-2-15A	CA	sandy tailings	16.0	16.5	CL	12.3	93.1	2.65	28	20	8				
W-1	W-1-17.5A	CA	tailings	18.5	19.0	CH	21.7	100.4	2.66	59	17	42			31.5	
S-2	S-2-30A	CA	alluvium	31.0	31.5	CL	12.3	105.8	2.68	25	18	7	73.6	26.2		33.6 (29.4)
S-1	S-1-15B	CA	sandy tailings	15.5	16.0	SC	11.5	106.1	2.65				64.1	35.9	33.4	
N-1	N-1-10A	CA	sandy tailings	11.0	11.5	CL-ML	20.9	100.5	2.66	22	17	5				31.5 (32.7)
S-1	S-1-17.5B	CA	tailings	18.0	18.5	SC	15.6	109.5					61.7	38.3		38.7 (32.5)

Notes:

1. Sample Types: CA = California sample, Bulk = bucket/grab sample

2. Alluvium = natural ground, sandy tailings = structural fill type A (sandy tailings), tailings = in-place tailings

3. USCS = Unified Soil Classification System, material descriptions are based on field observations, and refined with laboratory data, if available. USCS classifications are provided only where sufficient laboratory data are available. CH = high plasticity clay, CL = low plasticity clay, CL-ML = clay-silt, SC = clayey sands, SM = silty sands

4. LL = liquid limit, PL = plastic limit, PI = plasticity index, NP = non-plastic

Material Properties Evaluation
May 7, 2019

5 MATERIAL PROPERTIES EVALUATION

5.1 STABILITY MODEL MATERIAL PROPERTIES

Stantec evaluated slope stability of the pond embankments based on the design grading plans and existing embankment topography as part of the EP-1 relining design. Material properties used in the slope stability evaluation are based in part on data in the 1990 Design Brief by AKG. The stability analysis models the embankments for three scenarios: (1) at the end of construction, prior to adding fill material and a liner system to EP-1; (2) long-term stability with the added weight of the water in the pond; and (3) one condition post-construction to represent liner failure and seepage through the embankment. The Grants Reclamation Project – EP-1 Relining Feasibility Study, Appendix A.6 developed for HMC by Stantec (2018b) describes the slope stability analyses results. Stantec compared the model property values and the geotechnical investigation results from the embankment subsurface to confirm the design values used in the slope stability analyses represent the current conditions.

Specifically, Stantec evaluated total unit weight and drained friction angle values. During model development, Stantec calculated total unit weight of embankment subsurface materials using an estimated water content of 20 percent and a selected dry density based on standard Proctor testing data in the 1990 Design Brief (AKG, 1990 and Stantec, 2018b). Dry densities for Type A Structural Fill (Sandy Tailings) and Natural Ground were based on standard Proctor testing conducted for the 1990 Design Brief. In-Place Tailings dry density was determined prior to the 1990 Design Brief and the density value was accepted by regulatory agencies. The following paragraphs and tables describe the evaluation of total unit weight and drained friction angle for Type A Structural Fill (Sandy Tailings), In-Place Tailings, and Natural Ground used in slope stability modeling. Stantec did not evaluate the salts and sediments within the pond as part of this investigation. The following sections describe the design and geotechnical investigation material properties evaluation.

5.1.1 EP-1 Design Properties

Table 4 summarizes design parameters for each material, which are discussed in Appendix A.6 of the Grants Reclamation Project – EP-1 Relining Feasibility Study (Stantec, 2018b).

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION REPORT

Material Properties Evaluation
May 7, 2019

Table 4 Design Material Property Values Summary

Material	Total Unit Weight (pcf)	Drained Strength, Friction Angle (degrees)	Cohesion (psf)	Source
Type A Structural Fill (Sandy Tailings)	130	30	0	1990 Design Brief (AKG, 1990)
In-Place Tailings	120.0	29.0	0	1990 Design Brief (AKG, 1990)
Natural Ground	114.0	30.0	0	Assumed to be same as Type B Structural Fill

5.2 GEOTECHNICAL INVESTIGATION PROPERTIES

Geotechnical investigation properties are based on samples selected for laboratory testing. Stantec selected samples to represent the embankment subsurface. Based on the 1990 AKG Design Brief (1990), the slope stability model embankment subsurface consists of Type A Structural Fill (Sandy Tailings), In-Place Tailings, and Natural Ground. Geotechnical investigation results have been generally categorized by depth using this nomenclature for material types and are summarized in the following sections.

5.2.1 Type A Structural Fill (Sandy Tailings)

Four laboratory test results show Type A Structural (Sandy Tailings) with a total unit weight ranging between 99.3 and 121.5. Stantec used a design value of 130 pcf. Two test results show Type A Structural Fill (Sandy Tailings) having an effective stress (drained) friction angle of 31.5 and 33.4 degrees. Stantec used a design value of 30 degrees in the models. Table 5 summarizes Type A Structural Fill (Sandy Tailings) design and test result values.

Table 5 Type A Structural Fill (Sandy Tailings) Property Values Comparison

	Design Value	Geotechnical Investigation Max. Value	Geotechnical Investigation Average Value	Geotechnical Investigation Median Value	Geotechnical Investigation Min. Value
Total Unit Weight (pcf)	130	121.5	110.9	111.4	99.3
Drained Strength, Friction Angle (deg.)	30	33.4	32.5	32.5	31.5

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION REPORT

Material Properties Evaluation
May 7, 2019

5.2.2 In-Place Tailings

Six test results show In-Place Tailings with total unit weight ranging between 126.6 and 92.8 pcf, with an average of 114.1 pcf. Two test results show In-Place Tailings having effective stress (drained) friction angles of 31.5 and 38.7 degrees. Stantec used a design drained friction angle of 29 degrees and a total unit weight of 120 pcf in the models, which is conservative with respect to the lab results. Table 6 summarizes In-Place Tailings design property values and test result value ranges.

Table 6 In-Place Tailings Property Values Comparison

	Design Value	Geotechnical Investigation Max. Value	Geotechnical Investigation Average Value	Geotechnical Investigation Median Value	Geotechnical Investigation Min. Value
Total Unit Weight (pcf)	120	126.6	114.1	117.0	92.8
Drained Strength, Friction Angle (deg.)	29	38.7	35.1	35.1	31.5

5.2.3 Natural Ground (Alluvium)

One test result shows Natural Ground (alluvium) having a total unit weight of 118.8 pcf. Stantec used a design value of 114 pcf. One test result shows alluvium having an effective stress (drained) friction angle of 33.6 degrees. Stantec used a design strength value of 30 degrees. Table 7 compares design and laboratory test result property values for the alluvium.

Table 7 Natural Ground (Alluvium) Property Values Comparison

	Design Value	Geotechnical Investigation Value
Total Unit Weight (pcf)	114	118.8
Drained Strength, Friction Angle (deg.)	30	33.6

Conclusions
May 7, 2019

6 CONCLUSIONS

Stantec evaluated the design properties used for the slope stability modeling for the Grants Reclamation Project – EP-1 Relining Feasibility Study, Appendix A.6 developed for HMC by Stantec (2018b). For the structural fill and the In-Place Tailings, modeled strength values were less than the values indicated by the laboratory results and total unit weights modeled were greater than the total unit weights from the laboratory. For the properties of the Natural Ground, the design strength and the total unit weight modeled were less than the values reported by the lab. The lower unit weight for the Natural Ground in the model does not affect the resulting critical failure surfaces evaluated.

Based on the evaluation and the data collected during the 2018 geotechnical investigation, Stantec concludes that the design total unit weights and drained strength friction angles used in the slope stability analyses are appropriate for the modeling completed for the EP-1 FS design.

The New Mexico Administrative Code (19.25.12.13(c)(i)) states that pseudo-static analysis is acceptable for embankments to be mechanically compacted to 95 percent of maximum standard Proctor density, if no materials susceptible to liquefaction exist in the foundation, and PGA is equal to or less than 0.20 g (NMAC, 2005). The PGA calculated for the site is 0.20 g and the original EP-1 design documents dictate that the embankment was to be constructed in 1-foot lifts and compacted to 95 percent of maximum standard Proctor density (AKG, 1990), although Stantec did not review as-built information that confirms this occurred. Based on liquefaction susceptibility screening of the samples collected from the EP-1 structure foundation, two of eleven samples were identified as liquefaction-susceptible material types. However, within the boreholes drilled for this evaluation, the materials encountered were unsaturated. The two susceptible samples were collected from 10-12 feet bgs, which is at least 23 feet above the site static groundwater level.

Based on requirements in NUREG Guide 3.11 (NRC, 2008) Section C.2.f., Stantec recommends CPT characterization of the STP profile and installation of piezometers to further confirm the presence, or limits, of susceptible layers and the phreatic surface. The NUREG states that evaluation of liquefaction potential should include laboratory testing, in situ testing, and comparisons to similar soil deposits. The pseudo-static analysis conducted for the EP-1 Feasibility Study (Stantec, 2018b) should be revisited after completing additional characterization of the profile. Stantec recommends completing the CPT characterization concurrently with the LTP CPT investigation.

References
May 7, 2019

7 REFERENCES

American Society of Civil Engineers (ASCE), 2010. ASCE Standard ASCE/SEI 7-10, Minimum Design Loads for Buildings and Other Structures.

Arcadis, 2013. Decommissioning and Reclamation Plan (DRP) Update 2013 SUA-1471. April.

AK GeoConsults, Inc. (AKG), 1990. Design Brief Evaporation Pond.

Bray, J.D. and Sancio, R.B. 2006. Assessment of the Liquefaction Susceptibility of Fine-Grained Soils. *Journal of Geotechnical & Geoenvironmental Engineering*, Vol. 132, Issue 9. September. Pp 1165 - 1177.

CH2M, 2018. Grants Reclamation Project Water Management Prefeasibility Study. March 20.

Homestake Mining Company of California and Hydro-Engineering, LLC (HMC and Hydro-Engineering), 2018. 2017 Annual Monitoring Report / Performance Review for Homestake's Grants Project Pursuant to NRC License SUA-1471 and Discharge Plan DP-200. March.

Jacobs, 2018. Grants Reclamation Project PFS Fault Study for Seismic Design to support Detailed Design, Draft Technical Memorandum. April 25.

Kelley, V.C. 1967. Tectonics of the Zuni-Defiance Region, New Mexico and Arizona. In: F.D. Trauger (ed.), *Guidebook of Defiance-Zuni-Mt. Taylor Region, Arizona and New Mexico*. Eighteenth Field Conference, October 19, 20, and 21 1967. Pp. 27-32.

New Mexico Administrative Code (NMAC), 2005.19.25.12.13(c)(i) – Dam Design, Construction, and Dam Safety. New Mexico Office of the State Engineer. March.

Stantec Consulting Services Inc. (Stantec), 2018a. Work Plan for EP-1 Geotechnical Characterization Revision 1. August.

Stantec Consulting Services Inc. (Stantec), 2018b. Grants Reclamation Project EP-1 Re-Lining Feasibility Study Revision 1. December.

U.S. Nuclear Regulatory Commission (NRC), 2008. Design, Construction, and Inspection of Embankment Retention Systems at Uranium Recovery Facilities Revision 3. November.

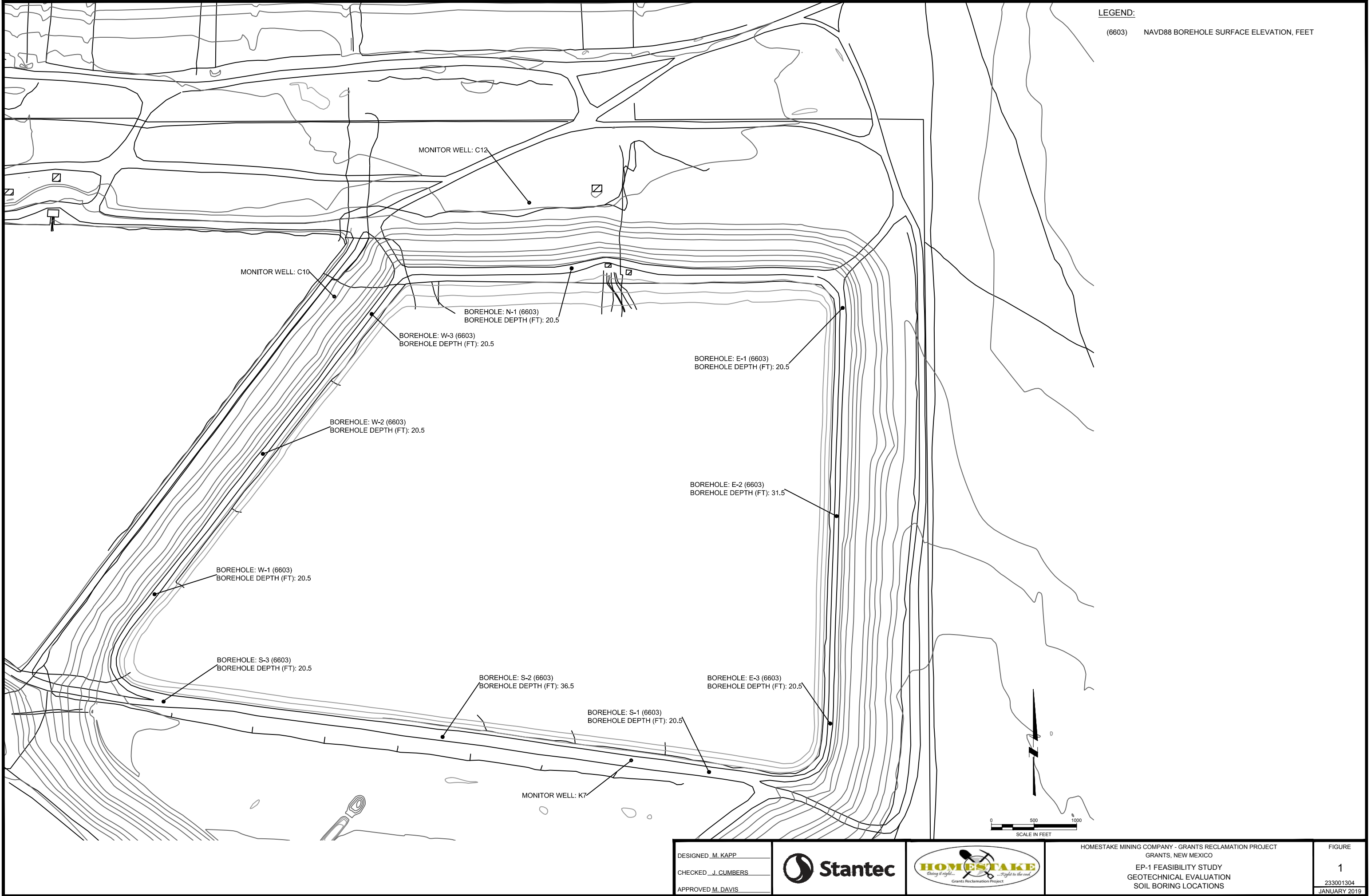
Figures and Appendices
May 7, 2019

FIGURES AND APPENDICES

Figure 1
May 7, 2019

Figure 1
EP-1 Soil Boring and Well Locations

Thursday, January 31, 2019 10:28:59 AM MK4APP O:\2330\ACTIVE\23300130\STANTEC REPORTS\GEOTECH INVEST REPORT\FIGURE\GRANTS EP-1 BOREHOLE FIGURE.DWG Layout\Figure



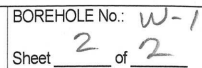
Appendix A
May 7, 2019

APPENDIX A BORING LOGS, SAMPLE PHOTOS, AND DAILY FIELD LOGS

Appendix A
May 7, 2019

BORING LOGS

[illegible]

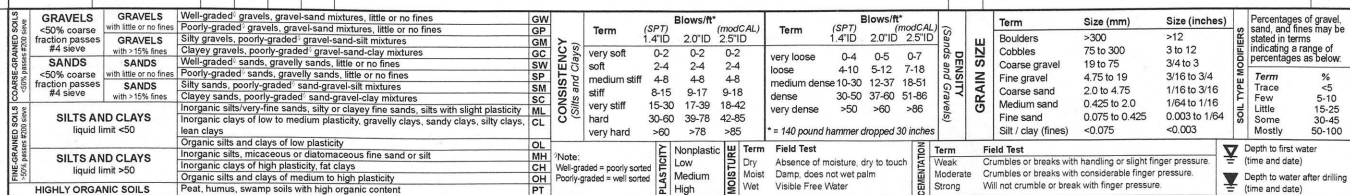


Start Date:

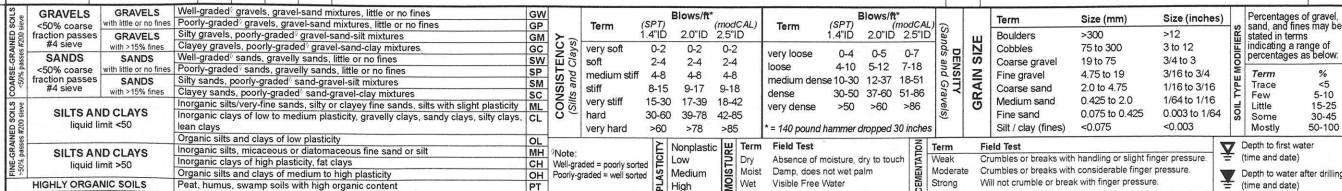
Finish Date:

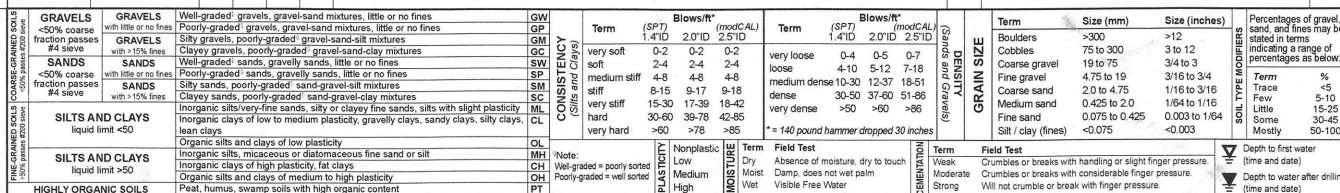
Total Depth:

[illegible]



GRAVELS <50% coarse fraction passes #4 sieve SANDS <50% coarse fraction passes #4 sieve SILTS AND CLAYS liquid limit <50 SILTS AND CLAYS liquid limit >50 HIGHLY ORGANIC SOILS	GRAVELS with little or no fines GRAVELS with >15% fines SANDS with little or no fines SANDS with >15% fines SILTS AND CLAYS liquid limit <50 SILTS AND CLAYS liquid limit >50 HIGHLY ORGANIC SOILS	Well-graded* gravels, gravel-sand mixtures, little or no fines Poorly-graded* gravels, gravel-sand mixtures, little or no fines Silty gravels, poorly-graded* gravel-sand-silt mixtures Clayey gravels, poorly-graded* gravel-silt clay mixtures Silty sands, poorly-graded* gravel-sand mixtures Organic silty sands, gravel-sand mixtures, little or no fines Silty sands, poorly-graded* sand-gravel-silt mixtures Clayey sands, poorly-graded* sand-gravel mixtures Inorganic silty-sand mixtures, silty clay or clayey fine sand Inorganic clays of low to medium plasticity, gravelly clays, silty clays, silty clays, lean clays Organic silts and clays of low plasticity Inorganic silts, micaceous or diatomaceous fine sand or silt Inorganic clays of high plasticity, fat clays Organic silts and clays of medium to high plasticity Peat, humus, peatmoss soils with humus, peatmoss soil	GW GP GM GC SW SP SC SI CL OL MH CH OH	Term (SPT) very soft medium stiff stiff very stiff hard very hard	Blows/ft* (mod CAL) 1.41D 2.01D 2.51D 0.2 0.2 0.2 2.4 2.4 2.4 4.4 4.4 4.4 8.15 9.17 9.18 15.30 17.79 18.42 30.00 36.78 42.85 >80 >78 >85	Term (SPT) very loose loose medium dense dense very dense	Blows/ft* (mod CAL) 1.41D 2.01D 2.51D 0.5 0.7 1.0 1.2 1.7 10.30 13.27 15.81 30.00 40.60 51.86 >50 >60 >86	Term (SPT) very loose loose medium dense dense very dense	Blows/ft* (mod CAL) 1.41D 2.01D 2.51D 0.5 0.7 1.0 1.2 1.7 10.30 13.27 15.81 30.00 40.60 51.86 >50 >60 >86	Term (SPT) very loose loose medium dense dense very dense	Blows/ft* (mod CAL) 1.41D 2.01D 2.51D 0.5 0.7 1.0 1.2 1.7 10.30 13.27 15.81 30.00 40.60 51.86 >50 >60 >86	Term (SPT) very loose loose medium dense dense very dense	Blows/ft* (mod CAL) 1.41D 2.01D 2.51D 0.5 0.7 1.0 1.2 1.7 10.30 13.27 15.81 30.00 40.60 51.86 >50 >60 >86	Term (SPT) very loose loose medium dense dense very dense	Blows/ft* (mod CAL) 1.41D 2.01D 2.51D 0.5 0.7 1.0 1.2 1.7 10.30 13.27 15.81 30.00 40.60 51.86 >50 >60 >86	Term (SPT) very loose loose medium dense dense very dense	Blows/ft* (mod CAL) 1.41D 2.01D 2.51D 0.5 0.7 1.0 1.2 1.7 10.30 13.27 15.81 30.00 40.60 51.86 >50 >60 >86	Term (SPT) very loose loose medium dense dense very dense	Blows/ft* (mod CAL) 1.41D 2.01D 2.51D 0.5 0.7 1.0 1.2 1.7 10.30 13.27 15.81 30.00 40.60 51.86 >50 >60 >86	Term (SPT) very loose loose medium dense dense very dense	Blows/ft* (mod CAL) 1.41D 2.01D 2.51D 0.5 0.7 1.0 1.2 1.7 10.30 13.27 15.81 30.00 40.60 51.86 >50 >60 >86	Term (SPT) very loose loose medium dense dense very dense	Blows/ft* (mod CAL) 1.41D 2.01D 2.51D 0.5 0.7 1.0 1.2 1.7 10.30 13.27 15.81 30.00 40.60 51.86 >50 >60 >86	Term (SPT) very loose loose medium dense dense very dense	Blows/ft* (mod CAL) 1.41D 2.01D 2.51D 0.5 0.7 1.0 1.2 1.7 10.30 13.27 15.81 30.00 40.60 51.86 >50 >60 >86	Term (SPT) very loose loose medium dense dense very dense	Blows/ft* (mod CAL) 1.41D 2.01D 2.51D 0.5 0.7 1.0 1.2 1.7 10.30 13.27 15.81 30.00 40.60 51.86 >50 >60 >86	Term (SPT) very loose loose medium dense dense very dense	Blows/ft* (mod CAL) 1.41D 2.01D 2.51D 0.5 0.7 1.0 1.2 1.7 10.30 13.27 15.81 30.00 40.60 51.86 >50 >60 >86	Term (SPT) very loose loose medium dense dense very dense	Blows/ft* (mod CAL) 1.41D 2.01D 2.51D 0.5 0.7 1.0 1.2 1.7 10.30 13.27 15.81 30.00 40.60 51.86 >50 >60 >86	Term (SPT) very loose loose medium dense dense very dense	Blows/ft* (mod CAL) 1.41D 2.01D 2.51D 0.5 0.7 1.0 1.2 1.7 10.30 13.27 15.81 30.00 40.60 51.86 >50 >60 >86	Term (SPT) very loose loose medium dense dense very dense	Blows/ft* (mod CAL) 1.41D 2.01D 2.51D 0.5 0.7 1.0 1.2 1.7 10.30 13.27 15.81 30.00 40.60 51.86 >50 >60 >86	Term (SPT) very loose loose medium dense dense very dense	Blows/ft* (mod CAL) 1.41D 2.01D 2.51D 0.5 0.7 1.0 1.2 1.7 10.30 13.27 15.81 30.00 40.60 51.86 >50 >60 >86	Term (SPT) very loose loose medium dense dense very dense	Blows/ft* (mod CAL) 1.41D 2.01D 2.51D 0.5 0.7 1.0 1.2 1.7 10.30 13.27 15.81 30.00 40.60 51.86 >50 >60
--	--	---	--	--	---	---	--	---	--	---	--	---	--	---	--	---	--	---	--	---	--	---	--	---	--	---	--	---	--	---	--	---	--	---	--	---	--	---	--

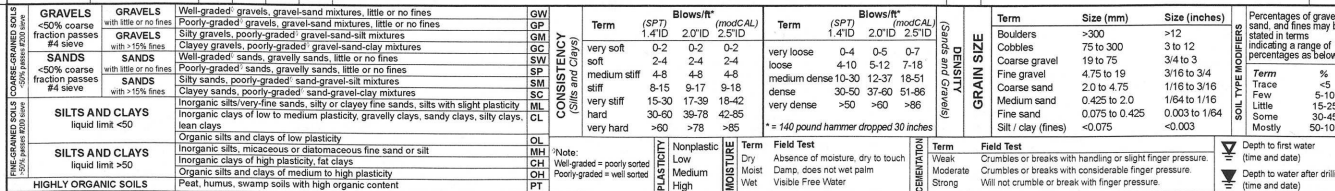




Drilling Company:	Drilling Rig:	Bit Type:	Start Date:
Drillers (day / night):	Drilling Method:	Logged by:	Finish Date:
Field Representative (day / night):	Core Diameter:		Total Depth:

Depth	Sample Number	Blow Count	Recovery (in.)	q _u (tsf)	Lithology / Symbol	Description	Graphic	Remarks	Well Details
10		15				SILTY SAND (SM) CONT'D			
11	B A	29 33	18						
12									
13	B A	20 35	18						
14		47							
15									
16	B A	14 27	18						
17		36							
18	B A	14 21	18						
19		26							
20	B A	8 9	18			TOTAL DEPTH 20.5'			

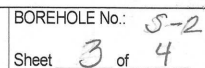
[illegible]



Drilling Company:	Drilling Rig:	Bit Type:	Start Date:
Drillers (day / night):	Drilling Method:	Logged by:	Finish Date:
Field Representative (day / night):	Core Diameter:		Total Depth:

Depth	Sample Number	Blow Count Recovery (in.)	q _u (tsf)	Lithology / Symbol	Description	Graphic	Remarks	Well Details
10		16			SILTY SAND (SM) CONT'D			
		22 1/8						
11	A	28						
12								
		11						
13		18 1/8						
	A	30						
14								
15		17						
		27 1/8						
16	A	31						
17								
		19			CLAYEY SAND (SC), GREY-BROWN, MOIST (LINER ?)			
18	B	22 1/8						
		39						
19								
20								

[illegible]

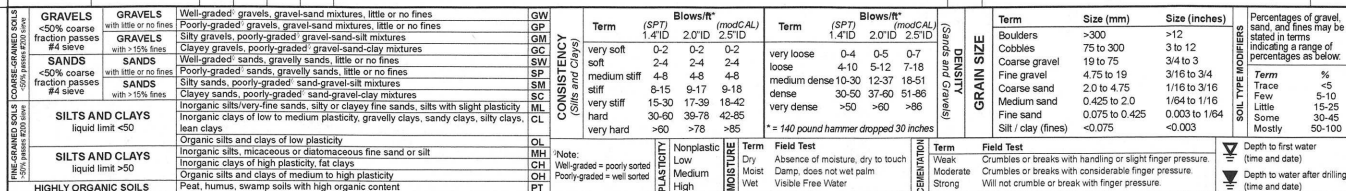


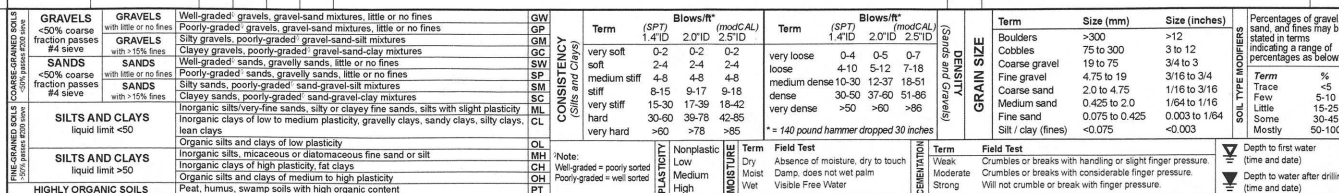
Drilling Company:	Drilling Rig:	Bit Type:	Start Date:
Drillers (day / night):	Drilling Method:	Logged by:	Finish Date:
Field Representative (day / night):	Core Diameter:		Total Depth:

Depth	Sample Number	Blow Count Recovery (in.)	q _u (tsf)	Lithology / Symbol	Description	Graphic	Remarks	Well Details
20		16			SILTY SAND (SM), BROWN,			
		23			MOIST			
21	A	25			(NATIVE?)			
22								
23								
24								
25		7						
		6						
26	A	5			CLAYEY SAND (SC), BROWN, MOIST			
					(NATIVE?)			
27								
28								
29								
30								

GRAVELS <40% coarse fraction passes #4 sieve SANDS with little or no fine sand <50% coarse fraction passes #20 sieve with >15% fines	GRAVELS with little or no fine sand <50% coarse fraction passes #20 sieve with >15% fines	Well-graded* gravels, gravel-sand mixtures, little or no fines Poorly-graded* gravels, gravel-sand mixtures, little or no fines Silty gravels, poorly-graded* gravel-sand-silt mixtures Clayey gravels, poorly-graded* gravel-sand-silt mixtures	GW GP GM GC	Term	Blows/ft* (SPT) 1.4'10 2.0'10 2.5'10	(modCL) 2.5'10	Term	Blows/ft* (SPT) 1.4'10 2.0'10 2.5'10	(modCL) 2.5'10	Term	Size (mm)	Size (inches)	Percentages of gravel, sand, and fines may be stated in terms of percentages ranging from 0 to 100 as follows	TEST METHODS
SANDS with little or no fine sand <50% coarse fraction passes #20 sieve with >15% fines	SANDS with little or no fine sand <50% coarse fraction passes #20 sieve with >15% fines	Poorly-graded* sands, gravelly sands, little or no fines Silty sands, poorly-graded* sand-gravel-silt mixtures Clayey sands, poorly-graded* sand-gravel-silt mixtures Inorganic silt very fine-line sands, silty or clayey fine sands, silts with slight plasticity Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	SP SM SC ML CL	very soft medium stiff medium stiff stiff very hard very hard	0-2 0.2-0.2 0.2-0.2 0.2-0.2 0.2-0.2 0.2-0.2	0-2 0.2-0.2 0.2-0.2 0.2-0.2 0.2-0.2 0.2-0.2	very loose loose medium dense very dense	0-4 0.5-0.7 1.0-1.2 >1.2	0-4 0.5-0.7 1.0-1.2 >1.2	very loose loose medium dense very dense	300 75 to 300 19 to 75 4.75 to 19 2.0 to 4.75 0.425 to 2.0 0.075 to 0.425	12 3 to 12 3/4 to 3 1/4 to 3/4 1/16 to 3/16 1/64 to 1/16 0.003 to 1/64	Trace 5 10 15-25 50-100	ASTM D 1557 ASTM D 1586 ASTM

[illegible]







Client: SEE SHEET 1
Project Number:

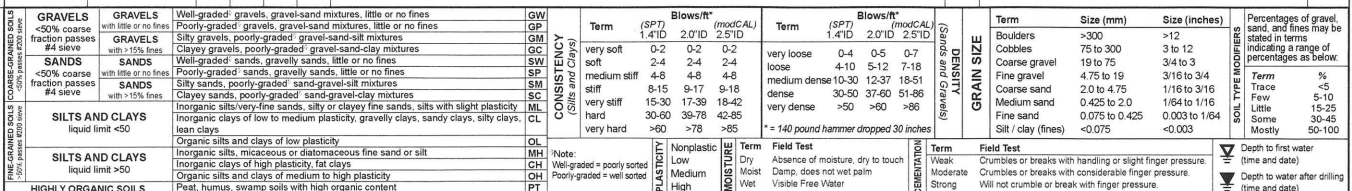
SOIL BORING
LOG FORM

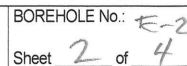
BOREHOLE No.: E-1
Sheet 2 of 2

Drilling Company: Drilling Rig: Bit Type: Start Date:
Drillers (day / night): Drilling Method: Logged by: Finish Date:
Field Representative (day / night): Core Diameter: Total Depth:

Depth	Sample Number	Blow Count	Recovery (in.)	q _u (tsf)	Lithology / Symbol	Description	Graphic	Remarks	Well Details
10		5				SILTY SAND (SM) CONT'D			
11	A	6	18						
12									
13		4				CLAYEY SAND LENSE (SC), GRAY, MOIST			
14	A	5	18						
15									
16	A	3							
17		4	18						
18		7				CLAYEY SAND LENSE (SC), GRAY, MOIST			
19	A	7							
20		6							
	A	7	18						
		9				TOTAL DEPTH 20.5'			

GRAVELS	GRAVELS	Well-graded: gravels, gravel-sand mixtures, little or no fines	GW	Term	(SPT)	Blows/ft	(mod CAL)	Term	(SPT)	Blows/ft	(mod CAL)	Term	Size (mm)	Size (inches)	Percentage of gravel, sand, and fines may be stated in terms indicating a range of percentages as below
<50% coarse fraction passes #4 sieve	<50% coarse fraction passes #4 sieve	Poorly-graded: gravels, gravel-sand mixtures, little or no fines	GP	very soft	0-2	0-2	0-2	very loose	0-4	0-5	0-7	loose	>300	>12	
<50% coarse fraction passes #4 sieve	<50% coarse fraction passes #4 sieve	Silty gravels, poorly-graded: gravel-sand-silt mixtures	GM	soft	2-4	2-4	2-4	medium dense	10-30	12-37	18-51	loose	75 to 300	3 to 12	
<50% coarse fraction passes #4 sieve	<50% coarse fraction passes #4 sieve	Clayey gravels, poorly-graded: gravel-sand-silt mixtures	GC	medium stiff	4-8	4-8	4-8	dense	30-50	37-60	51-86	loose	19 to 75	3/4 to 3	
<50% coarse fraction passes #4 sieve	<50% coarse fraction passes #4 sieve	Well-graded: sands, gravelly sands, little or no fines	SW	stiff	8-15	9-17	9-18	very dense	>50	>60	>86	loose	4.75 to 19	3/16 to 3/4	
<50% coarse fraction passes #4 sieve	<50% coarse fraction passes #4 sieve	Poorly-graded: sands, gravelly sands, little or no fines	SP	very stiff	15-30	17-39	18-42					loose	2.0 to 4.75	1/16 to 3/16	
<50% coarse fraction passes #4 sieve	<50% coarse fraction passes #4 sieve	Silty sands, poorly-graded: sand-gravel-silt mixtures	SM	hard	30-60	39-78	42-85					loose	0.425 to 2.0	1/64 to 1/16	
<50% coarse fraction passes #4 sieve	<50% coarse fraction passes #4 sieve	Clayey sands, poorly-graded: sand-gravel-clay mixtures	SC	very hard	>60	>78	>85					loose	0.075 to 0.425	0.003 to 1/64	
<50% coarse fraction passes #4 sieve	<50% coarse fraction passes #4 sieve	Inorganic silts, micaceous or diatomaceous fine sand or silt	ML									loose	<0.075	<0.003	
<50% coarse fraction passes #4 sieve	<50% coarse fraction passes #4 sieve	Organic silts and clays of low plasticity	OL									loose			
<50% coarse fraction passes #4 sieve	<50% coarse fraction passes #4 sieve	Inorganic clays of high plasticity, fat clays	MH									loose			
<50% coarse fraction passes #4 sieve	<50% coarse fraction passes #4 sieve	Organic clays of medium to high plasticity	CH									loose			
<50% coarse fraction passes #4 sieve	<50% coarse fraction passes #4 sieve	Peat, humus, swamp soils with high organic content	PT									loose			

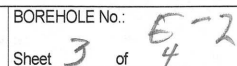




Drilling Company:	Drilling Rig:	Bit Type:	Start Date:
Drillers (day / night):	Drilling Method:	Logged by:	Finish Date:
Field Representative (day / night):	Core Diameter:		Total Depth:

Depth	Sample Number	Blow Count Recovery (in.)	q _u (tsf)	Lithology / Symbol	Description	Graphic	Remarks	Well Details
10		26			CLAYEY SAND (SC), GRAY-BROWN, MOIST			
11	A	44.8 <u>50</u> 5"						
12								
13		15 15.8						
14	A	19						
15								
16	A	7 6.8 10			SANDY CLAY LENSSE (CL), GRAY, MOIST			
17								
18	B A	3 3.8 6			SANDY CLAY LENSSE (CL), GRAY, MOIST			
19								
20								

[illegible]



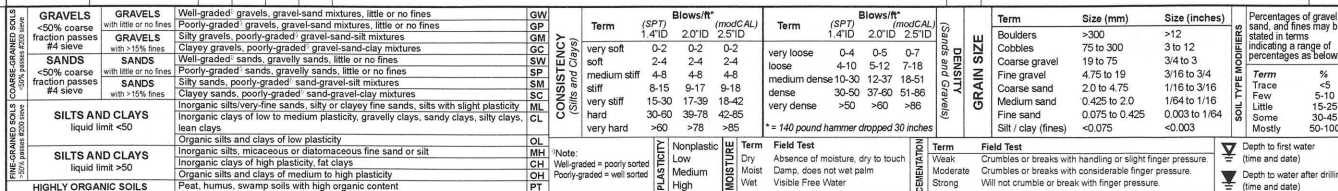
Drilling Company:	Drilling Rig:	Bit Type:	Start Date:
Drillers (day / night):	Drilling Method:	Logged by:	Finish Date:
Field Representative (day / night):	Core Diameter:		Total Depth:

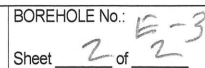
Depth	Sample Number	Blow Count Recovery (in.) q_u (tsf)	Lithology / Symbol	Description	Graphic	Remarks	Well Details
20		6		SILTY SAND (SM), GRAY-BROWN, MOIST (NATIVE)			
21	A	6 ¹⁸ 9					
22							
23							
24							
25		5 4 ¹⁸					
26	A	6					
27							
28							
29							
30							

[illegible]

Drilling Company:	Drilling Rig:	Bit Type:	Start Date:
Drillers (day / night):	Drilling Method:	Logged by:	Finish Date:
Field Representative (day / night):	Core Diameter:		Total Depth:

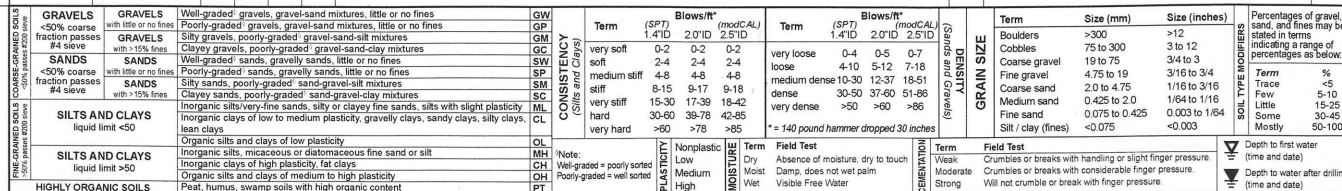
[illegible][illegible]

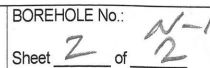




Depth	Sample Number	Blow Count Recovery (in.) q _u (tsf)	Lithology / Symbol	Description	Graphic	Remarks	Well Details
	A	24 32 18 38		SILTY SAND (SM) CONT'D			
	A	21 44 18 36					
	A	13 20 18 33					
	A	17 29 18 40		CLAYEY SAND (SC), GRAY-BROWN, MOIST			
	A	9 19 18 14		SILTY SAND (SM), GRAY-BROWN, MOIST (14.5' - 18')			
				TOTAL DEPTH 20.5'			

[illegible]





Start Date:

Finish Date:

Total Depth:	
--------------	--

[illegible]

Appendix A
May 7, 2019

SAMPLE PHOTOS

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 1. Sample E-3-5A



Photoset 2. Sample E-3-10A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 3. Sample E-3-12.5A

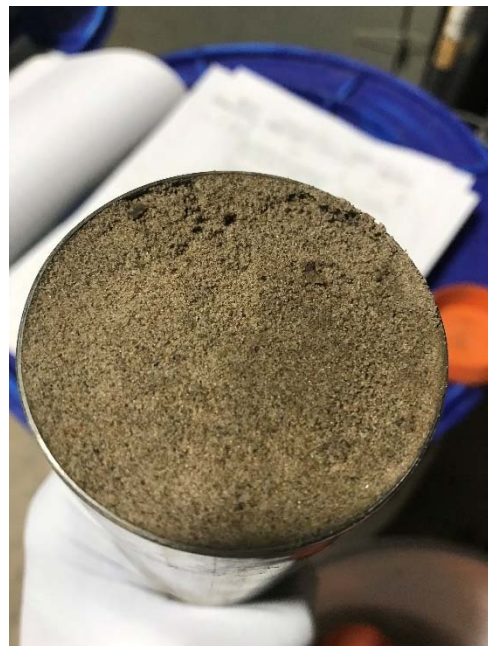


Photoset 4. Sample E-3-15A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION

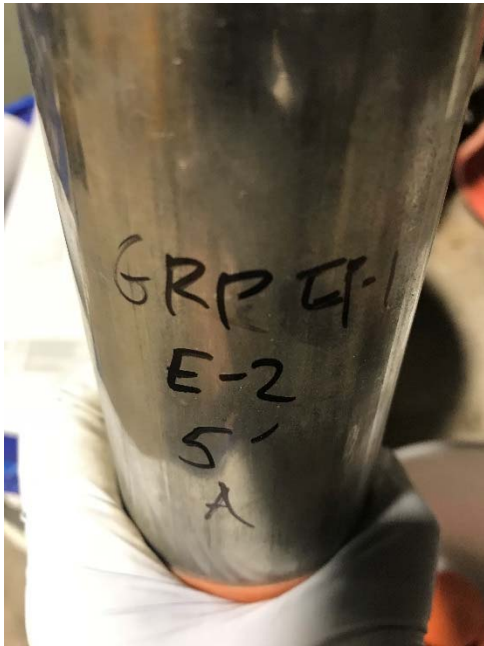


Photoset 5. Sample E-3-17.5A



Photoset 6. Sample E-3-19A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION

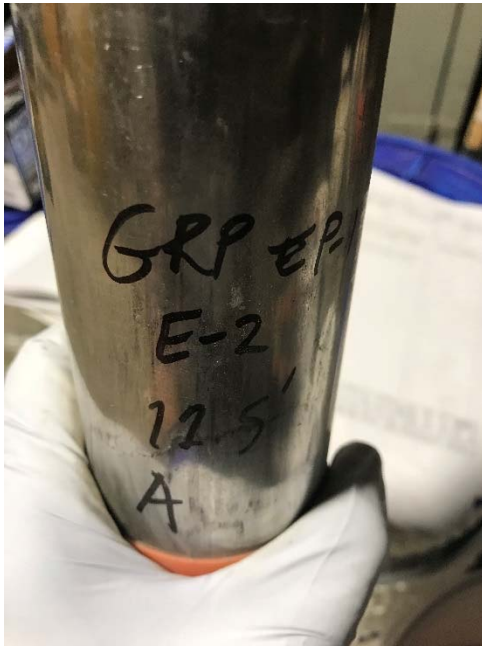


Photoset 7. Sample E-2-5A



Photoset 8. Sample E-2-10A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 9. Sample E-2-12.5A



Photoset 10. Sample E-2-15A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 11. Sample E-2-17.5B



Photoset 12. Sample E-2-17.5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 13. Sample E-2-20A



Photoset 14. Sample E-2-25A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 15. Sample E-2-30A



Photoset 16. Sample E-1-5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 17. Sample E-1-10A



Photoset 18. Sample E-1-12.5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 19. Sample E-1-15A



Photoset 20. Sample E-1-17.5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 21. Sample E-1-19A



Photoset 22. Sample N-1-5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 23. Sample N-1-10A



Photoset 24. Sample N-1-12.5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 25. Sample N-1-15A



Photoset 26. Sample N-1-17.5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 27. Sample N-1-19A



Photoset 28. Sample W-3-5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 29. Sample W-3-10A



Photoset 30. Sample W-3-12.5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 31. Sample W-3-15A



Photoset 32. Sample W-3-17.5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 33. Sample W-3-19A



Photoset 34. Sample W-2-5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 35. Sample W-2-10A



Photoset 36. Sample W-2-12.5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 37. Sample W-2-15A



Photoset 38. Sample W-2-17.5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 39. Sample W-2-19A



Photoset 40. Sample W-1-5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 41. Sample W-1-10A



Photoset 42. Sample W-1-12.5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 43. Sample W-1-15A



Photoset 44. Sample W-1-17.5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 45. Sample W-1-19A



Photoset 46. Sample S-3-5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 47. Sample S-1-10A



Photoset 48. Sample S-3-12.5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 49. Sample S-3-15A



Photoset 50. Sample S-3-17.5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 51. Sample S-3-19A



Photoset 52. Sample S-1-5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 53. Sample S-1-10A



Photoset 54. Sample S-1-12.5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 55. Sample S-1-15A



Photoset 56. Sample S-1-17.5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 57. Sample S-1-19A



Photoset 58. Sample S-2-5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 59. Sample S-2-10A



Photoset 60. Sample S-2-12.5A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 61. Sample S-2-15A



Photoset 62. Sample S-2-17.5B

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 63. Sample S-2-20A



Photoset 64. Sample S-2-25A

GRANTS RECLAMATION PROJECT EP-1 GEOTECHNICAL INVESTIGATION



Photoset 65. Sample S-2-30A



Photoset 66. Sample S-2-35A

Appendix A
May 7, 2019

DAILY FIELD LOGS

Date Mon, 9/17/2018

PROJECT: GRP EP-1 Drilling

JOB NO: 233001304

CLIENT: Homestake Mining Co.

CONTRACTOR: Stantec

PROJECT MANAGER: Melanie Davis

Weather	<input checked="" type="checkbox"/> Bright Sun	<input type="checkbox"/> Sunny	<input type="checkbox"/> Over-cast	<input type="checkbox"/> Rain	<input type="checkbox"/> Snow
Temp. °F	<input type="checkbox"/> <32	<input type="checkbox"/> 32-50	<input type="checkbox"/> 50-70	<input type="checkbox"/> 70-85	<input checked="" type="checkbox"/> 85-100
Wind	<input type="checkbox"/> Still	<input checked="" type="checkbox"/> Moder.	<input type="checkbox"/> High	Report No.	
Humidity	<input checked="" type="checkbox"/> Dry	<input type="checkbox"/> Moder.	<input type="checkbox"/> Humid	1	

Onsite Personnel

Name	Company	Position	Remarks
Matthew Kapp	Stantec	Field Engineer	
Matthew Cain	Cascade	Drill Operator	
Matthew Sanchez	Cascade	Drill Hand	
Sibert Leslie	Cascade	Drill Hand	

Equipment

Item	Company	Op Hrs
CME 85 Drill Rig	Cascade	9

Safety:

No incidents reported

Activities Summary:

Stantec and Cascade arrived onsite at 0700. Site specific training was conducted, completing at approximately 0900. Rig prep was complete at approximately 1130. Drilling started at 1200 at S-1 and was complete at approximately 1330. Six SPT drives were conducted, with 12 sample sleeves kept for laboratory testing. Total Depth of S-1 was 20.5 feet bgs. The drill rig was mobilized to S-2 and drilling commenced at approximately 1400. At 1530 drilling was stopped to allow cleanup and exit screening time before the 1600 site gate closure. A depth of 31.5 feet bgs was reached at S-2 and 8 SPT drives were conducted, with 8 sample sleeves kept for laboratory testing. Cascade and Stantec signed out and left the site at 1600.

A total of approximately 52 feet were drilled and 19 sample sleeves were kept on this day.

By: M. Kapp

Title: Field Engineer

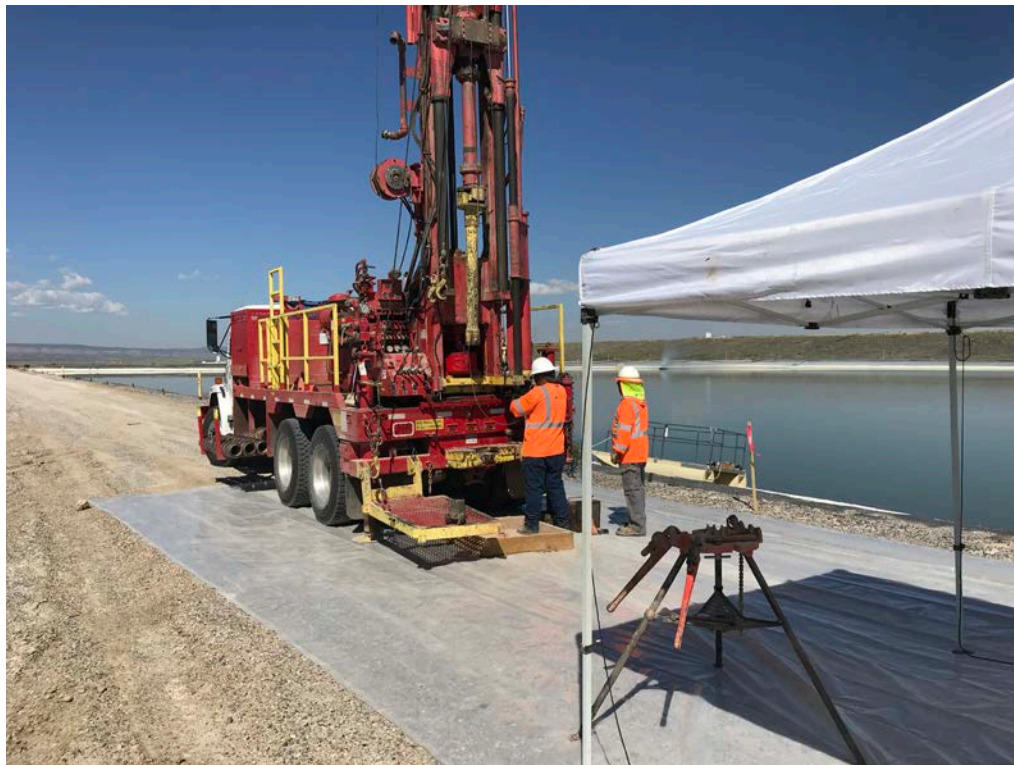


Photo 1. Drilling setup at borehole S-1



Photo 1. Drilling at borehole S-1

Date Tue, 9/18/2018

PROJECT: GRP EP-1 DrillingJOB NO: 233001304CLIENT: Homestake Mining Co.CONTRACTOR: StantecPROJECT MANAGER: Melanie Davis

Weather	<input checked="" type="checkbox"/> Bright Sun	<input type="checkbox"/> Sunny	<input type="checkbox"/> Over-cast	<input type="checkbox"/> Rain	<input type="checkbox"/> Snow
Temp. °F	<input type="checkbox"/> <32	<input type="checkbox"/> 32-50	<input type="checkbox"/> 50-70	<input type="checkbox"/> 70-85	<input checked="" type="checkbox"/> 85-100
Wind	<input type="checkbox"/> Still	<input checked="" type="checkbox"/> Moder.	<input type="checkbox"/> High	Report No. 2	
Humidity	<input checked="" type="checkbox"/> Dry	<input type="checkbox"/> Moder.	<input type="checkbox"/> Humid		

Onsite Personnel

Name	Company	Position	Remarks
Matthew Kapp	Stantec	Field Engineer	
Matthew Cain	Cascade	Drill Operator	
Matthew Sanchez	Cascade	Drill Hand	
Sibert Leslie	Cascade	Drill Hand	

Equipment

Item	Company	Op Hrs
CME 85 Drill Rig	Cascade	9

Safety:

No incidents reported

Activities Summary:

Stantec and Cascade arrived onsite at 0630. Paperwork, donning, and drill rig warmup were complete at approximately 0730. S-2 drilling reconvened at 0730 and was complete at approximately 0800. One SPT drive was conducted at SB-2, with 1 sample sleeve kept for laboratory testing. Total Depth of S-2 was 36.5 feet bgs. The drill rig was mobilized to S-3 and drilling commenced at approximately 0830, completing at 0915. Total depth of S-3 was 20.5 feet bgs, with 6 SPT drives conducted and 6 sample sleeves kept for laboratory testing. The drill rig was mobilized to W-1 and drilling commenced at approximately 0945, completing at 1030. Total depth of W-1 was 20.5 feet bgs, with 6 SPT drives conducted and 6 sample sleeves kept for laboratory testing. The drill rig was mobilized to W-2 and drilling commenced at approximately 1045, completing at 1130. Total depth of W-2 was 20.5 feet bgs, with 6 SPT drives conducted and 6 sample sleeves kept for laboratory testing. The drill rig was mobilized to W-3 and drilling commenced at approximately 1300, completing at 1345. Total depth of W-3 was 20.5 feet bgs, with 6 SPT drives conducted and 6 sample sleeves kept for laboratory testing. The drill rig was mobilized to N-1 and drilling commenced at approximately 1430, completing at 1530. Total depth of N-1 was 20.5 feet bgs, with 6 SPT drives conducted and 6 sample sleeves kept for laboratory testing. After completion of N-1, the drill rig was secured for the night. Cascade and Stantec doffed, screened out, and filled out daily exit paperwork.

A total of approximately 107.5 feet were drilled and 31 sample sleeves were kept on this day.

By: M. KappTitle: Field Engineer

Date Wed, 9/19/2018

PROJECT: GRP EP-1 Drilling

JOB NO: 233001304

CLIENT: Homestake Mining Co.

CONTRACTOR: Stantec

PROJECT MANAGER: Melanie Davis

Weather	<input type="checkbox"/> Bright Sun	<input type="checkbox"/> Sunny	<input checked="" type="checkbox"/> Over-cast	<input type="checkbox"/> Rain	<input type="checkbox"/> Snow
Temp. °F	<input type="checkbox"/> <32	<input type="checkbox"/> 32-50	<input type="checkbox"/> 50-70	<input checked="" type="checkbox"/> 70-85	<input type="checkbox"/> 85-100
Wind	<input type="checkbox"/> Still	<input checked="" type="checkbox"/> Moder.	<input type="checkbox"/> High	Report No.	
Humidity	<input checked="" type="checkbox"/> Dry	<input type="checkbox"/> Moder.	<input type="checkbox"/> Humid	3	

Onsite Personnel

Name	Company	Position	Remarks
Matthew Kapp	Stantec	Field Engineer	
Matthew Cain	Cascade	Drill Operator	
Matthew Sanchez	Cascade	Drill Hand	
Sibert Leslie	Cascade	Drill Hand	

Equipment

Item	Company	Op Hrs
CME 85 Drill Rig	Cascade	9

Safety:

No incidents reported

Activities Summary:

Stantec and Cascade arrived onsite at 0630. Paperwork, donning, and drill rig warmup were complete at approximately 0730. E-1 drilling started at 0730 and was complete at approximately 0815. Total depth of E-1 was 20.5 feet bgs, with 6 SPT drives conducted and 6 sample sleeves kept for laboratory testing. The drill rig was mobilized to E-2 and drilling commenced at approximately 0830, completing at 0930. Total depth of E-2 was 31.5 feet bgs, with 8 SPT drives conducted and 9 sample sleeves kept for laboratory testing. The drill rig was mobilized to E-3 and drilling commenced at approximately 1000, completing at 1100. Total depth of E-3 was 20.5 feet bgs, with 6 SPT drives conducted and 6 sample sleeves kept for laboratory testing. After completion of E-3, the drill rig and Stantec rental vehicles were cleaned and decontaminated. Vehicles and equipment were exit screened by HMC staff. Stantec and Cascade staff completed job/site exit paperwork and bioassays. Stantec signed out and left the site at approximately 1430.

A total of approximately 72.5 feet were drilled and 21 sample sleeves were kept on this day.

By: M. Kapp

Title: Field Engineer



Photo 1. Drilling at borehole W-1

Appendix B
May 7, 2019

APPENDIX B LABORATORY DATA



ADVANCED TERRA TESTING

Moisture and Density ASTM D 2216 and ASTM D 7263

CLIENT	Stantec	JOB NO.	2868-024
PROJECT	GRP EP-1 Relining	LOCATION	--
PROJECT NO.	233001304		
BORING NO.	W-3		
DEPTH	18.5-19'		
SAMPLE NO.	W-3-17.5A		
DATE SAMPLED			
DATE TESTED	11/29/18		
TECHNICIAN	CAL		
DESCRIPTION	Native - SC		
Mass of Wet Pan and Soil (g):	367.36		
Mass of Dry Pan and Soil (g):	327.82		
Mass of Pan (g):	124.06		
Moisture (%):	19.4		
Diameter (in):	2.37		
Height (in):	3.79		
Mass of Wet Soil and Ring (g):	491.48		
Mass of Ring (g):			
Wet Density (lbs/ft³):	111.9		
Dry Density (lbs/ft³):	93.7		
Wet Density (kg/m³):	1792		
Dry Density (kg/m³):	1501		
BORING NO.			
DEPTH			
SAMPLE NO.			
DATE SAMPLED			
DATE TESTED			
TECHNICIAN			
DESCRIPTION			
Mass of Wet Pan and Soil (g):			
Mass of Dry Pan and Soil (g):			
Mass of Pan (g):			
Moisture (%):			
Diameter (in):			
Height (in):			
Mass of Wet Soil and Ring (g):			
Mass of Ring (g):			
Wet Density (lbs/ft³):			
Dry Density (lbs/ft³):			
Wet Density (kg/m³):			
Dry Density (kg/m³):			
NOTES			
Data entry by:	SPH	Date:	11/30/2018
Checked by:	<u>CAL</u>	Date:	<u>12/03/2018</u>
File name:	2868024_Moisture and Density ASTM D7236_0.xls		



ADVANCED TERRA TESTING

Moisture and Density ASTM D 2216 and ASTM D 7263

CLIENT	Stantec			JOB NO.	2868-024
PROJECT	GRP EP-1 Relining			LOCATION	--
PROJECT NO.	233001304				

BORING NO.	E-1	E-2	E-2	S-2
DEPTH	11-11.5'	18.5-19'	26.0-26.5'	18-18.5'
SAMPLE NO.	E-1-10A	E-2-17.5A	E-2-25A	S-2-17.5B
DATE SAMPLED				
DATE TESTED	12/03/18	12/03/18	12/03/18	12/03/18
TECHNICIAN	DPM	DPM	DPM	DPM
DESCRIPTION				

Mass of Wet Pan and Soil (g):	124.64	133.31	116.03	157.07
Mass of Dry Pan and Soil (g):	119.05	111.94	107.63	132.27
Mass of Pan (g):	7.32	6.74	8.35	6.96
Moisture (%):	5.0	20.3	8.5	19.8
Diameter (in):	2.40	2.41	2.38	2.41
Height (in):	1.00	1.00	1.00	1.00
Mass of Wet Soil and Ring (g):	159.47	168.72	149.83	192.26
Mass of Ring (g):	42.15	42.15	42.15	42.15
Wet Density (lbs/ft³):	99.3	105.9	92.8	125.6
Dry Density (lbs/ft³):	94.6	88.0	85.5	104.9
Wet Density (kg/m³):	1591	1697	1486	2012
Dry Density (kg/m³):	1515	1410	1370	1680

BORING NO.	W-2
DEPTH	16-16.5'
SAMPLE NO.	W-2-15A
DATE SAMPLED	
DATE TESTED	12/03/18
TECHNICIAN	DPM
DESCRIPTION	

Mass of Wet Pan and Soil (g):	127.97
Mass of Dry Pan and Soil (g):	114.68
Mass of Pan (g):	6.72
Moisture (%):	12.3
Diameter (in):	2.37
Height (in):	1.00
Mass of Wet Soil and Ring (g):	163.40
Mass of Ring (g):	42.15
Wet Density (lbs/ft³):	104.6
Dry Density (lbs/ft³):	93.1
Wet Density (kg/m³):	1675
Dry Density (kg/m³):	1491

NOTES	
-------	--

Data entry by:	SPH	Date:	12/4/2018
Checked by:	<u>CH</u>	Date:	<u>12/5/18</u>
File name:	2868024_Moisture and Density ASTM D7236_1.xls		



Atterberg Limits ASTM D 4318

ADVANCED TERRA TESTING

CLIENT Stantec
JOB NO. 2868-024
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
LOCATION --
DATE TESTED 11/29/18
TECHNICIAN CAL

BORING NO. W-1
DEPTH 18.5-19.0'
SAMPLE NO. W-1-17.5 A
DATE SAMPLED --
SAMPLED BY --
DESCRIPTION --

Plastic Limits

Mass of Wet Pan and Soil (g):	5.59	5.86
Mass of Dry Pan and Soil (g):	4.94	5.19
Mass of Pan (g):	1.06	1.15
Moisture (%)	16.7	16.5

Liquid Limits

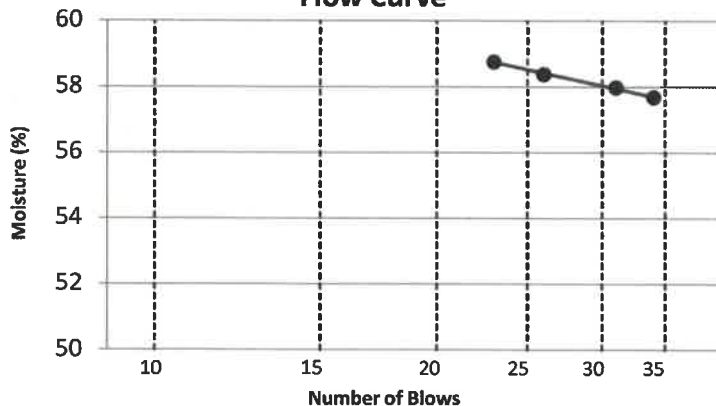
Number of Blows	23	26	31	34
Mass of Wet Pan and Soil (g):	10.00	10.20	8.93	11.03
Mass of Dry Pan and Soil (g):	6.73	6.84	6.08	7.42
Mass of Pan (g):	1.17	1.08	1.15	1.15
Moisture (%)	58.8	58.4	58.0	57.7

Plastic Index

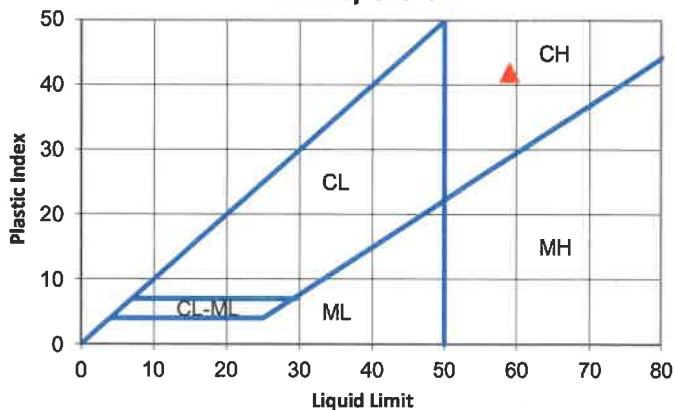
Plastic Limit: 17
Liquid Limit: 59
Plastic Index: 42

Atterberg Classification: CH
Method: A

Flow Curve



Plasticity Chart



NOTES

Data entry by: CAL
Checked by: SPH
File name: 2868024 Atterberg ASTM D4318_0.xlsm

Date: 11/30/2018
Date: 12-3-18



Atterberg Limits
ASTM D 4318

ADVANCED TERRA TESTING

CLIENT Stantec
JOB NO. 2868-024
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
LOCATION --
DATE TESTED 12/05/18
TECHNICIAN SKS

BORING NO. W-3
DEPTH 18.5-19'
SAMPLE NO. W-3-17.5A
DATE SAMPLED --
SAMPLED BY --
DESCRIPTION --

Plastic Limits

Mass of Wet Pan and Soil (g):
Mass of Dry Pan and Soil (g):
Mass of Pan (g):

Moisture (%)

Non-Plastic

Liquid Limits

Number of Blows
Mass of Wet Pan and Soil (g):
Mass of Dry Pan and Soil (g):
Mass of Pan (g):

Moisture (%)

Corrected Moisture (%)

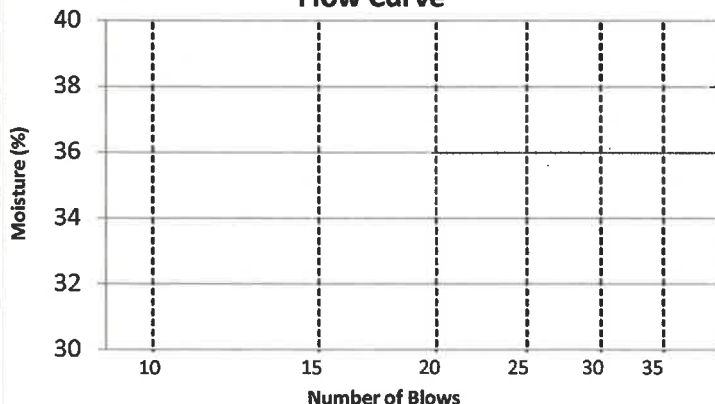
Non-Plastic

Plastic Index

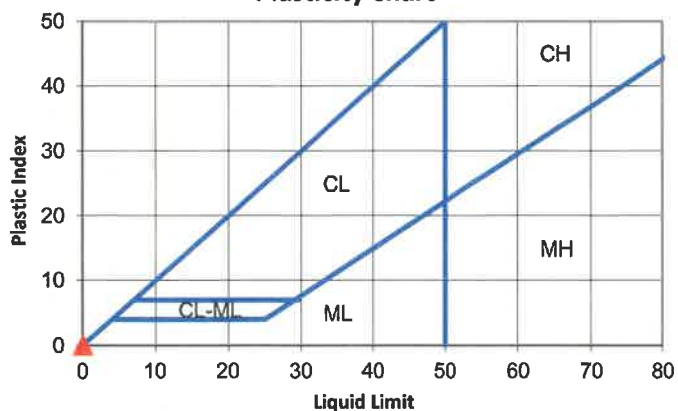
Plastic Limit: --
Liquid Limit: --
Plastic Index: --

Atterberg Classification: NP
Method: A

Flow Curve



Plasticity Chart



NOTES

Data entry by: SPH
Checked by: CAC
File name: 2868024 Atterberg ASTM D4318 1.xlsm

Date: 12/6/2018
Date: 12/6/2018



Atterberg Limits ASTM D 4318

ADVANCED TERRA TESTING

CLIENT Stantec
JOB NO. 2868-024
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
LOCATION --
DATE TESTED 12/05/18
TECHNICIAN SKS

BORING NO. S-2
DEPTH 18-18.5'
SAMPLE NO. S-2-17.5B
DATE SAMPLED --
SAMPLED BY --
DESCRIPTION --

Plastic Limits

Mass of Wet Pan and Soil (g):	7.27	7.20
Mass of Dry Pan and Soil (g):	6.45	6.42
Mass of Pan (g):	1.09	1.14
Moisture (%)	15.4	14.6

Liquid Limits

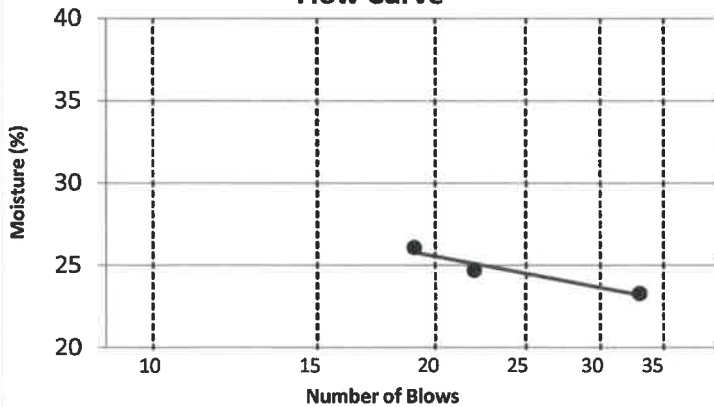
Number of Blows	19	22	33
Mass of Wet Pan and Soil (g):	14.24	17.45	17.13
Mass of Dry Pan and Soil (g):	11.52	14.22	14.10
Mass of Pan (g):	1.10	1.11	1.09
Moisture (%)	26.1	24.7	23.3

Plastic Index

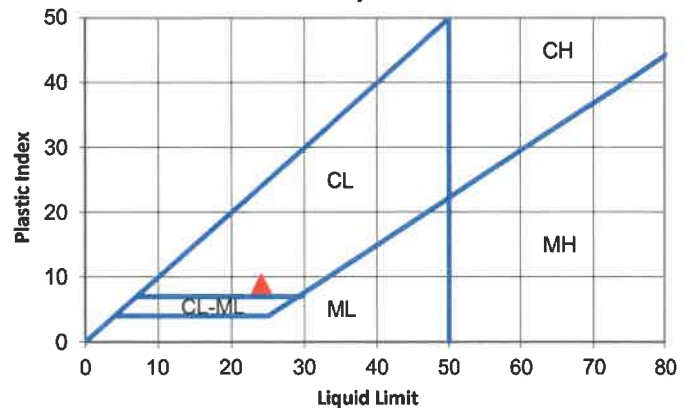
Plastic Limit: 15
Liquid Limit: 24
Plastic Index: 9

Atterberg Classification: CL
Method: A

Flow Curve



Plasticity Chart



NOTES

Data entry by: SPH
Checked by: CM
File name: 2868024 Atterberg ASTM D4318_3.xlsm

Date: 12/6/2018
Date: 12/6/2018



Atterberg Limits ASTM D 4318

ADVANCED TERRA TESTING

CLIENT Stantec
JOB NO. 2868-024
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
LOCATION --
DATE TESTED 12/05/18
TECHNICIAN SPH

BORING NO. E-2
DEPTH 18.5-19'
SAMPLE NO. E-2-17.5A
DATE SAMPLED --
SAMPLED BY --
DESCRIPTION --

Plastic Limits

Mass of Wet Pan and Soil (g):	10.37	10.73	10.60
Mass of Dry Pan and Soil (g):	8.87	9.17	9.08
Mass of Pan (g):	1.12	1.14	1.14
Moisture (%)	19.4	19.4	19.2

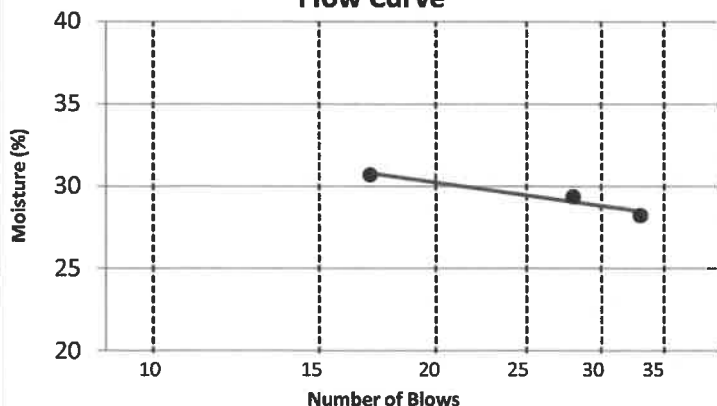
Liquid Limits

Number of Blows	17	28	33
Mass of Wet Pan and Soil (g):	15.40	17.23	17.12
Mass of Dry Pan and Soil (g):	12.06	13.57	13.60
Mass of Pan (g):	1.17	1.13	1.15
Moisture (%)	30.7	29.4	28.2

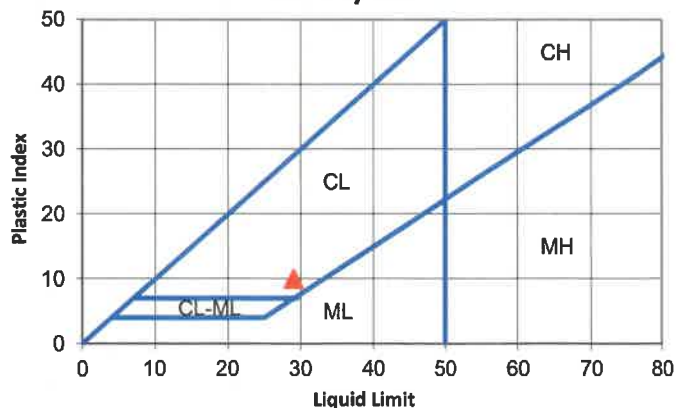
Plastic Index

Plastic Limit: 19 Atterberg Classification: CL
Liquid Limit: 29 Method: A
Plastic Index: 10

Flow Curve



Plasticity Chart



NOTES

Data entry by: SPH
Checked by: cm
File name: 2868024 Atterberg ASTM D4318_4.xlsm

Date: 12/6/2018
Date: 12/6/2018



Atterberg Limits ASTM D 4318

ADVANCED TERRA TESTING

CLIENT Stantec
JOB NO. 2868-024
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
LOCATION --
DATE TESTED 12/05/18
TECHNICIAN SPH

BORING NO. E-1
DEPTH 11-11.5'
SAMPLE NO. E-1-10A
DATE SAMPLED --
SAMPLED BY --
DESCRIPTION --

Plastic Limits

Mass of Wet Pan and Soil (g):
Mass of Dry Pan and Soil (g):
Mass of Pan (g):

Moisture (%)

Non-Plastic

Liquid Limits

Number of Blows
Mass of Wet Pan and Soil (g):
Mass of Dry Pan and Soil (g):
Mass of Pan (g):

Moisture (%)
Corrected Moisture (%)

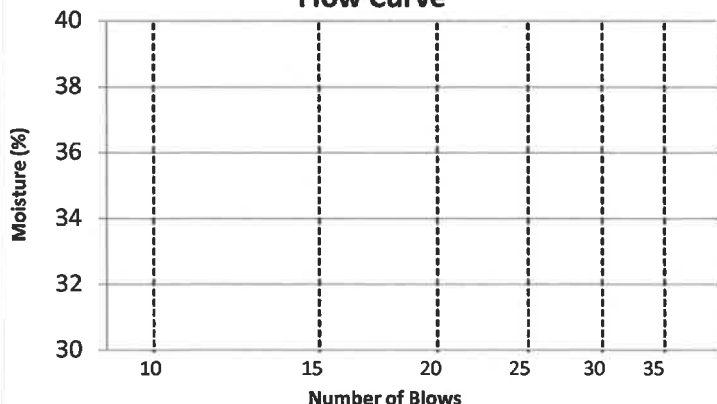
Non-Plastic

Plastic Index

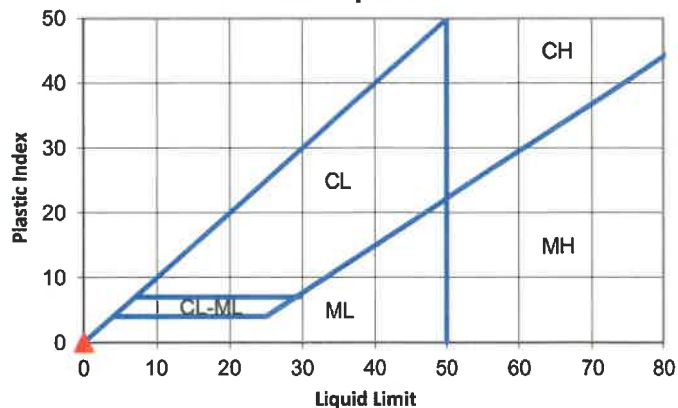
Plastic Limit: --
Liquid Limit: --
Plastic Index: --

Atterberg Classification: NP
Method: A

Flow Curve



Plasticity Chart



NOTES

Data entry by: SPH
Checked by: CAL
File name: 2868024 Atterberg ASTM D4318 2.xlsm

Date: 12/6/2018
Date: 12/6/2018



Atterberg Limits ASTM D 4318

ADVANCED TERRA TESTING

CLIENT Stantec
JOB NO. 2868-024
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
LOCATION --
DATE TESTED 12/05/18
TECHNICIAN SPH

BORING NO. W-2
DEPTH 16-16.5'
SAMPLE NO. W-2-15A
DATE SAMPLED --
SAMPLED BY --
DESCRIPTION --

Plastic Limits

Mass of Wet Pan and Soil (g):	11.17	11.11
Mass of Dry Pan and Soil (g):	9.46	9.42
Mass of Pan (g):	1.17	1.15
Moisture (%)	20.5	20.5

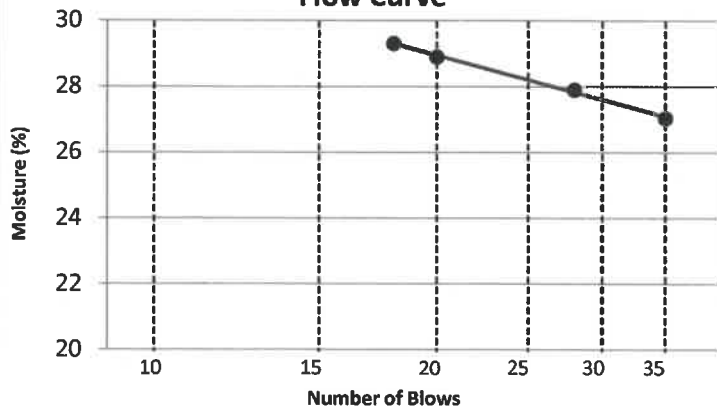
Liquid Limits

Number of Blows	18	20	28	35
Mass of Wet Pan and Soil (g):	14.20	14.38	12.19	14.37
Mass of Dry Pan and Soil (g):	11.24	11.42	9.78	11.56
Mass of Pan (g):	1.15	1.16	1.12	1.16
Moisture (%)	29.3	28.9	27.9	27.0

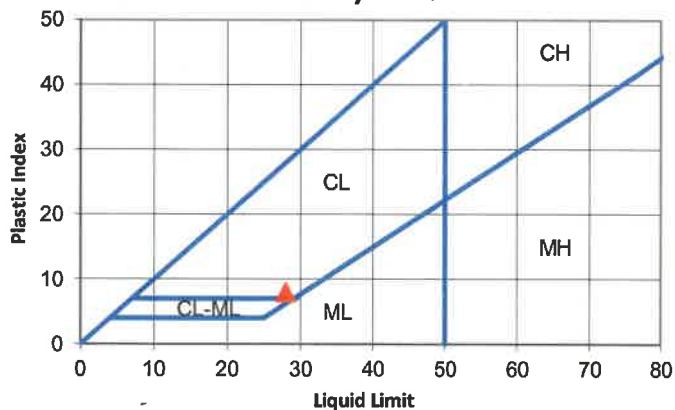
Plastic Index

Plastic Limit: 20
Liquid Limit: 28
Plastic Index: 8
Atterberg Classification: CL
Method: A

Flow Curve



Plasticity Chart



NOTES

Data entry by: SPH
Checked by: KMS
File name: 2868024 Atterberg ASTM D4318 5.xlsm

Date: 12/6/2018
Date: 12/13/18



Atterberg Limits ASTM D 4318

ADVANCED TERRA TESTING

CLIENT Stantec
JOB NO. 2868-024
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
LOCATION --
DATE TESTED 12/13/18
TECHNICIAN KJT

BORING NO. S-2
DEPTH 31-31.5'
SAMPLE NO. S-2-30A
DATE SAMPLED --
SAMPLED BY --
DESCRIPTION --

Plastic Limits

Mass of Wet Pan and Soil (g):	7.31	7.86
Mass of Dry Pan and Soil (g):	6.36	6.84
Mass of Pan (g):	1.10	1.14
Moisture (%)	18.1	17.9

Liquid Limits

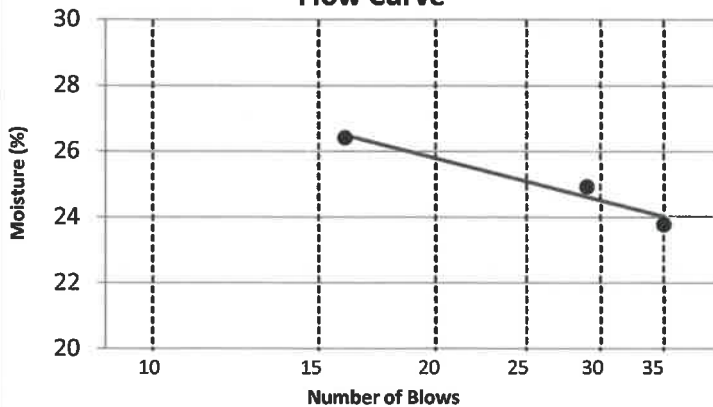
Number of Blows	16	29	35
Mass of Wet Pan and Soil (g):	14.77	12.86	12.57
Mass of Dry Pan and Soil (g):	11.92	10.51	10.37
Mass of Pan (g):	1.13	1.09	1.15
Moisture (%)	26.4	24.9	23.8

Plastic Index

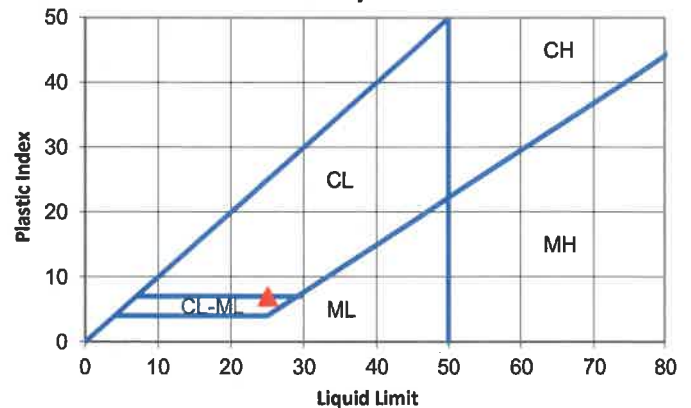
Plastic Limit: 18
Liquid Limit: 25
Plastic Index: 7

Atterberg Classification: CL
Method: A

Flow Curve



Plasticity Chart



NOTES

Data entry by: SPH
Checked by: DPM
File name: 2868024 Atterberg ASTM D4318 6.xlsm

Date: 12/14/2018
Date: 12/17/18



Atterberg Limits ASTM D 4318

ADVANCED TERRA TESTING

CLIENT Stantec
JOB NO. 2868-024
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
LOCATION --
DATE TESTED 12/17/18
TECHNICIAN PEB

BORING NO. N-1
DEPTH 11-11.5'
SAMPLE NO. N-1-10A
DATE SAMPLED --
SAMPLED BY --
DESCRIPTION --

Plastic Limits

Mass of Wet Pan and Soil (g):	8.79	8.67
Mass of Dry Pan and Soil (g):	7.65	7.58
Mass of Pan (g):	1.14	1.14
Moisture (%)	17.5	16.8

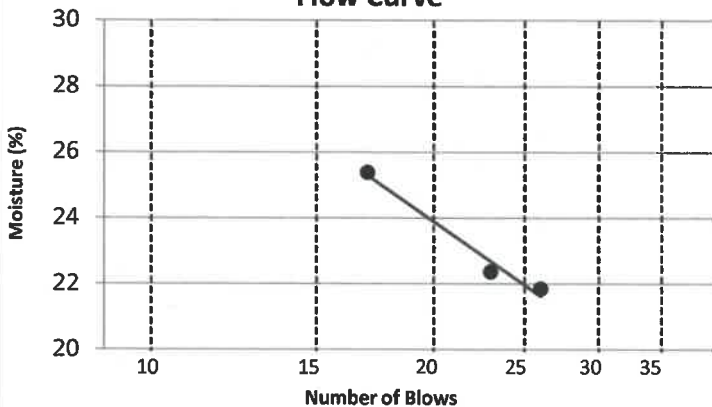
Liquid Limits

Number of Blows	17	23	26
Mass of Wet Pan and Soil (g):	19.32	16.81	15.19
Mass of Dry Pan and Soil (g):	15.64	13.94	12.65
Mass of Pan (g):	1.14	1.12	1.06
Moisture (%)	25.4	22.4	21.8

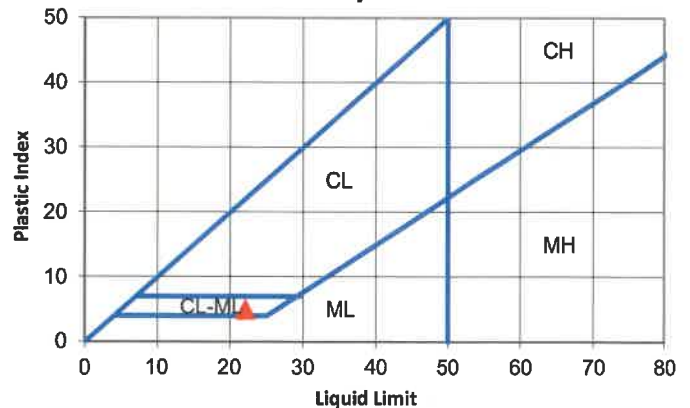
Plastic Index

Plastic Limit:	17	Atterberg Classification:	CL-ML
Liquid Limit:	22	Method:	A
Plastic Index:	5		

Flow Curve



Plasticity Chart



NOTES

Data entry by: SPH
Checked by: KR
File name: 2868024 Atterberg ASTM D4318 7.xlsm

Date: 12/18/2018
Date: 12/18/18

Specific Gravity
ASTM D 854 - Method B

CLIENT	Stantec	JOB NO.	2868-024
PROJECT	GRP EP-1 Relining	LOCATION	--
PROJECT NO.	233001304		

BORING NO.	W-3
DEPTH	18.5-19'
SAMPLE NO.	W-3-17.5A
DATE SAMPLED	
DATE TESTED	12/04/18
TECHNICIAN	CAL
DESCRIPTION	

Flask Identification:	1172
Mass of Dry Soil (g):	79.41
Mass of Flask, Water, and Soil (g):	726.80
Temperature (°C):	23.3
Mass of Flask (g):	179.13
Calibrated Volume (g/cm³):	499.40
Temperature Coefficient:	0.99926
Mass of Flask and Water (g):	677.27
Specific Gravity at 20°C:	2.656

BORING NO.	
DEPTH	
SAMPLE NO.	
DATE SAMPLED	
DATE TESTED	
TECHNICIAN	
DESCRIPTION	

Flask Identification:	
Mass of Dry Soil (g):	
Mass of Flask, Water, and Soil (g):	
Temperature (°C):	
Mass of Flask (g):	
Calibrated Volume (g/cm³):	
Temperature Coefficient:	
Mass of Flask and Water (g):	
Specific Gravity at 20°C:	

NOTES	
-------	--

Data entry by:	CAL	Date:	12/4/2018
Checked by:	SPH	Date:	12-5-18
File name:	2868024_Specific Gravity and Porosity ASTM D854_0.xls		



ADVANCED TERRA TESTING

**Specific Gravity
ASTM D 854 - Method B**

CLIENT	Stantec	JOB NO.	2868-024
PROJECT	GRP EP-1 Relining	LOCATION	--
PROJECT NO.	233001304		

BORING NO.	S-2	E-2	W-2	E-1
DEPTH	18-18.5'	18.5-19'	16-16.5'	11-11.5'
SAMPLE NO.	S-2-17.5B	E-2-17.5A	W-2-15A	E-1-10A
DATE SAMPLED				
DATE TESTED	12/06/18	12/06/18	12/06/18	12/06/18
TECHNICIAN	SPH	SPH	SPH	SPH
DESCRIPTION				

Flask Identification:	1167	1172	1174	1168
Mass of Dry Soil (g):	123.99	104.50	107.61	111.72
Mass of Flask, Water, and Soil (g):	749.29	742.13	739.70	744.40
Temperature (°C):	23.7	23.6	23.7	23.7
Mass of Flask (g):	173.49	179.13	174.45	176.47
Calibrated Volume (g/cm³):	499.46	499.40	499.49	499.64
Temperature Coefficient:	0.99917	0.99919	0.99917	0.99917
Mass of Flask and Water (g):	671.64	677.23	672.63	674.80
Specific Gravity at 20°C:	2.673	2.637	2.652	2.650

BORING NO.	
DEPTH	
SAMPLE NO.	
DATE SAMPLED	
DATE TESTED	
TECHNICIAN	
DESCRIPTION	

Flask Identification:	
Mass of Dry Soil (g):	
Mass of Flask, Water, and Soil (g):	
Temperature (°C):	
Mass of Flask (g):	
Calibrated Volume (g/cm³):	
Temperature Coefficient:	
Mass of Flask and Water (g):	
Specific Gravity at 20°C:	

NOTES	
-------	--

Data entry by:	SPH	Date:	12/11/2018
Checked by:	<u>CAL</u>	Date:	<u>12/13/2018</u>
File name:	2868024__Specific Gravity and Porosity ASTM D854_1.xls		

**Specific Gravity
ASTM D 854 - Method B**

CLIENT	Stantec	JOB NO.	2868-024	
PROJECT	GRP EP-1 Relining	LOCATION	--	
PROJECT NO.	233001304			

BORING NO.	S-1	W-1	S-2	N-1
DEPTH	15.5-16'	18.5-19'	31-31.5'	11-11.5'
SAMPLE NO.	S-1-15B	W-1-17.5A	S-2-30A	N-1-10A
DATE SAMPLED				
DATE TESTED	12/13/18	12/13/18	12/14/18	12/14/18
TECHNICIAN	CAL	CAL	CAL	CAL
DESCRIPTION				

Flask Identification:	1173	1022	1174	1172
Mass of Dry Soil (g):	62.92	49.89	83.13	61.91
Mass of Flask, Water, and Soil (g):	712.31	702.79	724.64	715.85
Temperature (°C):	24.6	24.4	24.4	24.2
Mass of Flask (g):	174.99	173.79	174.45	179.13
Calibrated Volume (g/cm³):	499.53	499.26	499.49	499.40
Temperature Coefficient:	0.99895	0.99900	0.99900	0.99905
Mass of Flask and Water (g):	673.10	671.65	672.54	677.16
Specific Gravity at 20°C:	2.651	2.657	2.676	2.664

BORING NO.	
DEPTH	
SAMPLE NO.	
DATE SAMPLED	
DATE TESTED	
TECHNICIAN	
DESCRIPTION	

Flask Identification:	
Mass of Dry Soil (g):	
Mass of Flask, Water, and Soil (g):	
Temperature (°C):	
Mass of Flask (g):	
Calibrated Volume (g/cm³):	
Temperature Coefficient:	
Mass of Flask and Water (g):	
Specific Gravity at 20°C:	

NOTES	
-------	--

Data entry by:	SPH	Date:	12/17/2018
Checked by:	<u>CAL</u>	Date:	<u>12/18/18</u>
File name:	2868024_Specific Gravity and Porosity ASTM D854_2.xls		



Grain Size Analysis ASTM D 6913

ADVANCED TERRA TESTING

CLIENT Stantec
JOB NO. 2868-024
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
LOCATION --
DATE TESTED 12/03/18
TECHNICIAN CAL

BORING NO. W-3
DEPTH 18.5-19'
SAMPLE NO. W-3-17.5A
DATE SAMPLED --
DESCRIPTION --

Hygroscopic Moisture

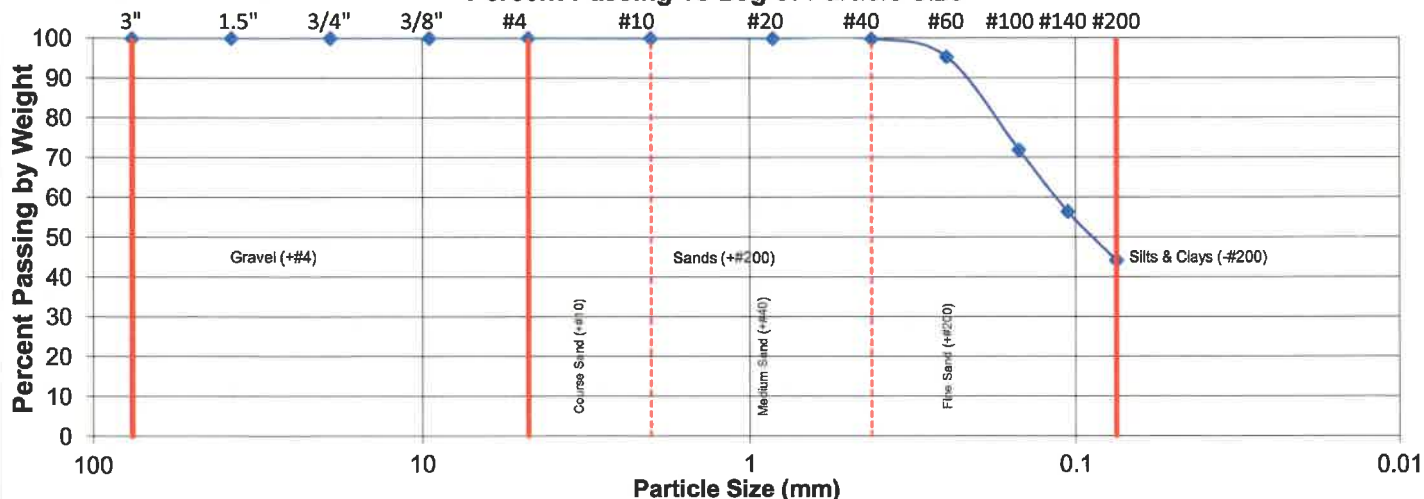
Mass Wet Pan and Soil (g): 367.36
Mass Dry Pan and Soil (g): 327.82
Mass of Pan (g): 124.06
Moisture (%): 19.4

Sample Data

Total Wet Mass of Sample (g): 243.3
Total Dry Mass of Sample (g): 203.8

Sieve Number	Sieve Size (mm)	Mass of Pan and Soil (g)	Mass of Pan (g)	Mass of Individual Retained Soil (g)	Correction Factor	Percent Passing by Weight (%)
3"	76.2	--	--	--	--	--
1.5"	38.1	--	--	--	--	--
3/4"	19.05	--	--	--	--	--
3/8"	9.53	--	--	--	--	--
#4	4.75	0.0	--	--	--	--
#10	2.00	0.0	--	0.0	1.00	100.0
#20	0.850	0.1	--	0.1	1.00	99.9
#40	0.425	0.2	--	0.2	1.00	99.8
#60	0.250	9.1	--	9.1	1.00	95.4
#100	0.150	47.6	--	47.6	1.00	72.0
#140	0.106	31.6	--	31.6	1.00	56.5
#200	0.075	25.0	--	25.0	1.00	44.2

Percent Passing vs Log of Particle Size



USCS Classification ASTM D 2487

Atterberg Classification: NP

Coefficient of Curvature - C_c : --

Group Symbol: SM

Coefficient of Uniformity - C_u : --

USCS Classification: Silty Sand

Data entry by: SPH

Date: 12/6/2018

Checked by: CAL

Date: 12/6/2018

File name: 2868024 Grain Size Analysis ASTM D6913_0.xlsm



Grain Size Analysis ASTM D 6913

ADVANCED TERRA TESTING

CLIENT Stantec
JOB NO. 2868-024
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
LOCATION --
DATE TESTED 12/06/18
TECHNICIAN PEB

BORING NO. E-2
DEPTH 18.5-19'
SAMPLE NO. E-2-17.5A
DATE SAMPLED --
DESCRIPTION --

Hygroscopic Moisture

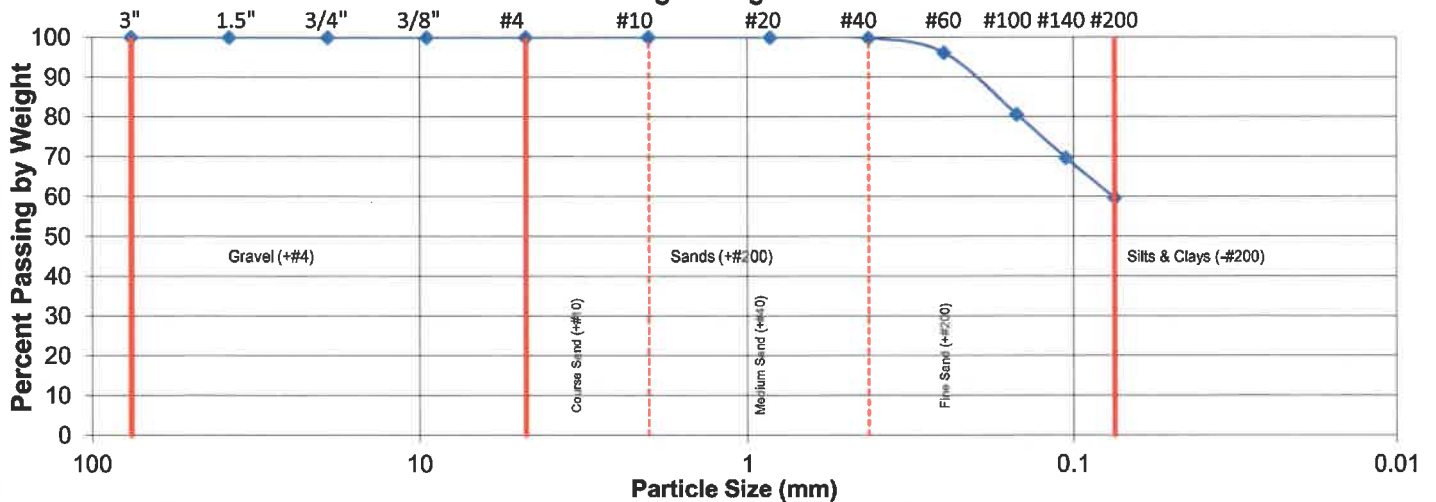
Mass Wet Pan and Soil (g): 416.48
Mass Dry Pan and Soil (g): 415.91
Mass of Pan (g): 171.84
Moisture (%): 0.2

Sample Data

Total Wet Mass of Sample (g): 244.6
Total Dry Mass of Sample (g): 244.1

Sieve Number	Sieve Size (mm)	Mass of Pan and Soil (g)	Mass of Pan (g)	Mass of Individual Retained Soil (g)	Correction Factor	Percent Passing by Weight (%)
3"	76.2	--	--	--	--	--
1.5"	38.1	--	--	--	--	--
3/4"	19.05	--	--	--	--	--
3/8"	9.53	--	--	--	--	--
#4	4.75	--	--	--	--	--
#10	2.00	0.0	--	--	--	--
#20	0.850	0.1	--	0.1	1.00	100.0
#40	0.425	0.3	--	0.3	1.00	99.9
#60	0.250	9.0	--	9.0	1.00	96.2
#100	0.150	37.7	--	37.7	1.00	80.7
#140	0.106	26.6	--	26.6	1.00	69.8
#200	0.075	24.6	--	24.6	1.00	59.8

Percent Passing vs Log of Particle Size



USCS Classification ASTM D 2487

Atterberg Classification: CL

Coefficient of Curvature - C_c : --

Group Symbol: CL

Coefficient of Uniformity - C_u : --

USCS Classification: Sandy Lean Clay

Data entry by: SPH

Date: 12/7/2018

Checked by: cas

Date: 12/11/18

File name: 2868024 Grain Size Analysis ASTM D6913 1.xlsm



Grain Size Analysis ASTM D 6913

ADVANCED TERRA TESTING

CLIENT Stantec
JOB NO. 2868-024
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
LOCATION --
DATE TESTED 12/06/18
TECHNICIAN PEB

BORING NO. S-2
DEPTH 18-18.5'
SAMPLE NO. S-2-17.5B
DATE SAMPLED --
DESCRIPTION --

Hygroscopic Moisture of Fines

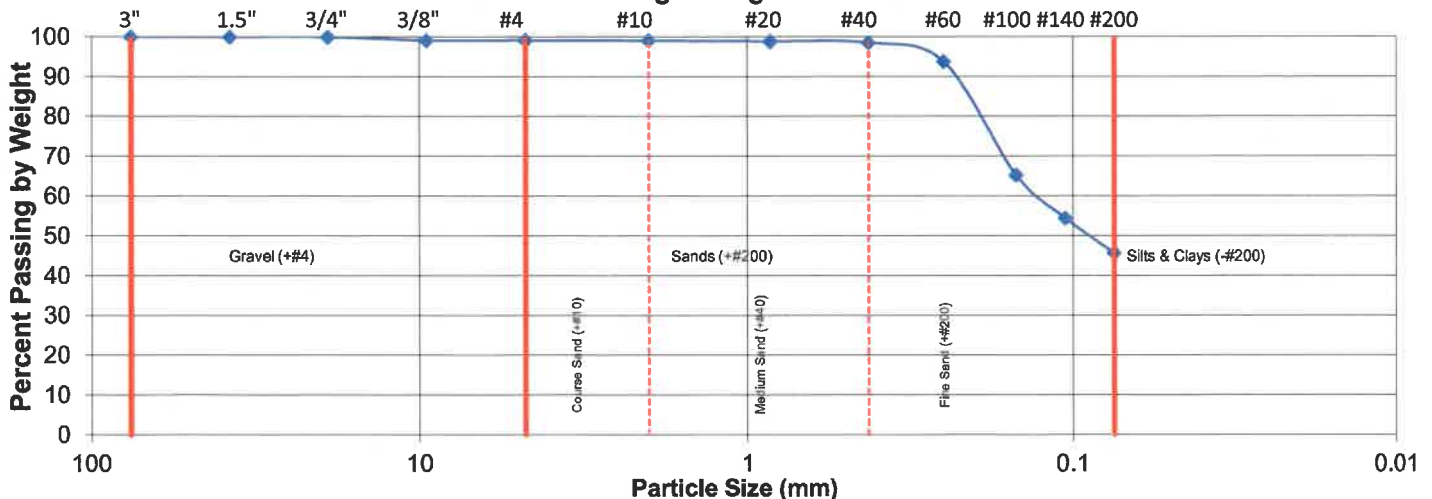
Mass Wet Pan and Soil (g): 597.73
Mass Dry Pan and Soil (g): 596.09
Mass of Pan (g): 264.07
Moisture (%): 0.5

Sample Data

Total Wet Mass of Sample (g): 602.4
Total Dry Mass of Sample (g): 599.5
Split Fraction: #4
Mass of Sub-Sample Fraction (g): 333.66

Sieve Number	Sieve Size (mm)	Mass of Pan and Soil (g)	Mass of Pan (g)	Mass of Individual Retained Soil (g)	Correction Factor	Percent Passing by Weight (%)
3"	76.2	--	--	--	--	--
1.5"	38.1	--	--	--	--	--
3/4"	19.05	0.0	--	--	--	--
3/8"	9.53	5.1	--	5.1	1.00	99.1
#4	4.75	0.0	--	--	--	--
#10	2.00	0.4	--	0.4	0.99	99.0
#20	0.850	0.6	--	0.6	0.99	98.9
#40	0.425	1.0	--	1.0	0.99	98.6
#60	0.250	15.9	--	15.9	0.99	93.8
#100	0.150	95.4	--	95.4	0.99	65.3
#140	0.106	36.3	--	36.3	0.99	54.5
#200	0.075	29.4	--	29.4	0.99	45.8

Percent Passing vs Log of Particle Size



USCS Classification ASTM D 2487

Atterberg Classification: CL

Coefficient of Curvature - C_c : --

Group Symbol: SC

Coefficient of Uniformity - C_u : --

USCS Classification: Clayey Sand

Data entry by: SPH

Date: 12/7/2018

Checked by: CAC

Date: 12/11/18

File name: 2868024_Grain Size Analysis ASTM D6913_2.xlsm



Grain Size Analysis ASTM D 6913

ADVANCED TERRA TESTING

CLIENT Stantec
JOB NO. 2868-024
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
LOCATION --
DATE TESTED 12/06/18
TECHNICIAN PEB

BORING NO. E-1
DEPTH 11-11.5'
SAMPLE NO. E-1-10A
DATE SAMPLED --
DESCRIPTION --

Hygroscopic Moisture

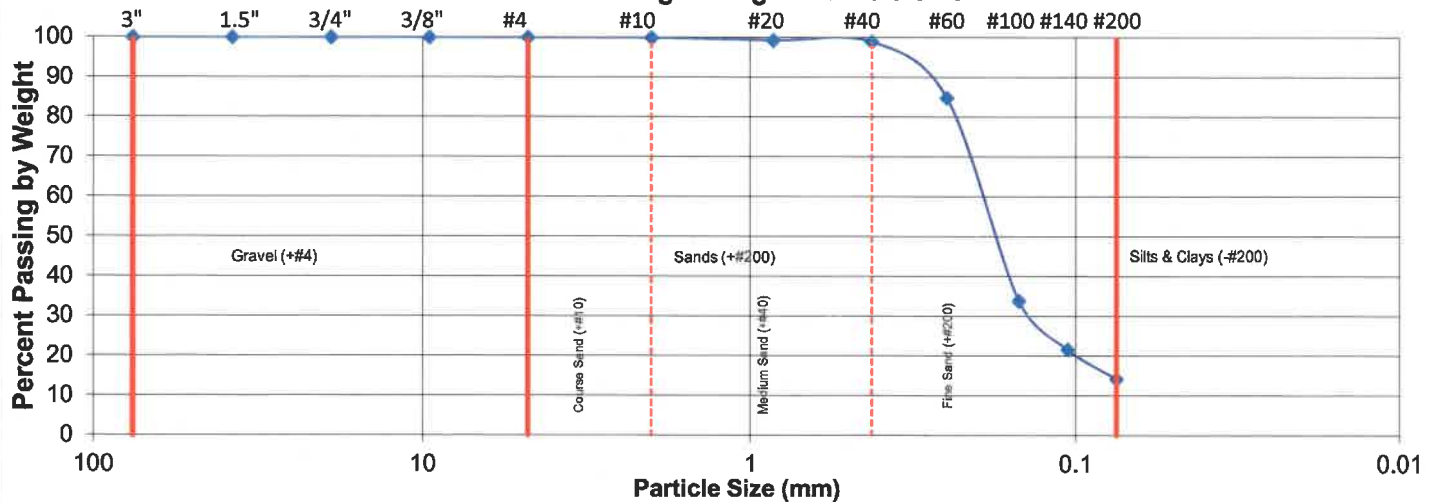
Mass Wet Pan and Soil (g): 425.63
Mass Dry Pan and Soil (g): 424.90
Mass of Pan (g): 170.64
Moisture (%): 0.3

Sample Data

Total Wet Mass of Sample (g): 255.0
Total Dry Mass of Sample (g): 254.3

Sieve Number	Sieve Size (mm)	Mass of Pan and Soil (g)	Mass of Pan (g)	Mass of Individual Retained Soil (g)	Correction Factor	Percent Passing by Weight (%)
3"	76.2	--	--	--	--	--
1.5"	38.1	--	--	--	--	--
3/4"	19.05	--	--	--	--	--
3/8"	9.53	--	--	--	--	--
#4	4.75	0.0	--	--	--	--
#10	2.00	0.1	--	0.1	1.00	100.0
#20	0.850	1.6	--	1.6	1.00	99.3
#40	0.425	1.0	--	1.0	1.00	99.0
#60	0.250	35.7	--	35.7	1.00	84.9
#100	0.150	129.5	--	129.5	1.00	34.0
#140	0.106	31.1	--	31.1	1.00	21.7
#200	0.075	18.9	--	18.9	1.00	14.3

Percent Passing vs Log of Particle Size



USCS Classification ASTM D 2487

Atterberg Classification: NP

Coefficient of Curvature - C_c : --

Group Symbol: SM

Coefficient of Uniformity - C_u : --

USCS Classification: Silty Sand

Data entry by: SPH

Date: 12/10/2018

Checked by: CH

Date: 12/12/18

File name: 2868024_Grain Size Analysis ASTM D6913_3.xlsm



Grain Size Analysis ASTM D 6913

ADVANCED TERRA TESTING

CLIENT Stantec
JOB NO. 2868-024
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
LOCATION --
DATE TESTED 12/06/18
TECHNICIAN PEB

BORING NO. E-2
DEPTH 26.0-26.5'
SAMPLE NO. E-2-25A
DATE SAMPLED --
DESCRIPTION --

Hygroscopic Moisture

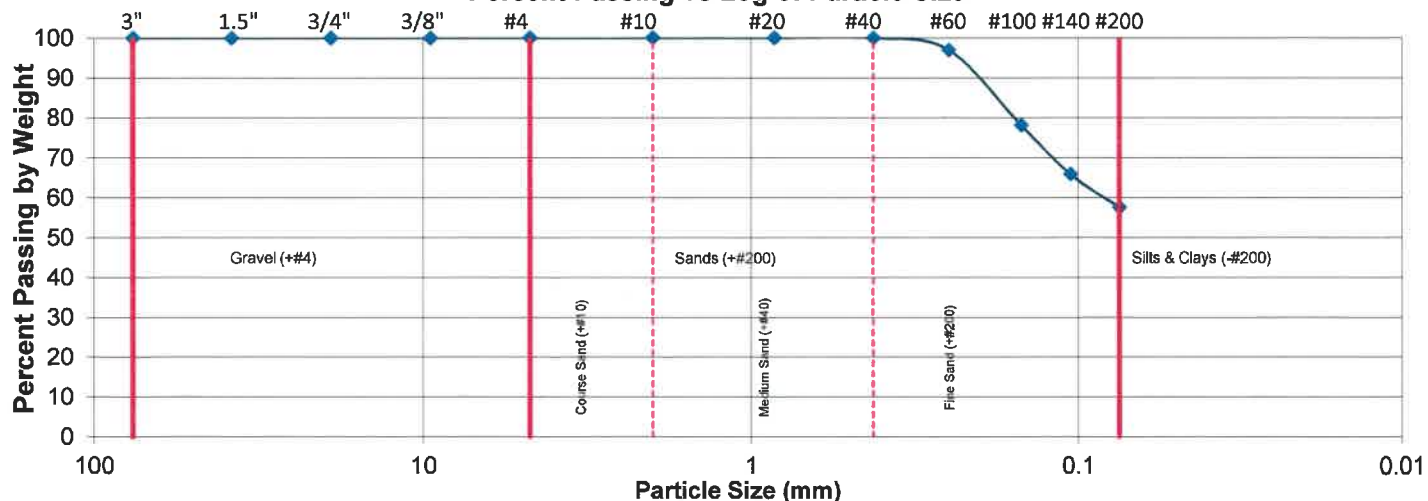
Mass Wet Pan and Soil (g): 610.25
Mass Dry Pan and Soil (g): 609.17
Mass of Pan (g): 163.91
Moisture (%): **0.2**

Sample Data

Total Wet Mass of Sample (g): 446.3
Total Dry Mass of Sample (g): 445.3

Sieve Number	Sieve Size (mm)	Mass of Pan and Soil (g)	Mass of Pan (g)	Mass of Individual Retained Soil (g)	Correction Factor	Percent Passing by Weight (%)
3"	76.2	--	--	--	--	--
1.5"	38.1	--	--	--	--	--
3/4"	19.05	--	--	--	--	--
3/8"	9.53	--	--	--	--	--
#4	4.75	--	--	--	--	--
#10	2.00	0.0	--	--	--	--
#20	0.850	0.0	--	0.0	1.00	100.0
#40	0.425	0.3	--	0.3	1.00	99.9
#60	0.250	13.4	--	13.4	1.00	96.9
#100	0.150	83.6	--	83.6	1.00	78.1
#140	0.106	54.6	--	54.6	1.00	65.9
#200	0.075	37.2	--	37.2	1.00	57.5

Percent Passing vs Log of Particle Size



USCS Classification ASTM D 2487

Atterberg Classification: --
Group Symbol: --
USCS Classification: --

Coefficient of Curvature - C_c : --
Coefficient of Uniformity - C_u : --

Data entry by: CAL Date: 12/13/2018
Checked by: KMS Date: 12/13/18
File name: 2868024_Grain Size Analysis ASTM D6913_4.xlsm



Grain Size Analysis ASTM D 6913

ADVANCED TERRA TESTING

CLIENT Stantec
JOB NO. 2868-024
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
LOCATION --
DATE TESTED 12/13/18
TECHNICIAN DPM

BORING NO. S-2
DEPTH 31-31.5'
SAMPLE NO. S-2-30A
DATE SAMPLED --
DESCRIPTION --

Hygroscopic Moisture of Fines

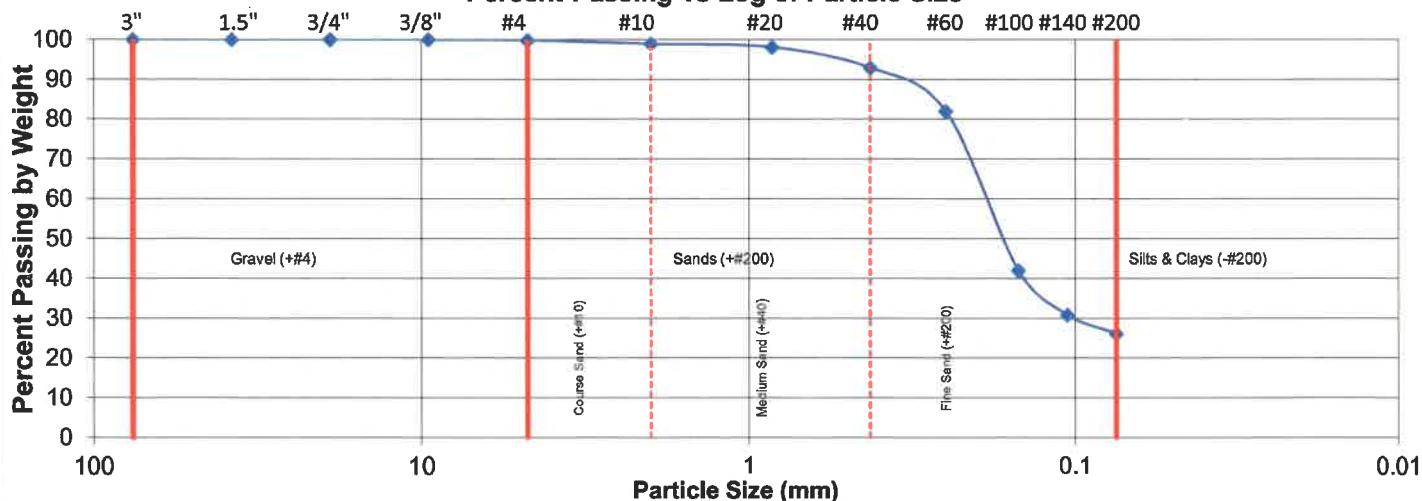
Mass Wet Pan and Soil (g): 582.44
Mass Dry Pan and Soil (g): 580.13
Mass of Pan (g): 243.92
Moisture (%): 0.7

Sample Data

Total Wet Mass of Sample (g): 695.3
Total Dry Mass of Sample (g): 690.6
Split Fraction: #4
Mass of Sub-Sample Fraction (g): 252.44

Sieve Number	Sieve Size (mm)	Mass of Pan and Soil (g)	Mass of Pan (g)	Mass of Individual Retained Soil (g)	Correction Factor	Percent Passing by Weight (%)
3"	76.2	--	--	--	--	--
1.5"	38.1	--	--	--	--	--
3/4"	19.05	--	--	--	--	--
3/8"	9.53	0.0	--	--	--	--
#4	4.75	1.3	--	1.3	1.00	99.8
#10	2.00	2.2	--	2.2	1.00	98.9
#20	0.850	2.2	--	2.2	1.00	98.1
#40	0.425	12.9	--	12.9	1.00	93.0
#60	0.250	27.3	--	27.3	1.00	82.1
#100	0.150	100.5	--	100.5	1.00	42.1
#140	0.106	28.1	--	28.1	1.00	30.9
#200	0.075	11.9	--	11.9	1.00	26.2

Percent Passing vs Log of Particle Size



USCS Classification ASTM D 2487

Atterberg Classification: CL

Coefficient of Curvature - C_c : --

Group Symbol: SC

Coefficient of Uniformity - C_u : --

USCS Classification: Clayey Sand

Data entry by: SPH

Date: 12/14/2018

Checked by: *DPM*

Date: 12/17/18

File name: 2868024_Grain Size Analysis ASTM D6913_5.xlsm



Grain Size Analysis ASTM D 6913

ADVANCED TERRA TESTING

CLIENT Stantec
JOB NO. 2868-024
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
LOCATION --
DATE TESTED 12/13/18
TECHNICIAN DPM

BORING NO. S-1
DEPTH 18-18.5'
SAMPLE NO. S-1-17.5B
DATE SAMPLED --
DESCRIPTION --

Hygroscopic Moisture of Fines

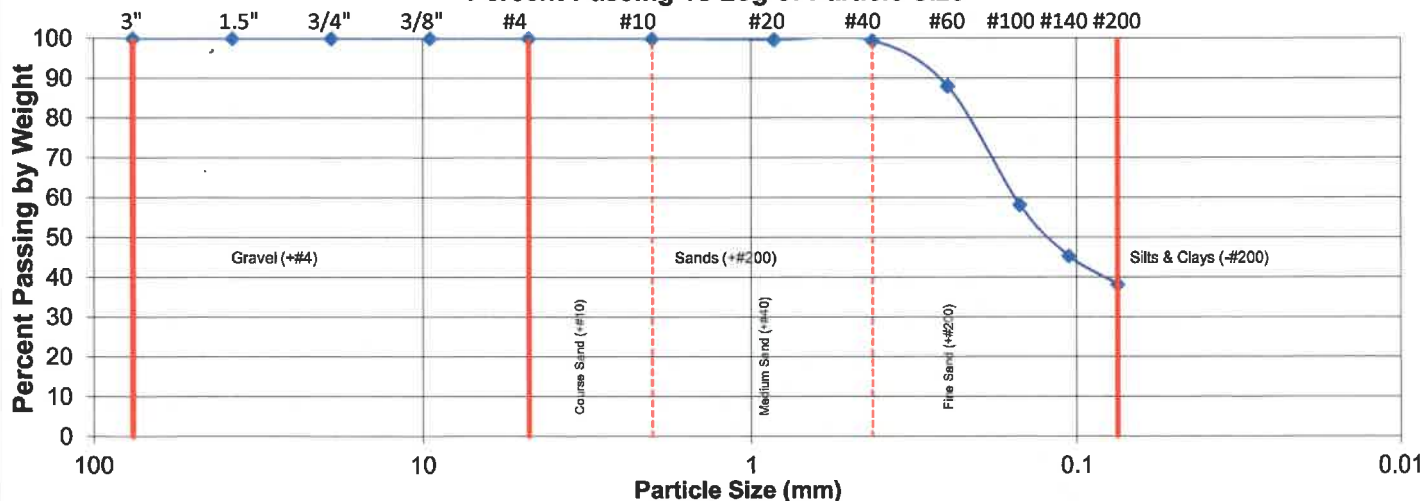
Mass Wet Pan and Soil (g): 317.78
Mass Dry Pan and Soil (g): 315.98
Mass of Pan (g): 138.97
Moisture (%): 1.0

Sample Data

Total Wet Mass of Sample (g): 728.3
Total Dry Mass of Sample (g): 721.0
Split Fraction: #4
Mass of Sub-Sample Fraction (g): 178.81

Sieve Number	Sieve Size (mm)	Mass of Pan and Soil (g)	Mass of Pan (g)	Mass of Individual Retained Soil (g)	Correction Factor	Percent Passing by Weight (%)
3"	76.2	--	--	--	--	--
1.5"	38.1	--	--	--	--	--
3/4"	19.05	--	--	--	--	--
3/8"	9.53	--	--	--	--	--
#4	4.75	0.0	--	--	--	--
#10	2.00	0.1	--	0.1	1.00	99.9
#20	0.850	0.4	--	0.4	1.00	99.7
#40	0.425	0.5	--	0.5	1.00	99.5
#60	0.250	20.3	--	20.3	1.00	88.1
#100	0.150	52.8	--	52.8	1.00	58.2
#140	0.106	22.7	--	22.7	1.00	45.4
#200	0.075	12.6	--	12.6	1.00	38.3

Percent Passing vs Log of Particle Size



USCS Classification ASTM D 2487

Atterberg Classification: --
Group Symbol: --
USCS Classification: --

Coefficient of Curvature - C_c : --
Coefficient of Uniformity - C_u : --

Data entry by: SPH
Checked by: DPM
File name: 2868024 Grain Size Analysis ASTM D6913_7.xlsx

Date: 12/14/2018
Date: 12/17/18



Grain Size Analysis ASTM D 6913

ADVANCED TERRA TESTING

CLIENT Stantec
JOB NO. 2868-024
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
LOCATION --
DATE TESTED 12/13/18
TECHNICIAN DPM

BORING NO. S-1
DEPTH 15.5-16'
SAMPLE NO. S-1-15B
DATE SAMPLED --
DESCRIPTION --

Hygroscopic Moisture

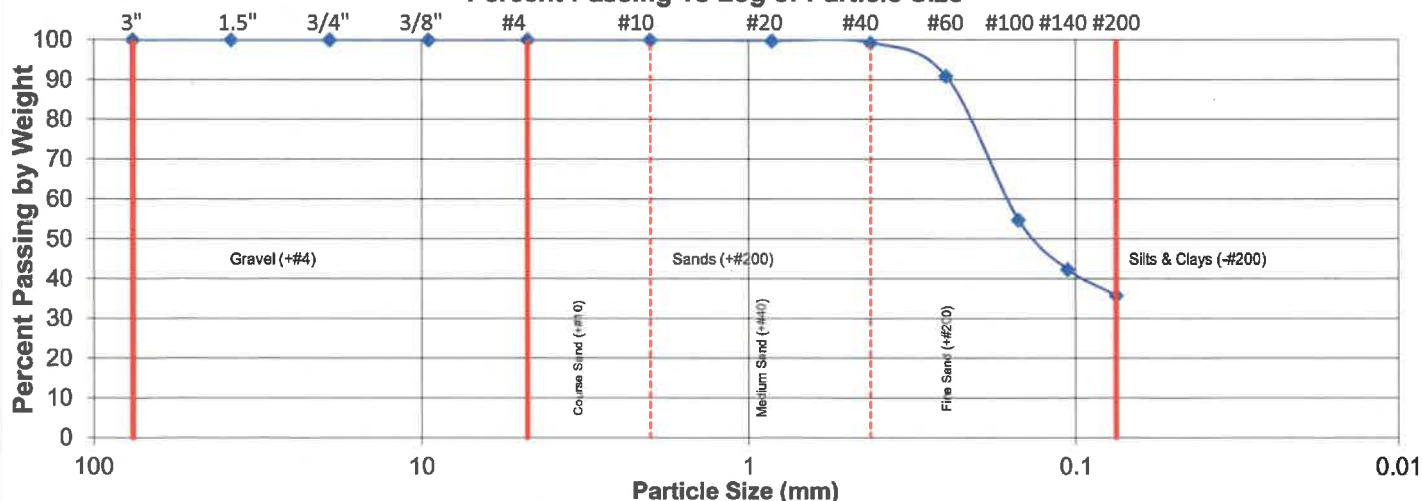
Mass Wet Pan and Soil (g): 500.82
Mass Dry Pan and Soil (g): 500.10
Mass of Pan (g): 171.79
Moisture (%): 0.2

Sample Data

Total Wet Mass of Sample (g): 329.0
Total Dry Mass of Sample (g): 328.3

Sieve Number	Sieve Size (mm)	Mass of Pan and Soil (g)	Mass of Pan (g)	Mass of Individual Retained Soil (g)	Correction Factor	Percent Passing by Weight (%)
3"	76.2	--	--	--	--	--
1.5"	38.1	--	--	--	--	--
3/4"	19.05	--	--	--	--	--
3/8"	9.53	--	--	--	--	--
#4	4.75	0.0	--	--	--	--
#10	2.00	0.2	--	0.2	1.00	100.0
#20	0.850	0.6	--	0.6	1.00	99.8
#40	0.425	1.5	--	1.5	1.00	99.3
#60	0.250	27.3	--	27.3	1.00	91.0
#100	0.150	118.6	--	118.6	1.00	54.9
#140	0.106	40.9	--	40.9	1.00	42.4
#200	0.075	21.5	--	21.5	1.00	35.9

Percent Passing vs Log of Particle Size



USCS Classification ASTM D 2487

Atterberg Classification: --

Coefficient of Curvature - C_c : --

Group Symbol: --

Coefficient of Uniformity - C_u : --

USCS Classification: --

Data entry by: SPH

Date: 12/14/2018

Checked by: *DPM*

Date: 12/17/18

File name: 2868024_Grain Size Analysis ASTM D6913_6.xlsm



ADVANCED TERRA TESTING

Direct Shear

ASTM D 3080

CLIENT Stantec
 JOB NO. 2868-024
 PROJECT GRP EP-1 Relining
 PROJECT NO. 233001304
 LOCATION --
 DATE TESTED 11/28/18
 TECHNICIAN DPM

BORING NO. S-2
 DEPTH 31-31.5'
 SAMPLE NO. S-2-30A
 DATE SAMPLED --
 DESCRIPTION --

Direct Shear Results

Point:	A	B	C
Normal Load (psf):	3750	1875	1100
Normal Load (kPa):	180.0	90.0	52.8
Peak Strength (psf):	2556	1314	796
Ultimate Strength (psf):	2255	1290	736
Peak Strength (kPa):	122.7	63.1	38.2
Ultimate Strength (kPa):	108.2	61.9	35.3

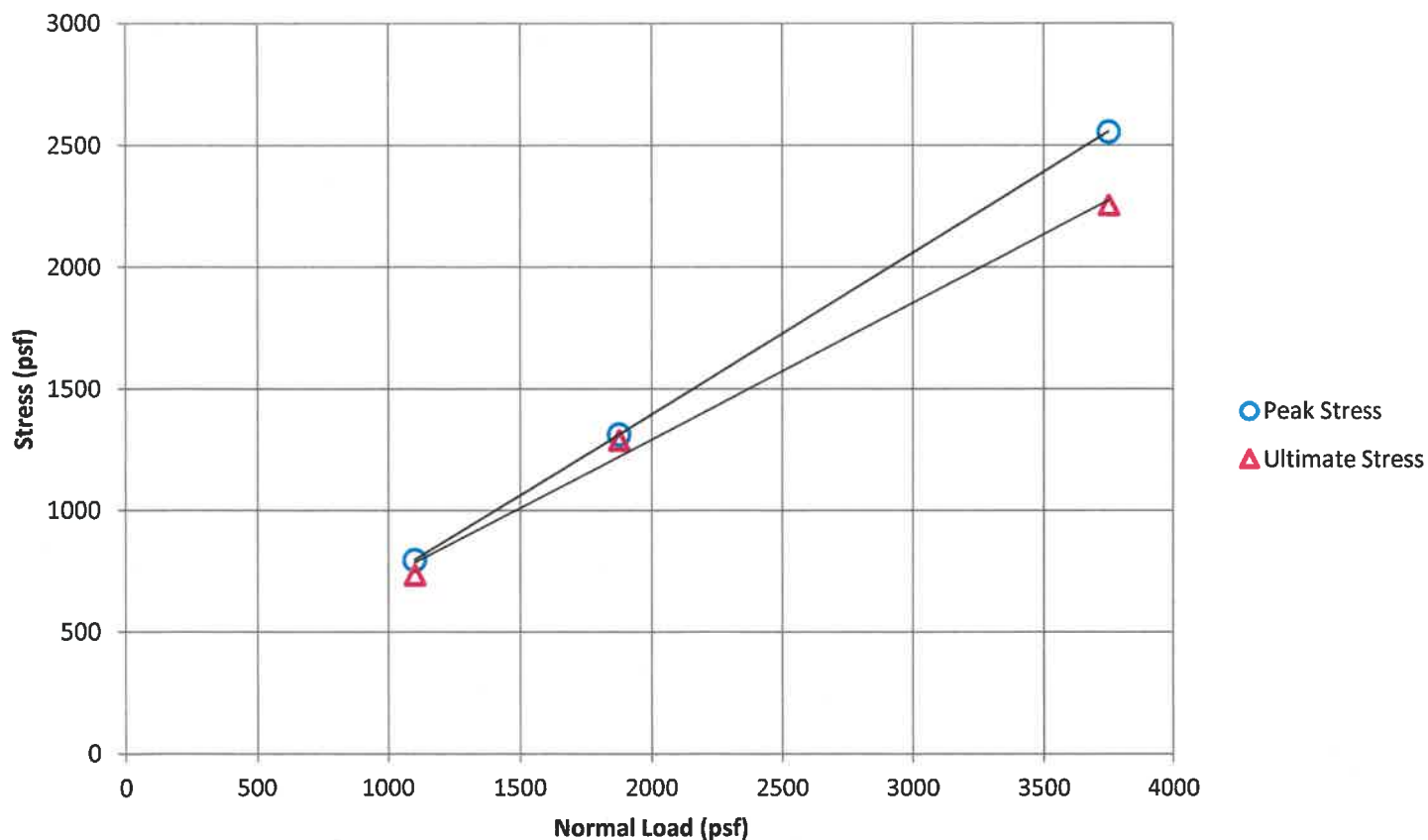
Peak Strength

Friction Angle: 33.6
 Cohesion (psf): 67
 Cohesion (kPa): 3.2

Ultimate Strength

Friction Angle: 29.4
 Cohesion (psf): 166
 Cohesion (kPa): 8.0

Normal Load vs. Stress



Data entry by: DPM Date: 12/5/2018
 Checked by: ctc Date: 12/6/18
 File name: 2868024_Direct Shear ASTM D3080_0.xlsm

CLIENT Stantec
JOB NO. 2868-024
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
LOCATION --
DATE TESTED 11/28/18
TECHNICIAN DPM

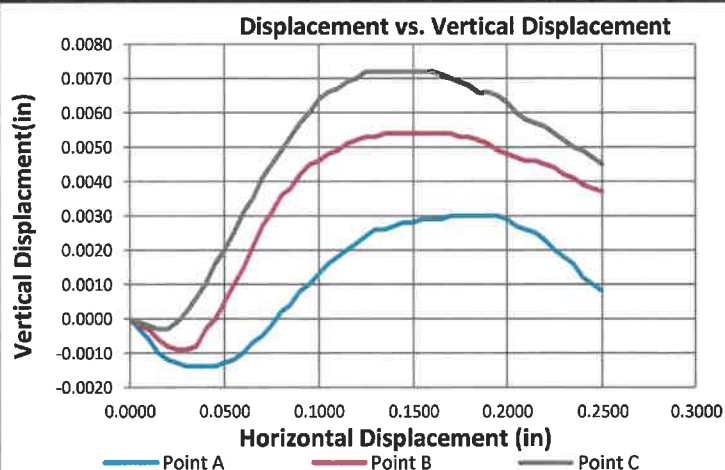
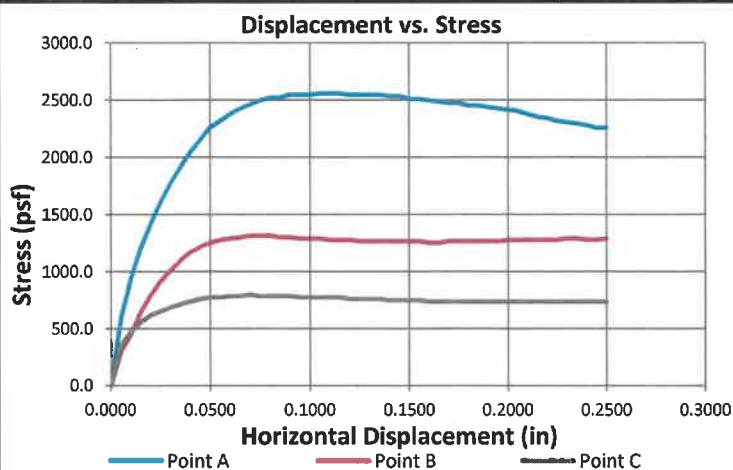
BORING NO. S-2
DEPTH 31-31.5'
SAMPLE NO. S-2-30A
DATE SAMPLED --
DESCRIPTION --

Test Parameters

Displacement Rate (in/min): 0.0023 Displacement Rate (cm/min): 0.005842

Raw Data Files: STDSS23A.DAT, STDSS23B.DAT, STDSS23C.DAT,

Before Test Mass of Wet Soil and Ring (g):	186.54	184.57	180.37
After Test Mass of Wet Soil and Pan (g):	156.49	156.22	154.41
Mass of Dry Soil and Pan (g):	134.18	133.30	131.20
Mass of Ring (g):	41.72	42.27	41.44
Mass of Pan (g):	6.70	6.59	6.55
Diameter (in):	2.41	2.41	2.41
Initial Height (in):	1.00	1.00	1.00
Height Change (in):	0.0178	0.0139	0.0133
Area (in ²):	4.56	4.56	4.56
Initial Wet Density (pcf):	120.9	118.8	116.0
Initial Dry Density (pcf):	106.5	105.8	104.1
Initial Wet Density (kg/m ³):	1937	1904	1859
Initial Dry Density (kg/m ³):	1705	1695	1668
Initial Moisture (%):	13.6	12.3	11.5
Final Wet Density (pcf):	127.4	126.7	125.2
Final Dry Density (pcf):	108.4	107.3	105.5
Final Wet Density (kg/m ³):	2040	2030	2005
Final Dry Density (kg/m ³):	1736	1719	1690
Final Moisture (%):	17.5	18.1	18.6



NOTES:

**Direct Shear Data
ASTM D3080**

CLIENT Stantec
 JOB NO. 2868-024
 PROJECT GRP EP-1 Relining
 PROJECT NO. 233001304
 LOCATION --
 DATE TESTED 11/28/18
 TECHNICIAN DPM

BORING NO. S-2
 DEPTH 31-31.5'
 SAMPLE NO. S-2-30A
 DATE SAMPLED --
 DESCRIPTION --

Point A			Point B			Point C			
Displacement (in)	Stress (psf)	Vertical Displacement (in)	Displacement (in)	Stress (psf)	Vertical Displacement (in)	Displacement (in)	Stress (psf)	Vertical Displacement (in)	
0.0000	0.0	0.0000	0.0000	0.0	0.0000	0.0000	12.0	0.0000	
0.0050	591.0	-0.0003	0.0050	301.0	-0.0002	0.0050	350.0	-0.0001	
0.0100	929.0	-0.0006	0.0100	446.0	-0.0003	0.0100	470.0	-0.0002	
0.0150	1194.0	-0.0010	0.0150	639.0	-0.0006	0.0150	555.0	-0.0003	
0.0200	1411.0	-0.0012	0.0200	796.0	-0.0008	0.0200	615.0	-0.0003	
0.0250	1604.0	-0.0013	0.0250	916.0	-0.0009	0.0250	651.0	-0.0001	
0.0300	1773.0	-0.0014	0.0300	1013.0	-0.0009	0.0300	687.0	0.0002	
0.0350	1905.0	-0.0014	0.0350	1097.0	-0.0008	0.0350	711.0	0.0006	
0.0400	2038.0	-0.0014	0.0400	1170.0	-0.0003	0.0400	736.0	0.0010	
0.0450	2146.0	-0.0014	0.0450	1218.0	0.0000	0.0450	760.0	0.0016	
0.0500	2255.0	-0.0013	0.0500	1254.0	0.0005	0.0500	772.0	0.0020	
0.0550	2315.0	-0.0012	0.0550	1278.0	0.0010	0.0550	772.0	0.0025	
0.0600	2376.0	-0.0010	0.0600	1290.0	0.0015	0.0600	784.0	0.0031	
0.0650	2424.0	-0.0007	0.0650	1302.0	0.0021	0.0650	784.0	0.0035	
0.0700	2460.0	-0.0005	0.0700	1314.0	0.0027	0.0700	796.0	0.0041	
0.0750	2496.0	-0.0002	0.0750	1314.0	0.0031	0.0750	784.0	0.0045	
0.0800	2520.0	0.0002	0.0800	1314.0	0.0036	0.0800	784.0	0.0049	
0.0850	2520.0	0.0004	0.0850	1302.0	0.0038	0.0850	784.0	0.0053	
0.0900	2544.0	0.0008	0.0900	1302.0	0.0042	0.0900	784.0	0.0057	
0.0950	2544.0	0.0010	0.0950	1290.0	0.0045	0.0950	772.0	0.0060	
0.1000	2544.0	0.0013	0.1000	1290.0	0.0046	0.1000	772.0	0.0064	
0.1050	2556.0	0.0016	0.1050	1290.0	0.0048	0.1050	772.0	0.0066	
0.1100	2556.0	0.0018	0.1100	1278.0	0.0049	0.1100	772.0	0.0067	
0.1150	2556.0	0.0020	0.1150	1278.0	0.0051	0.1150	772.0	0.0069	
0.1200	2544.0	0.0022	0.1200	1278.0	0.0052	0.1200	760.0	0.0070	
0.1250	2544.0	0.0024	0.1250	1266.0	0.0053	0.1250	760.0	0.0072	
0.1300	2544.0	0.0026	0.1300	1266.0	0.0053	0.1300	760.0	0.0072	
0.1350	2544.0	0.0026	0.1350	1266.0	0.0054	0.1350	760.0	0.0072	
0.1400	2532.0	0.0027	0.1400	1266.0	0.0054	0.1400	748.0	0.0072	
0.1450	2532.0	0.0028	0.1450	1266.0	0.0054	0.1450	748.0	0.0072	
0.1500	2508.0	0.0028	0.1500	1266.0	0.0054	0.1500	748.0	0.0072	
0.1550	2508.0	0.0029	0.1550	1266.0	0.0054	0.1550	748.0	0.0072	
0.1600	2496.0	0.0029	0.1600	1254.0	0.0054	0.1600	736.0	0.0072	
0.1650	2484.0	0.0029	0.1650	1254.0	0.0054	0.1650	736.0	0.0071	
0.1700	2472.0	0.0030	0.1700	1266.0	0.0054	0.1700	736.0	0.0070	
0.1750	2472.0	0.0030	0.1750	1266.0	0.0053	0.1750	736.0	0.0069	
0.1800	2448.0	0.0030	0.1800	1266.0	0.0053	0.1800	736.0	0.0068	
0.1850	2448.0	0.0030	0.1850	1266.0	0.0052	0.1850	736.0	0.0066	
0.1900	2436.0	0.0030	0.1900	1266.0	0.0051	0.1900	736.0	0.0066	
0.1950	2424.0	0.0030	0.1950	1266.0	0.0049	0.1950	736.0	0.0065	
0.2000	2412.0	0.0029	0.2000	1278.0	0.0048	0.2000	736.0	0.0063	
0.2050	2400.0	0.0027	0.2050	1278.0	0.0047	0.2050	736.0	0.0060	
0.2100	2376.0	0.0026	0.2100	1278.0	0.0046	0.2100	736.0	0.0058	

CLIENT	Stantec
JOB NO.	2868-024
PROJECT	GRP EP-1 Relining
PROJECT NO.	233001304
LOCATION	--
DATE TESTED	11/28/18
TECHNICIAN	DPM

BORING NO.	S-2
DEPTH	31-31.5'
SAMPLE NO.	S-2-30A
DATE SAMPLED	--
DESCRIPTION	--

Point A			Point B			Point C		
Displacement (in)	Stress (psf)	Vertical Displacement (in)	Displacement (in)	Stress (psf)	Vertical Displacement (in)	Displacement (in)	Stress (psf)	Vertical Displacement (in)
0.2150	2351.0	0.0025	0.2150	1278.0	0.0046	0.2150	736.0	0.0057
0.2200	2339.0	0.0023	0.2200	1278.0	0.0045	0.2200	736.0	0.0056
0.2250	2315.0	0.0020	0.2250	1278.0	0.0044	0.2250	736.0	0.0054
0.2300	2303.0	0.0018	0.2300	1290.0	0.0042	0.2300	736.0	0.0052
0.2350	2291.0	0.0016	0.2350	1290.0	0.0041	0.2350	736.0	0.0050
0.2400	2279.0	0.0012	0.2400	1278.0	0.0039	0.2400	736.0	0.0049
0.2450	2255.0	0.0010	0.2450	1278.0	0.0038	0.2450	736.0	0.0047
0.2500	2255.0	0.0008	0.2500	1290.0	0.0037	0.2500	736.0	0.0045

Direct Shear

ASTM D 3080

CLIENT	Stantec	BORING NO.	S-1
JOB NO.	2868-024	DEPTH	18-18.5'
PROJECT	GRP EP-1 Relining	SAMPLE NO.	S-1-17.5B
PROJECT NO.	233001304	DATE SAMPLED	--
LOCATION	--	DESCRIPTION	--
DATE TESTED	12/06/18		
TECHNICIAN	DPM		

Direct Shear Results

Point:	A	B	C
Normal Load (psf):	2150	1075	550
Normal Load (kPa):	103.2	51.6	26.4
Peak Strength (psf):	1833	1013	543
Ultimate Strength (psf):	1459	796	434
Peak Strength (kPa):	88.0	48.6	26.1
Ultimate Strength (kPa):	70.0	38.2	20.8

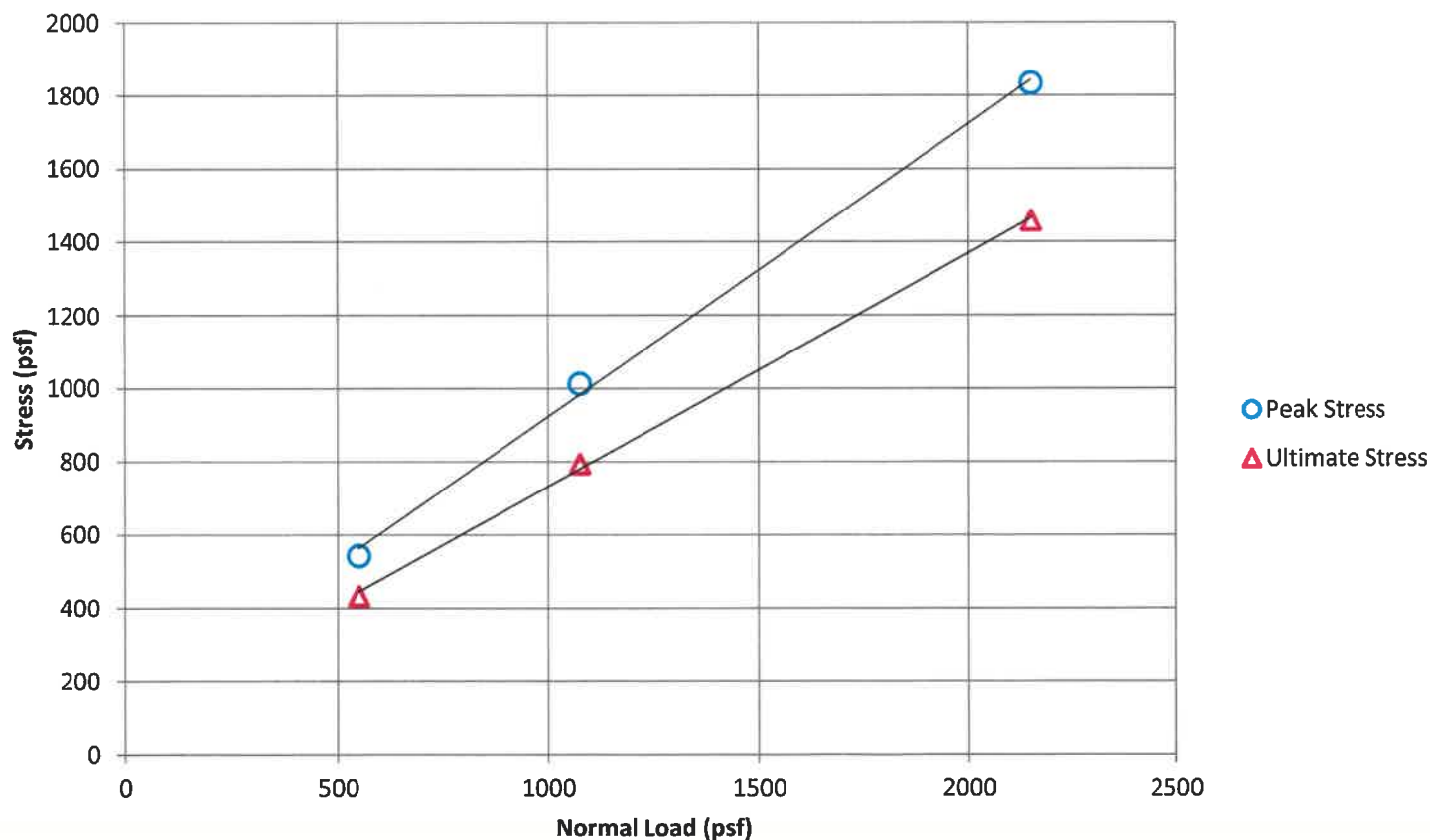
Peak Strength

Friction Angle: 38.7
Cohesion (psf): 123
Cohesion (kPa): 5.9

Ultimate Strength

Friction Angle: 32.5
Cohesion (psf): 95
Cohesion (kPa): 4.5

Normal Load vs. Stress



Data entry by: SPH
Checked by: *DPM*
File name: 2868024_Direct Shear ASTM D3080_1.xlsm

Date: 12/10/2018
Date: 12/11/18

Direct Shear

ASTM D 3080

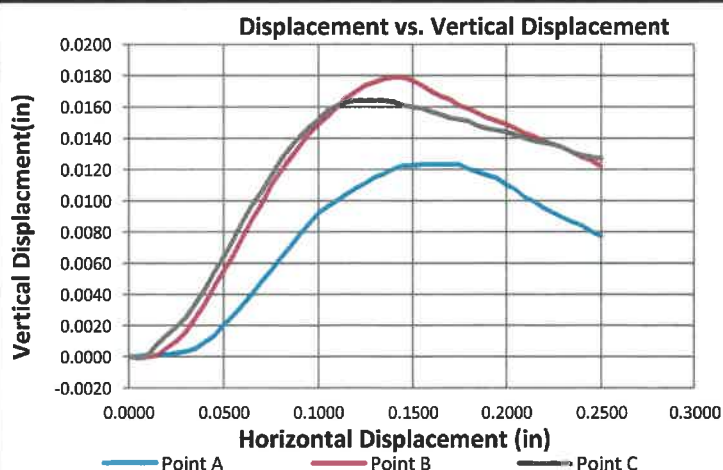
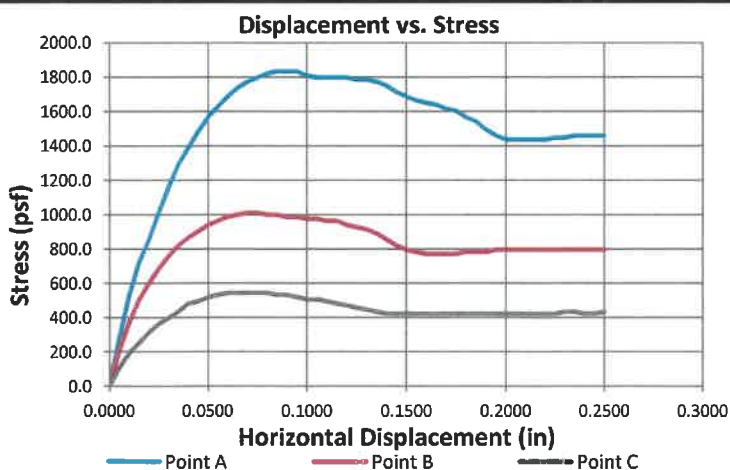
CLIENT	Stantec	BORING NO.	S-1
JOB NO.	2868-024	DEPTH	18-18.5'
PROJECT	GRP EP-1 Relining	SAMPLE NO.	S-1-17.5B
PROJECT NO.	233001304	DATE SAMPLED	--
LOCATION	--	DESCRIPTION	--
DATE TESTED	12/06/18		
TECHNICIAN	DPM		

Test Parameters

Displacement Rate (in/min): 0.01 Displacement Rate (cm/min): 0.0254

Raw Data Files: STDSS18A.DAT, STDSS18B.DAT, STDSS18C.DAT,

Before Test Mass of Wet Soil and Ring (g):	197.23	193.83	184.06
After Test Mass of Wet Soil and Pan (g):	164.59	161.02	153.82
Mass of Dry Soil and Pan (g):	139.87	137.74	130.75
Mass of Ring (g):	41.72	42.27	42.27
Mass of Pan (g):	6.62	6.63	6.51
Diameter (in):	2.41	2.41	2.41
Initial Height (in):	1.00	1.00	1.00
Height Change (in):	0.0203	0.0131	0.0122
Area (in ²):	4.56	4.56	4.56
Initial Wet Density (pcf):	129.9	126.6	118.4
Initial Dry Density (pcf):	111.3	109.5	103.8
Initial Wet Density (kg/m ³):	2080	2028	1897
Initial Dry Density (kg/m ³):	1783	1754	1662
Initial Moisture (%):	16.7	15.6	14.1
Final Wet Density (pcf):	134.7	130.6	124.5
Final Dry Density (pcf):	113.6	110.9	105.0
Final Wet Density (kg/m ³):	2157	2093	1995
Final Dry Density (kg/m ³):	1819	1777	1683
Final Moisture (%):	18.6	17.8	18.6



NOTES:

**Direct Shear Data
ASTM D3080**

CLIENT Stantec
JOB NO. 2868-024
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
LOCATION --
DATE TESTED 12/06/18
TECHNICIAN DPM

BORING NO. S-1
DEPTH 18-18.5'
SAMPLE NO. S-1-17.5B
DATE SAMPLED --
DESCRIPTION --

Point A			Point B			Point C		
Displacement (in)	Stress (psf)	Vertical Displacement (in)	Displacement (in)	Stress (psf)	Vertical Displacement (in)	Displacement (in)	Stress (psf)	Vertical Displacement (in)
0.0000	0.0	0.0000	0.0000	0.0	0.0000	0.0000	0.0	0.0000
0.0050	289.0	0.0000	0.0050	217.0	-0.0001	0.0050	109.0	-0.0001
0.0100	531.0	0.0001	0.0100	374.0	0.0000	0.0100	193.0	0.0001
0.0150	724.0	0.0001	0.0150	506.0	0.0001	0.0150	253.0	0.0008
0.0200	856.0	0.0001	0.0200	603.0	0.0006	0.0200	314.0	0.0014
0.0250	1013.0	0.0002	0.0250	687.0	0.0010	0.0250	362.0	0.0019
0.0300	1158.0	0.0003	0.0300	760.0	0.0016	0.0300	398.0	0.0025
0.0350	1290.0	0.0005	0.0350	820.0	0.0025	0.0350	434.0	0.0034
0.0400	1387.0	0.0009	0.0400	868.0	0.0034	0.0400	482.0	0.0043
0.0450	1483.0	0.0013	0.0450	904.0	0.0045	0.0450	494.0	0.0054
0.0500	1568.0	0.0020	0.0500	941.0	0.0055	0.0500	519.0	0.0064
0.0550	1628.0	0.0026	0.0550	965.0	0.0065	0.0550	531.0	0.0075
0.0600	1688.0	0.0033	0.0600	989.0	0.0077	0.0600	543.0	0.0087
0.0650	1736.0	0.0040	0.0650	1001.0	0.0088	0.0650	543.0	0.0097
0.0700	1773.0	0.0048	0.0700	1013.0	0.0098	0.0700	543.0	0.0106
0.0750	1797.0	0.0055	0.0750	1013.0	0.0110	0.0750	543.0	0.0116
0.0800	1821.0	0.0063	0.0800	1001.0	0.0119	0.0800	543.0	0.0126
0.0850	1833.0	0.0070	0.0850	1001.0	0.0127	0.0850	531.0	0.0134
0.0900	1833.0	0.0078	0.0900	989.0	0.0135	0.0900	531.0	0.0141
0.0950	1833.0	0.0085	0.0950	989.0	0.0143	0.0950	519.0	0.0147
0.1000	1809.0	0.0092	0.1000	977.0	0.0149	0.1000	506.0	0.0152
0.1050	1797.0	0.0096	0.1050	977.0	0.0154	0.1050	506.0	0.0158
0.1100	1797.0	0.0100	0.1100	965.0	0.0160	0.1100	494.0	0.0161
0.1150	1797.0	0.0104	0.1150	965.0	0.0166	0.1150	482.0	0.0163
0.1200	1797.0	0.0108	0.1200	941.0	0.0170	0.1200	470.0	0.0164
0.1250	1785.0	0.0111	0.1250	929.0	0.0174	0.1250	458.0	0.0164
0.1300	1785.0	0.0115	0.1300	916.0	0.0176	0.1300	446.0	0.0164
0.1350	1773.0	0.0117	0.1350	892.0	0.0178	0.1350	434.0	0.0164
0.1400	1749.0	0.0120	0.1400	856.0	0.0179	0.1400	422.0	0.0163
0.1450	1712.0	0.0122	0.1450	820.0	0.0179	0.1450	422.0	0.0161
0.1500	1688.0	0.0122	0.1500	796.0	0.0177	0.1500	422.0	0.0160
0.1550	1664.0	0.0123	0.1550	784.0	0.0174	0.1550	422.0	0.0159
0.1600	1652.0	0.0123	0.1600	772.0	0.0170	0.1600	422.0	0.0157
0.1650	1640.0	0.0123	0.1650	772.0	0.0167	0.1650	422.0	0.0155
0.1700	1616.0	0.0123	0.1700	772.0	0.0165	0.1700	422.0	0.0153
0.1750	1604.0	0.0123	0.1750	772.0	0.0161	0.1750	422.0	0.0152
0.1800	1568.0	0.0120	0.1800	784.0	0.0159	0.1800	422.0	0.0151
0.1850	1544.0	0.0118	0.1850	784.0	0.0156	0.1850	422.0	0.0148
0.1900	1495.0	0.0116	0.1900	784.0	0.0153	0.1900	422.0	0.0146
0.1950	1459.0	0.0114	0.1950	796.0	0.0151	0.1950	422.0	0.0145
0.2000	1435.0	0.0110	0.2000	796.0	0.0149	0.2000	422.0	0.0144
0.2050	1435.0	0.0107	0.2050	796.0	0.0146	0.2050	422.0	0.0142
0.2100	1435.0	0.0102	0.2100	796.0	0.0143	0.2100	422.0	0.0140

CLIENT	Stantec
JOB NO.	2868-024
PROJECT	GRP EP-1 Relining
PROJECT NO.	233001304
LOCATION	--
DATE TESTED	12/06/18
TECHNICIAN	DPM

BORING NO.	S-1
DEPTH	18-18.5'
SAMPLE NO.	S-1-17.5B
DATE SAMPLED	--
DESCRIPTION	--

Point A			Point B			Point C		
Displacement (in)	Stress (psf)	Vertical Displacement (in)	Displacement (in)	Stress (psf)	Vertical Displacement (in)	Displacement (in)	Stress (psf)	Vertical Displacement (in)
0.2150	1435.0	0.0099	0.2150	796.0	0.0141	0.2150	422.0	0.0138
0.2200	1435.0	0.0095	0.2200	796.0	0.0138	0.2200	422.0	0.0137
0.2250	1447.0	0.0092	0.2250	796.0	0.0136	0.2250	422.0	0.0136
0.2300	1447.0	0.0089	0.2300	796.0	0.0134	0.2300	434.0	0.0134
0.2350	1459.0	0.0086	0.2350	796.0	0.0131	0.2350	434.0	0.0131
0.2400	1459.0	0.0084	0.2400	796.0	0.0128	0.2400	422.0	0.0129
0.2450	1459.0	0.0080	0.2450	796.0	0.0126	0.2450	422.0	0.0128
0.2500	1459.0	0.0077	0.2500	796.0	0.0122	0.2500	434.0	0.0127

Direct Shear

ASTM D 3080

CLIENT	Stantec	BORING NO.	N-1
JOB NO.	2868-024	DEPTH	11-11.5
PROJECT	GRP EP-1 Relining	SAMPLE NO.	N-1-10A
PROJECT NO.	233001304	DATE SAMPLED	--
LOCATION	--	DESCRIPTION	Liner
DATE TESTED	12/10/18		
TECHNICIAN	DPM		

Direct Shear Results

Point:	A	B	C
Normal Load (psf):	1300	650	325
Normal Load (kPa):	62.4	31.2	15.6
Peak Strength (psf):	916	531	314
Ultimate Strength (psf):	916	506	289
Peak Strength (kPa):	44.0	25.5	15.1
Ultimate Strength (kPa):	44.0	24.3	13.9

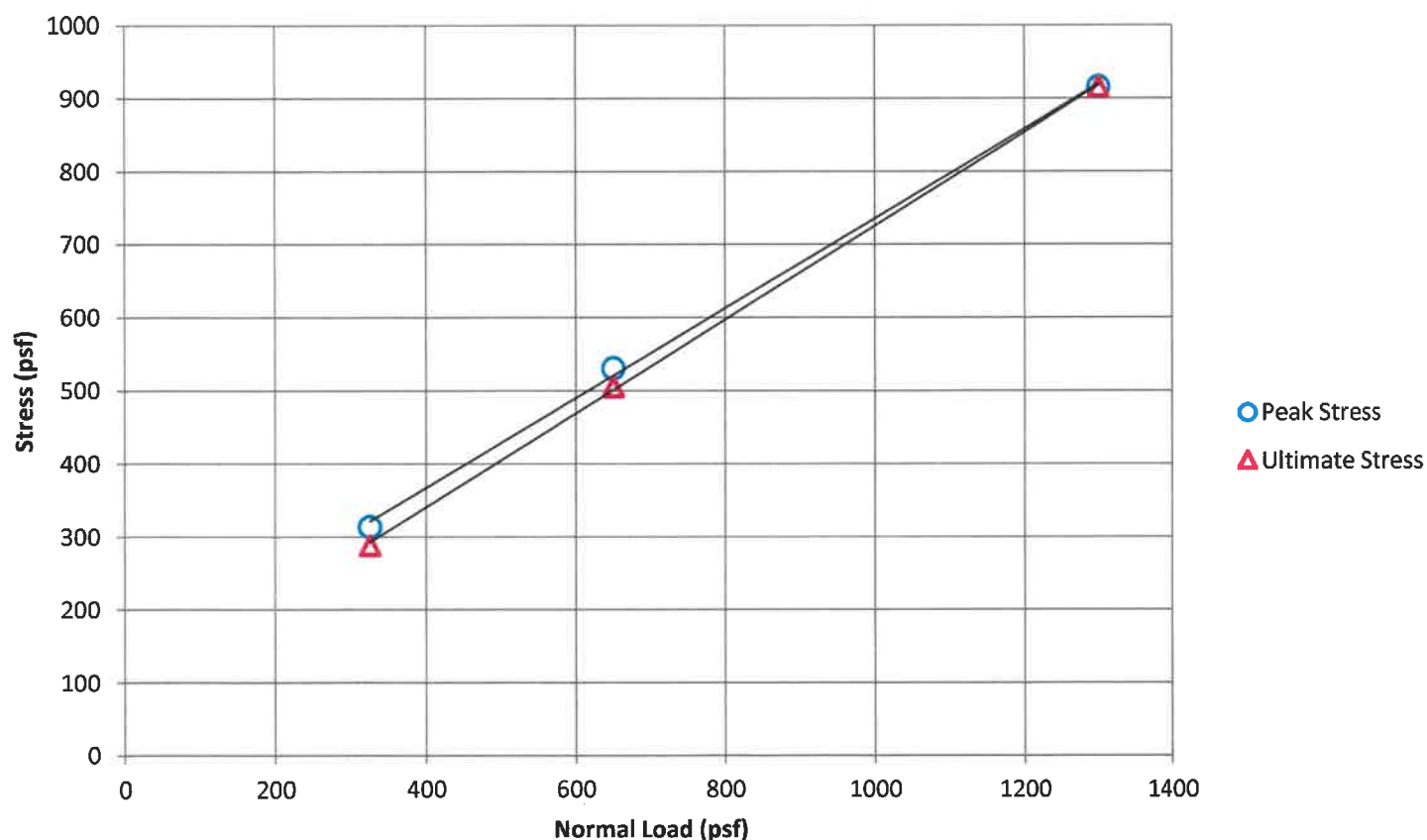
Peak Strength

Friction Angle: 31.5
Cohesion (psf): 122
Cohesion (kPa): 5.8

Ultimate Strength

Friction Angle: 32.7
Cohesion (psf): 84
Cohesion (kPa): 4.0

Normal Load vs. Stress



Data entry by: DPM Date: 12/12/2018
Checked by: cm Date: 12/13/2018
File name: 2868024__Direct Shear ASTM D3080_2.xlsm

Direct Shear

ASTM D 3080

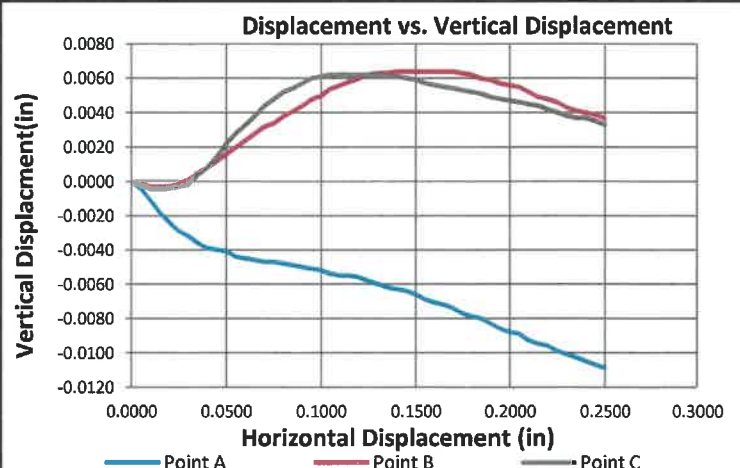
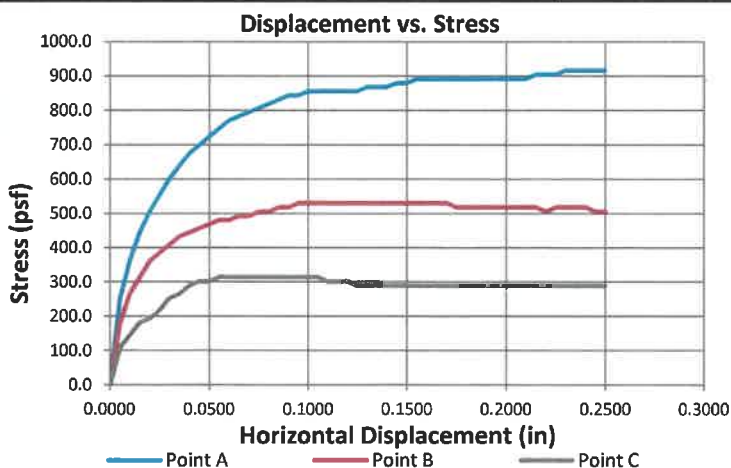
CLIENT	Stantec	BORING NO.	N-1
JOB NO.	2868-024	DEPTH	11-11.5
PROJECT	GRP EP-1 Relining	SAMPLE NO.	N-1-10A
PROJECT NO.	233001304	DATE SAMPLED	--
LOCATION	--	DESCRIPTION	Liner
DATE TESTED	12/10/18		
TECHNICIAN	DPM		

Test Parameters

Displacement Rate (in/min): 0.0033 Displacement Rate (cm/min): 0.008382

Raw Data Files: STDSN11A.DAT, STDSN11B.DAT, STDSN11C.DAT,

Before Test Mass of Wet Soil and Ring (g):	187.99	192.27	183.00
After Test Mass of Wet Soil and Pan (g):	154.15	161.95	152.71
Mass of Dry Soil and Pan (g):	126.98	136.76	121.91
Mass of Ring (g):	42.58	41.84	42.35
Mass of Pan (g):	6.68	6.80	6.75
Diameter (in):	2.41	2.41	2.41
Initial Height (in):	1.00	1.00	1.00
Height Change (in):	0.0188	0.0097	0.00945
Area (in ²):	4.56	4.56	4.56
Initial Wet Density (pcf):	121.4	125.6	117.5
Initial Dry Density (pcf):	100.5	108.5	96.2
Initial Wet Density (kg/m ³):	1945	2012	1882
Initial Dry Density (kg/m ³):	1609	1738	1541
Initial Moisture (%):	20.9	15.8	22.1
Final Wet Density (pcf):	125.5	130.8	123.1
Final Dry Density (pcf):	102.4	109.6	97.1
Final Wet Density (kg/m ³):	2011	2096	1971
Final Dry Density (kg/m ³):	1640	1756	1555
Final Moisture (%):	22.6	19.4	26.7



NOTES:

**Direct Shear Data
ASTM D3080**

CLIENT Stantec
JOB NO. 2868-024
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
LOCATION --
DATE TESTED 12/10/18
TECHNICIAN DPM

BORING NO. N-1
DEPTH 11-11.5
SAMPLE NO. N-1-10A
DATE SAMPLED --
DESCRIPTION Liner

Point A			Point B			Point C			
Displacement (in)	Stress (psf)	Vertical Displacement (in)	Displacement (in)	Stress (psf)	Vertical Displacement (in)	Displacement (in)	Stress (psf)	Vertical Displacement (in)	
0.0000	0.0	0.0000	0.0000	0.0	0.0000	0.0000	0.0	0.0000	
0.0050	253.0	-0.0004	0.0050	181.0	-0.0001	0.0050	109.0	-0.0002	
0.0100	362.0	-0.0011	0.0100	265.0	-0.0003	0.0100	145.0	-0.0004	
0.0150	446.0	-0.0018	0.0150	314.0	-0.0003	0.0150	181.0	-0.0004	
0.0200	506.0	-0.0024	0.0200	362.0	-0.0003	0.0200	193.0	-0.0004	
0.0250	555.0	-0.0029	0.0250	386.0	-0.0001	0.0250	217.0	-0.0003	
0.0300	603.0	-0.0032	0.0300	410.0	0.0001	0.0300	253.0	-0.0002	
0.0350	639.0	-0.0036	0.0350	434.0	0.0005	0.0350	265.0	0.0004	
0.0400	675.0	-0.0039	0.0400	446.0	0.0008	0.0400	289.0	0.0008	
0.0450	699.0	-0.0040	0.0450	458.0	0.0012	0.0450	301.0	0.0014	
0.0500	724.0	-0.0041	0.0500	470.0	0.0016	0.0500	301.0	0.0022	
0.0550	748.0	-0.0044	0.0550	482.0	0.0020	0.0550	314.0	0.0028	
0.0600	772.0	-0.0045	0.0600	482.0	0.0024	0.0600	314.0	0.0033	
0.0650	784.0	-0.0046	0.0650	494.0	0.0028	0.0650	314.0	0.0038	
0.0700	796.0	-0.0047	0.0700	494.0	0.0032	0.0700	314.0	0.0044	
0.0750	808.0	-0.0047	0.0750	506.0	0.0034	0.0750	314.0	0.0048	
0.0800	820.0	-0.0048	0.0800	506.0	0.0038	0.0800	314.0	0.0052	
0.0850	832.0	-0.0049	0.0850	519.0	0.0041	0.0850	314.0	0.0054	
0.0900	844.0	-0.0050	0.0900	519.0	0.0044	0.0900	314.0	0.0057	
0.0950	844.0	-0.0051	0.0950	531.0	0.0048	0.0950	314.0	0.0060	
0.1000	856.0	-0.0052	0.1000	531.0	0.0050	0.1000	314.0	0.0061	
0.1050	856.0	-0.0054	0.1050	531.0	0.0054	0.1050	314.0	0.0062	
0.1100	856.0	-0.0055	0.1100	531.0	0.0056	0.1100	301.0	0.0062	
0.1150	856.0	-0.0055	0.1150	531.0	0.0058	0.1150	301.0	0.0062	
0.1200	856.0	-0.0056	0.1200	531.0	0.0060	0.1200	301.0	0.0062	
0.1250	856.0	-0.0058	0.1250	531.0	0.0062	0.1250	289.0	0.0062	
0.1300	868.0	-0.0060	0.1300	531.0	0.0063	0.1300	289.0	0.0062	
0.1350	868.0	-0.0062	0.1350	531.0	0.0063	0.1350	289.0	0.0061	
0.1400	868.0	-0.0063	0.1400	531.0	0.0064	0.1400	289.0	0.0061	
0.1450	880.0	-0.0064	0.1450	531.0	0.0064	0.1450	289.0	0.0060	
0.1500	880.0	-0.0066	0.1500	531.0	0.0064	0.1500	289.0	0.0059	
0.1550	892.0	-0.0069	0.1550	531.0	0.0064	0.1550	289.0	0.0057	
0.1600	892.0	-0.0071	0.1600	531.0	0.0064	0.1600	289.0	0.0056	
0.1650	892.0	-0.0072	0.1650	531.0	0.0064	0.1650	289.0	0.0055	
0.1700	892.0	-0.0074	0.1700	531.0	0.0064	0.1700	289.0	0.0054	
0.1750	892.0	-0.0077	0.1750	519.0	0.0063	0.1750	289.0	0.0053	
0.1800	892.0	-0.0079	0.1800	519.0	0.0062	0.1800	289.0	0.0052	
0.1850	892.0	-0.0080	0.1850	519.0	0.0060	0.1850	289.0	0.0051	
0.1900	892.0	-0.0083	0.1900	519.0	0.0059	0.1900	289.0	0.0049	
0.1950	892.0	-0.0086	0.1950	519.0	0.0057	0.1950	289.0	0.0048	
0.2000	892.0	-0.0088	0.2000	519.0	0.0056	0.2000	289.0	0.0047	
0.2050	892.0	-0.0089	0.2050	519.0	0.0055	0.2050	289.0	0.0046	
0.2100	892.0	-0.0093	0.2100	519.0	0.0052	0.2100	289.0	0.0045	

BORING NO.	N-1
DEPTH	11-11.5
SAMPLE NO.	N-1-10A
DATE SAMPLED	--
DESCRIPTION	Liner

Point A			Point B			Point C		
Displacement (in)	Stress (psf)	Vertical Displacement (in)	Displacement (in)	Stress (psf)	Vertical Displacement (in)	Displacement (in)	Stress (psf)	Vertical Displacement (in)
0.2150	904.0	-0.0095	0.2150	519.0	0.0049	0.2150	289.0	0.0044
0.2200	904.0	-0.0096	0.2200	506.0	0.0048	0.2200	289.0	0.0042
0.2250	904.0	-0.0099	0.2250	519.0	0.0046	0.2250	289.0	0.0040
0.2300	916.0	-0.0101	0.2300	519.0	0.0043	0.2300	289.0	0.0038
0.2350	916.0	-0.0103	0.2350	519.0	0.0041	0.2350	289.0	0.0037
0.2400	916.0	-0.0105	0.2400	519.0	0.0040	0.2400	289.0	0.0037
0.2450	916.0	-0.0107	0.2450	506.0	0.0039	0.2450	289.0	0.0035
0.2500	916.0	-0.0109	0.2500	506.0	0.0037	0.2500	289.0	0.0033

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS

ASTM D4767 Modified for Multiple Stages

Stage 1

CLIENT	Stantec	JOB NO.	2868-24
PROJECT	GRP EP-1 Relining	DATE SAMPLED	—
PROJECT NO.	233001304	DATE STARTED	11/26/2018
BORING NO.	W-1	DATE FINISHED	12/5/2018
DEPTH	18.5-19'	CELL NUMBER	13S
SAMPLE NO.	W-1-17.5A	SATURATED TEST	Yes
LOCATION	Homestake Mining Co.	CONF. PRES. (psf)	547
SAMPLE TYPE	Clay		

MOISTURE/DENSITY DATA

BEFORE
TEST

AFTER
TEST

Wt. Soil + Moisture (g)	375.09	385.99
Wt. Wet Soil & Pan (g)	381.70	392.60
Wt. Dry Soil & Pan (g)	314.93	314.93
Wt. Lost Moisture (g)	66.77	77.67
Wt. of Pan Only (g)	6.61	6.61
Wt. of Dry Soil (g)	308.32	308.32
Moisture Content (%)	21.66	25.19
Wet Density (pcf)	122.2	124.6
Dry Density (pcf)	100.4	99.5

Initial Diameter (in)	1.930
Initial Area (sq in)	2.926
Initial Height (in)	3.997
Volume Before Consol. (cu ft)	0.00677
Volume After Consol. (cu ft)	0.00683

Notes & Comments:

Data entry by: CAL Date: 12/07/18 Technician: CAL
Data checked by: SPH Date: 12-10-18

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS							
ASTM D4767 Modified for Multiple Stages							
Stage 1							
CLIENT	Stantec				JOB NO.	2868-24	
PROJECT	GRP EP-1 Relining				DATE SAMPLED	--	
PROJECT NO.	233001304				DATE STARTED	11/26/2018	
BORING NO.	W-1				DATE FINISHED	12/5/2018	
DEPTH	18.5-19'				CELL NUMBER	13S	
SAMPLE NO.	W-1-17.5A				SATURATED TEST	Yes	
LOCATION	Homestake Mining Co.				CONF. PRES. (psf)	547	
SAMPLE TYPE	Clay						
SATURATION DATA							
Cell Pressure (psi)	Back Pressure (psi)	Burette Reading (cc)		Pore Pressure (psi)		Change	B
		Close	Open	Close	Open		
40	38	2.4	9.4				
50	48	5.0	6.1	38.3	47.1	8.8	0.88
60	58	6.0	7.0	48.5	57.5	9	0.90
70	68	6.9	7.8	58.4	67.5	9.1	0.91
80		7.7	7.8	68.0	77.6	9.6	0.96
CONSOLIDATION DATA							
	Elapsed Time (min)	SQRT Time (min)	Burette Reading (cc)	Volume Deflection (cc)			
	0.00	0.0	7.80	0.00			
	0.25	0.5	8.00	-0.20			
	0.5	0.7	8.05	-0.25			
	1	1.0	8.10	-0.30			
	2	1.4	8.15	-0.35			
	4	2.0	8.20	-0.40			
	9	3.0	8.30	-0.50			
	16	4.0	8.35	-0.55			
	30	5.5	8.40	-0.60			
	60	7.7	8.50	-0.70			
	120	11.0	8.55	-0.75			
	240	15.5	8.60	-0.80			
	360	19.0	8.65	-0.85			
	1440	37.9	8.90	-1.10			
Initial Height (in)	3.997			Initial Volume (cc)	191.654		
Height Change (in)	0.010			Volume Change (cc)	6.500		
Height After Consol. (in)	3.987			Cell Expansion (cc)	8.305		
Initial Area (sq in)	2.926			Net Volume Change (cc)	-1.805		
Area After Consol. (sq in)	2.960			Consol. Volume (cc)	193.459		

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS

ASTM D4767 Modified for Multiple Stages

Stage 1

CLIENT	Stantec	JOB NO.	2868-24
PROJECT	GRP EP-1 Relining	DATE SAMPLED	—
PROJECT NO.	233001304	DATE STARTED	11/26/2018
BORING NO.	W-1	DATE FINISHED	12/5/2018
DEPTH	18.5-19'	CELL NUMBER	13S
SAMPLE NO.	W-1-17.5A	SATURATED TEST	Yes
LOCATION	Homestake Mining Co.	CONF. PRES. (psf)	547
SAMPLE TYPE	Clay		

Initial Height (in)	3.997	Init. Area (sq in)	2.926
Consol. Height (in)	3.987	Consol. Area (sq in)	2.960
Back Pressure (psi)	68.4	Strain Rate (in/min)	0.0034

Axial Load (lbs)	Axial Load (psf)	Delta Ht. (in)	Axial Strain (%)	Area Final (sq in)	Deviator Stress (psf)	Pore Pres. (psi)	Delta Pres. (psf)	Sigma 3' (psf)	Sigma 1' (psf)	Prin. Stress Ratio
0	0	0.000	0.00	2.960	0	68.4	0	547	547	1.00
12	584	0.004	0.10	2.963	583	69.4	144	403	986	2.45
16	778	0.008	0.20	2.966	777	69.9	216	331	1108	3.35
19	924	0.012	0.30	2.969	921	70.2	259	288	1209	4.20
21	1021	0.016	0.40	2.972	1017	70.4	288	259	1277	4.92
22	1070	0.019	0.48	2.975	1065	70.5	302	245	1310	5.35
23	1119	0.024	0.60	2.978	1112	70.5	302	245	1357	5.54
25	1216	0.028	0.70	2.981	1207	70.5	302	245	1452	5.93
26	1265	0.032	0.80	2.984	1255	70.5	302	245	1499	6.12
27	1313	0.035	0.88	2.987	1302	70.5	302	245	1547	6.32
27	1313	0.039	0.98	2.990	1300	70.5	302	245	1545	6.31
28	1362	0.047	1.18	2.996	1346	70.5	302	245	1591	6.50
30	1459	0.055	1.38	3.002	1439	70.5	302	245	1684	6.88
32	1557	0.063	1.58	3.008	1532	70.5	302	245	1777	7.26
33	1605	0.071	1.78	3.014	1577	70.4	288	259	1836	7.08
34	1654	0.079	1.98	3.020	1621	70.3	274	274	1895	6.92
35	1702	0.087	2.18	3.027	1665	70.2	259	288	1953	6.78
37	1800	0.095	2.38	3.033	1757	70.1	245	302	2059	6.81
37	1800	0.103	2.58	3.039	1753	70.0	230	317	2070	6.53
39	1897	0.111	2.78	3.045	1844	69.9	216	331	2175	6.57
39	1897	0.119	2.98	3.0516	1840	69.8	202	346	2186	6.33
41	1994	0.127	3.19	3.0579	1931	69.7	187	360	2291	6.36
42	2043	0.139	3.49	3.0674	1972	69.6	173	374	2346	6.27

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS

ASTM D4767 Modified for Multiple Stages

Stage 2 of 3

CLIENT	Stantec	JOB NO.	2868-24
PROJECT	GRP EP-1 Relining	DATE SAMPLED	—
PROJECT NO.	233001304	DATE STARTED	11/26/2018
BORING NO.	W-1	DATE FINISHED	12/5/2018
DEPTH	18.5-19'	CELL NUMBER	13S
SAMPLE NO.	W-1-17.5A	SATURATED TEST	Yes
LOCATION	Homestake Mining Co.	CONF. PRES. (psf)	1080
SAMPLE TYPE	Clay		

MOISTURE/DENSITY DATA	BEFORE TEST	AFTER TEST
-----------------------	----------------	---------------

Wt. Soil + Moisture (g)	375.09	385.99
Wt. Wet Soil & Pan (g)	381.70	392.60
Wt. Dry Soil & Pan (g)	314.93	314.93
Wt. Lost Moisture (g)	66.77	77.67
Wt. of Pan Only (g)	6.61	6.61
Wt. of Dry Soil (g)	308.32	308.32
Moisture Content %	21.66	25.19
Wet Density (pcf)	121.1	126.2
Dry Density (pcf)	99.5	100.8

Initial Diameter (in)	1.976
Initial Area (sq in)	3.067
Initial Height (in)	3.848
Volume Before Consol. (cu ft)	0.00683
Volume After Consol. (cu ft)	0.00674

Notes & Comments:

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS

ASTM D4767 Modified for Multiple Stages

Stage 2 of 3

CLIENT	Stantec	JOB NO.	2868-24
PROJECT	GRP EP-1 Relining	DATE SAMPLED	--
PROJECT NO.	233001304	DATE STARTED	11/26/2018
BORING NO.	W-1	DATE FINISHED	12/5/2018
DEPTH	18.5-19'	CELL NUMBER	13S
SAMPLE NO.	W-1-17.5A	SATURATED TEST	Yes
LOCATION	Homestake Mining Co.	CONF. PRES. (psf)	1080
SAMPLE TYPE	Clay		

CONSOLIDATION DATA

Elapsed Time (min)	SQRT Time (min)	Burette Reading (cc)	Volume Deflection (cc)
0.00	0.0	8.95	0.00
0.25	0.5	9.35	-0.40
0.5	0.7	9.40	-0.45
1	1.0	9.50	-0.55
2	1.4	9.70	-0.75
4	2.0	9.80	-0.85
9	3.0	10.10	-1.15
16	4.0	10.30	-1.35
30	5.5	10.50	-1.55
60	7.7	10.80	-1.85
120	11.0	11.00	-2.05
240	15.5	11.10	-2.15
360	19.0	11.20	-2.25
430	20.7	11.20	-2.25

Initial Height (in)	3.848	Initial Volume (cc)	193.459
Height Change (in)	-0.003	Volume Change (cc)	2.850
Ht. After Consol. (in)	3.851	Cell Expansion (cc)	0.345
Initial Area (sq in)	3.067	Net Change (cc)	2.505
Area After Consol. (sq in)	3.025	Consol. Volume (cc)	190.953

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS

ASTM D4767 Modified for Multiple Stages

Stage 2 of 3

CLIENT	Stantec	JOB NO.	2868-24
PROJECT	GRP EP-1 Relining	DATE SAMPLED	--
PROJECT NO.	233001304	DATE STARTED	11/26/2018
BORING NO.	W-1	DATE FINISHED	12/5/2018
DEPTH	18.5-19'	CELL NUMBER	13S
SAMPLE NO.	W-1-17.5A	SATURATED TEST	Yes
LOCATION	Homestake Mining Co.	CONF. PRES. (psf)	1080
SAMPLE TYPE	Clay		

Initial Height (in)	3.848	Init. Area (sq in)	3.067
Consol. Height (in)	3.851	Consol. Area (sq in)	3.025
Back Pressure (psi)	68.3	Strain Rate (in/min)	0.0015

Axial Load (lbs)	Axial Load (psf)	Delta Ht. (in)	Axial Strain (%)	Area Final (sq in)	Deviator Stress (psf)	Pore Pres. (psi)	Delta Pres. (psf)	Sigma 3' (psf)	Sigma 1' (psf)	Prin. Stress Ratio
0	0	0.000	0.00	3.025	0	68.3	0	1080	1080	1.00
14	645	0.003	0.08	3.028	645	69.2	125	955	1599	1.68
27	1266	0.006	0.16	3.030	1264	70.0	251	829	2093	2.52
36	1737	0.010	0.25	3.033	1732	70.7	342	738	2470	3.35
43	2067	0.014	0.37	3.036	2059	71.0	389	691	2750	3.98
47	2249	0.018	0.47	3.040	2238	71.1	405	675	2913	4.32
50	2366	0.022	0.56	3.043	2353	71.1	407	673	3026	4.50
52	2476	0.025	0.65	3.045	2460	71.1	403	677	3137	4.63
54	2568	0.029	0.75	3.048	2549	71.0	394	686	3235	4.71
55	2611	0.032	0.84	3.051	2589	71.0	385	695	3285	4.72
55	2642	0.036	0.94	3.054	2617	70.9	375	705	3322	4.71
57	2723	0.041	1.06	3.058	2694	70.8	365	715	3409	4.77
58	2750	0.044	1.14	3.060	2718	70.8	354	726	3444	4.74
58	2763	0.048	1.25	3.064	2728	70.7	344	736	3464	4.71
59	2791	0.052	1.36	3.067	2753	70.6	333	747	3499	4.69
59	2823	0.056	1.46	3.070	2782	70.6	324	756	3538	4.68
60	2833	0.060	1.55	3.073	2789	70.5	313	767	3556	4.64
60	2856	0.064	1.65	3.076	2808	70.4	303	777	3585	4.62
61	2903	0.067	1.75	3.0793	2852	70.3	294	786	3638	4.63
61	2897	0.071	1.85	3.0825	2843	70.3	285	795	3638	4.58
63	2992	0.075	1.95	3.0855	2934	70.2	275	805	3739	4.64

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS ASTM D4767 Modified for Multiple Stages Stage 3 of 3			
CLIENT PROJECT PROJECT NO. BORING NO. DEPTH SAMPLE NO. LOCATION SAMPLE TYPE	Stantec GRP EP-1 Relining 233001304 W-1 18.5-19' W-1-17.5A Homestake Mining Co. Clay	JOB NO. DATE SAMPLED DATE STARTED DATE FINISHED CELL NUMBER SATURATED TEST CONF. PRES. (psf)	2868-24 -- 11/26/2018 12/5/2018 13S Yes 2160
MOISTURE/DENSITY DATA	BEFORE TEST	AFTER TEST	
Wt. Soil + Moisture (g)	375.09	385.99	
Wt. Wet Soil & Pan (g)	381.70	392.60	
Wt. Dry Soil & Pan (g)	314.93	314.93	
Wt. Lost Moisture (g)	66.77	77.67	
Wt. of Pan Only (g)	6.61	6.61	
Wt. of Dry Soil (g)	308.32	308.32	
Moisture Content %	21.66	25.19	
Wet Density (pcf)	122.6	127.6	
Dry Density (pcf)	100.8	101.9	
Initial Diameter (in)	1.982		
Initial Area (sq in)	3.086		
Initial Height (in)	3.776		
Volume Before Consol. (cu ft)	0.00674		
Volume After Consol. (cu ft)	0.00667		
Notes & Comments:			

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS				
ASTM D4767 Modified for Multiple Stages				
Stage 3 of 3				
CLIENT	Stantec	JOB NO.	2868-24	
PROJECT	GRP EP-1 Relining	DATE SAMPLED	--	
PROJECT NO.	233001304	DATE STARTED	11/26/2018	
BORING NO.	W-1	DATE FINISHED	12/5/2018	
DEPTH	18.5-19'	CELL NUMBER	13S	
SAMPLE NO.	W-1-17.5A	SATURATED TEST	Yes	
LOCATION	Homestake Mining Co.	CONF. PRES. (psf)	2160	
SAMPLE TYPE	Clay			
CONSOLIDATION DATA				
	Elapsed Time (min)	SQRT Time (min)	Burette Reading (cc)	Volume Deflection (cc)
	0.00	0.0	12.10	0.00
	0.25	0.5	12.70	-0.60
	0.5	0.7	12.80	-0.70
	1	1.0	12.90	-0.80
	2	1.4	13.00	-0.90
	4	2.0	13.20	-1.10
	9	3.0	13.45	-1.35
	16	4.0	13.65	-1.55
	30	5.5	13.90	-1.80
	60	7.7	14.15	-2.05
	120	11.0	14.40	-2.30
	240	15.5	14.60	-2.50
	360	19.0	14.70	-2.60
	1440	37.9	14.90	-2.80
Initial Height (in)	3.776	Initial Volume (cc)	190.953	
Height Change (in)	-0.004	Volume Change (cc)	2.800	
Ht. After Consol. (in)	3.780	Cell Expansion (cc)	0.699	
Initial Area (sq in)	3.086	Net Change (cc)	2.101	
Area After Consol. (sq in)	3.048	Consol. Volume (cc)	188.852	

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS

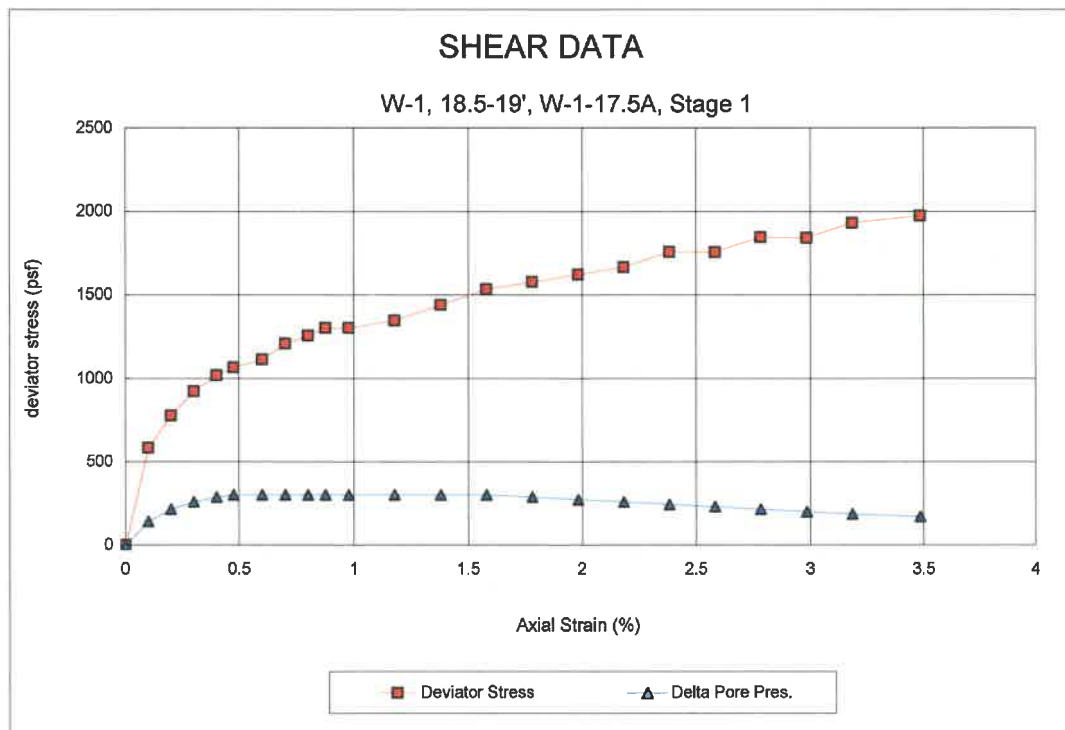
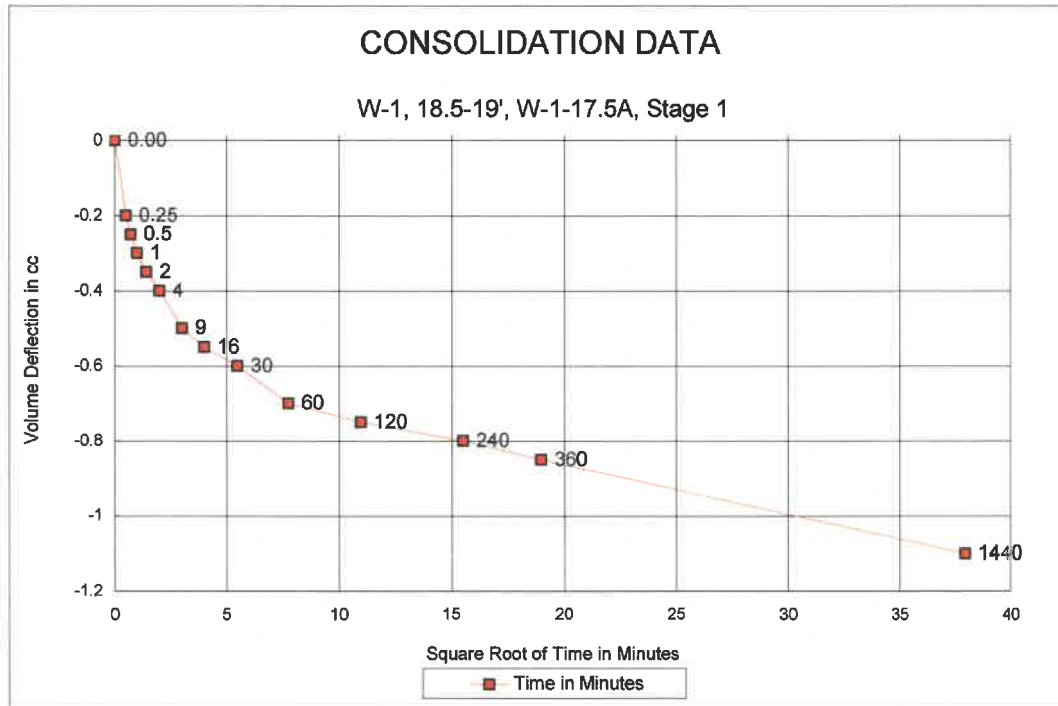
ASTM D4767

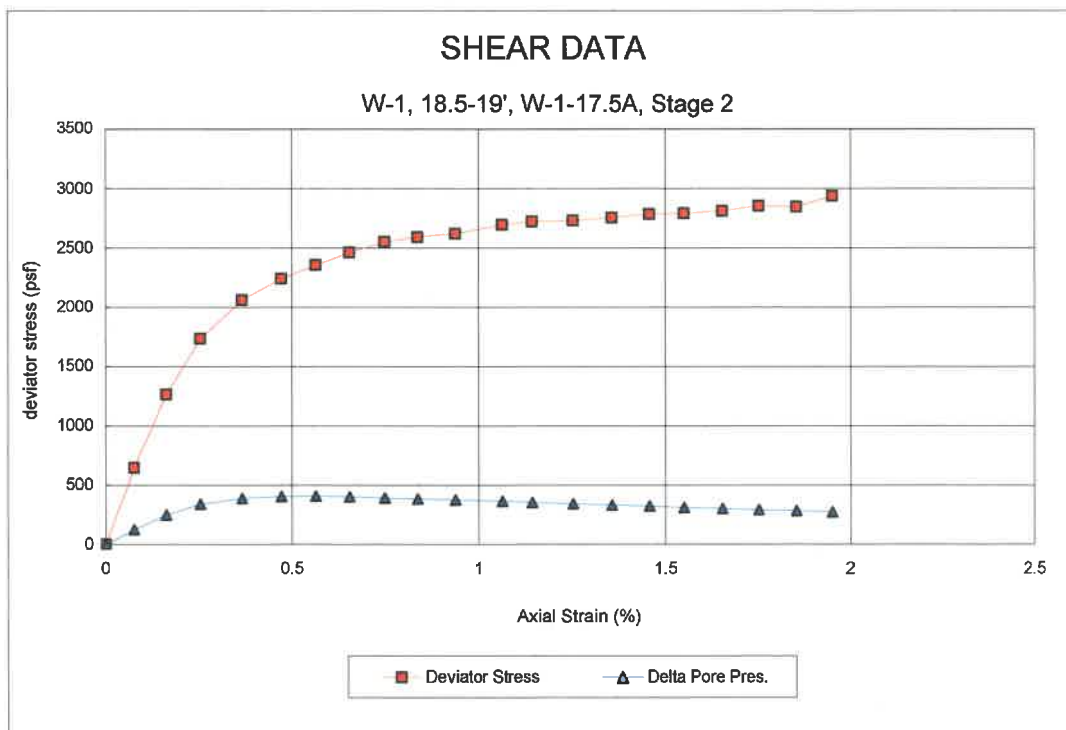
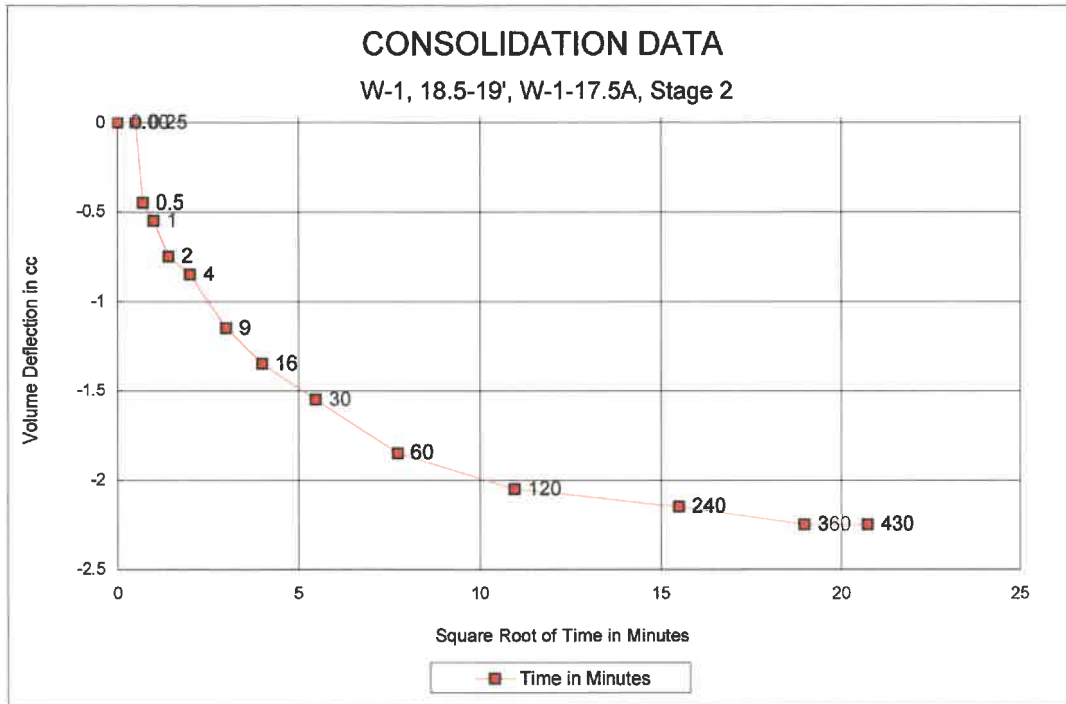
Stage 3 of 3

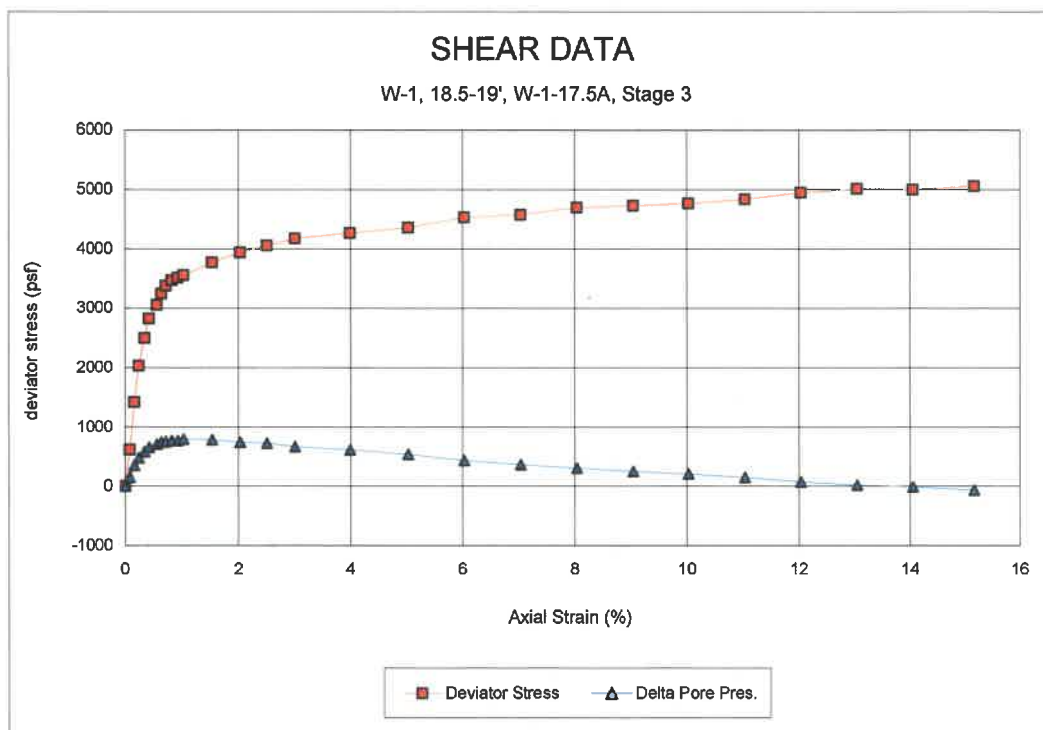
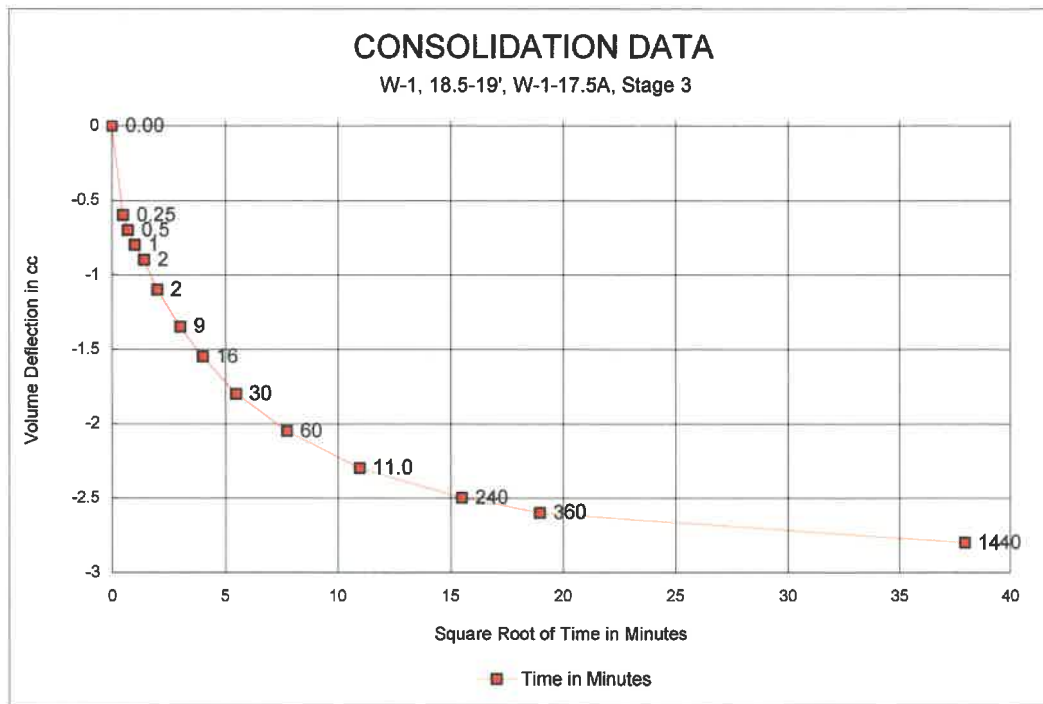
CLIENT	Stantec	JOB NO.	2868-24
PROJECT	GRP EP-1 Relining	DATE SAMPLED	—
PROJECT NO.	233001304	DATE STARTED	11/26/2018
BORING NO.	W-1	DATE FINISHED	12/5/2018
DEPTH	18.5-19'	CELL NUMBER	13S
SAMPLE NO.	W-1-17.5A	SATURATED TEST	Yes
LOCATION	Homestake Mining Co.	CONF. PRES. (psf)	2160
SAMPLE TYPE	Clay		

Initial Height (in)	3.776	Init. Area (sq in)	3.086
Consol. Height (in)	3.780	Consol. Area (sq in)	3.048
Back Pressure (psi)	68.3	Strain Rate (in/min)	0.0006

Axial Load (lbs)	Axial Load (psf)	Delta Ht. (in)	Axial Strain (%)	Area Final (sq in)	Deviator Stress (psf)	Pore Pres. (psi)	Delta Pres. (psf)	Sigma 3' (psf)	Sigma 1' (psf)	Prin. Stress Ratio
0	0	0.000	0.00	3.048	0	68.3	0	2160	2160	1.00
13	614	0.003	0.08	3.051	614	69.4	158	2002	2615	1.31
30	1417	0.006	0.16	3.053	1415	70.8	360	1800	3215	1.79
43	2031	0.009	0.24	3.056	2026	71.7	490	1670	3697	2.21
53	2504	0.013	0.34	3.059	2495	72.4	590	1570	4065	2.59
60	2834	0.016	0.42	3.061	2822	72.9	662	1498	4320	2.88
65	3071	0.021	0.56	3.065	3053	73.3	720	1440	4493	3.12
69	3259	0.024	0.63	3.068	3239	73.5	749	1411	4650	3.30
72	3401	0.027	0.71	3.070	3377	73.6	763	1397	4774	3.42
74	3496	0.031	0.82	3.074	3467	73.7	778	1382	4849	3.51
75	3543	0.035	0.93	3.077	3510	73.7	778	1382	4893	3.54
76	3590	0.039	1.03	3.080	3553	73.9	806	1354	4907	3.62
81	3826	0.058	1.53	3.096	3768	73.8	792	1368	5136	3.75
85	4015	0.077	2.04	3.112	3934	73.5	749	1411	5345	3.79
88	4157	0.095	2.51	3.127	4053	73.4	734	1426	5478	3.84
91	4299	0.114	3.02	3.143	4169	73.0	677	1483	5652	3.81
94	4440	0.151	3.99	3.175	4263	72.6	619	1541	5804	3.77
97	4582	0.190	5.03	3.210	4352	72.1	547	1613	5965	3.70
102	4818	0.228	6.03	3.244	4528	71.4	446	1714	6241	3.64
104	4913	0.266	7.04	3.279	4567	70.9	374	1786	6353	3.56
108	5102	0.304	8.04	3.315	4691	70.5	317	1843	6535	3.55
110	5196	0.342	9.05	3.352	4726	70.1	259	1901	6627	3.49
112	5291	0.379	10.03	3.388	4760	69.8	216	1944	6704	3.45
115	5432	0.417	11.03	3.426	4833	69.4	158	2002	6835	3.41
119	5621	0.455	12.04	3.465	4945	68.9	86	2074	7018	3.38
122	5763	0.493	13.04	3.506	5011	68.5	29	2131	7143	3.35
123	5810	0.531	14.05	3.547	4994	68.3	0	2160	7154	3.31
126	5952	0.573	15.16	3.593	5050	67.9	-58	2218	7267	3.28







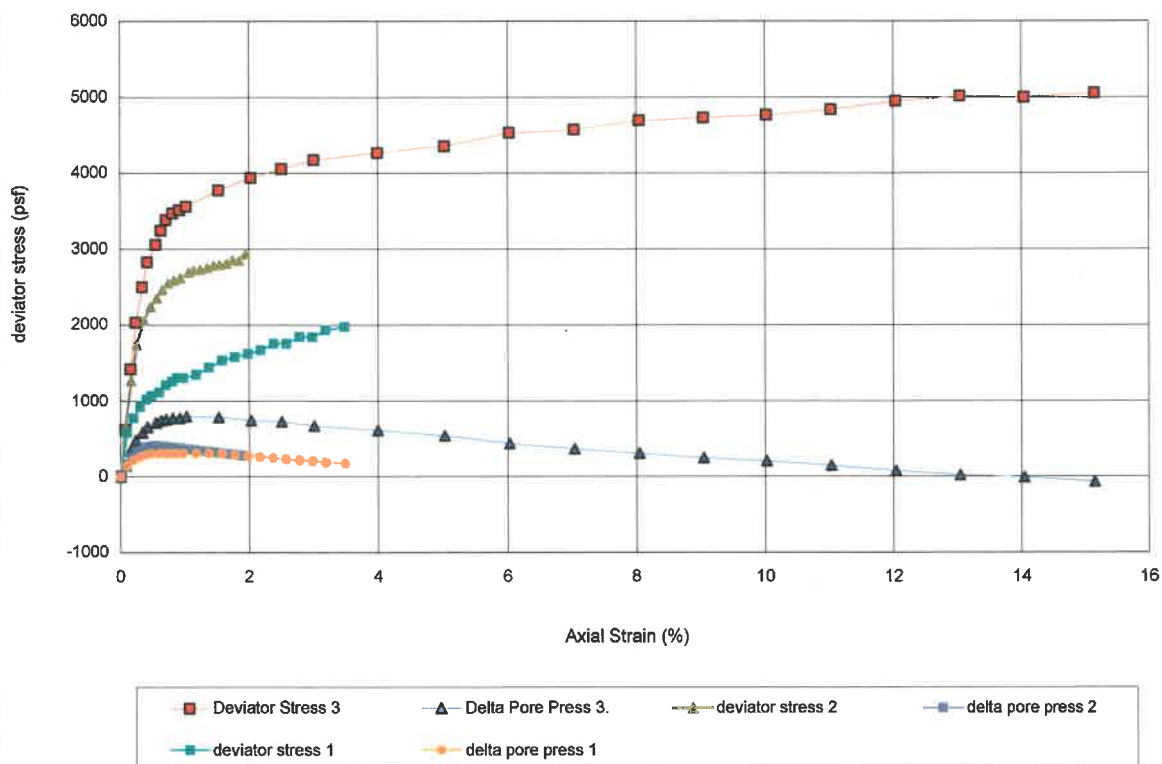
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS
ASTM D4767 Modified for Multiple Stages

CLIENT Stantec
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
BORING NO. W-1
DEPTH 18.5-19'
SAMPLE NO. W-1-17.5A
LOCATION Homestake Mining Co.
SAMPLE TYPE Clay

JOB NO. 2868-24
DATE SAMPLED —
DATE STARTED 11/26/2018
DATE FINISHED 12/5/2018
CELL NUMBER 13S
SATURATED TEST Yes

SHEAR DATA

Stages 1, 2 and 3



Client Stantec
Job Number 2868-24
Project GRP EP-1 Relining
Location Homestake Mining Co.
Project Number 233001304

Boring Number: W-1
Depth: 18.5-19'
Sample Number: W-1-17.5A
Sampled Date: --
Sampled By: --

Tested By: CAL

TEST TYPE TX/CUPP

σ_3 Confining Stresses (psf)	
STAGE 3	2160
STAGE 2	1080
STAGE 1	547.2

Peak Points	p' (psf)	q (psf)
STAGE 3	4743	2525
STAGE 2	2272	1467
STAGE 1	1360	986

Stress Condition at Maximum Deviator Stress (PSF)				
	σ_3	σ_1	σ'_3	σ'_1
STAGE 3	2160	7210	2218	7267
STAGE 2	1080	4014	805	3739
STAGE 1	547	2519	374	2346

STAGE 3 DATA

σ'_3 (psf)	σ'_1 (psf)	Deviator Stress ($\sigma_1 - \sigma_3$) (psf)	p' = ($\sigma'_1 + \sigma'_3$)/2 (psf)	q = ($\sigma_1 - \sigma_3$)/2 (psf)
2160	2160	0	2160	0
2002	2615	614	2308	307
1800	3215	1415	2507	707
1670	3697	2026	2684	1013
1570	4065	2495	2817	1248
1498	4320	2822	2909	1411
1440	4493	3053	2967	1527
1411	4650	3239	3031	1619
1397	4774	3377	3085	1688
1382	4849	3467	3116	1734
1382	4893	3510	3137	1755
1354	4907	3553	3130	1777
1368	5136	3768	3252	1884
1411	5345	3934	3378	1967
1426	5478	4053	3452	2026
1483	5652	4169	3568	2085
1541	5804	4263	3672	2132
1613	5965	4352	3789	2176
1714	6241	4528	3977	2264
1786	6353	4567	4069	2284
1843	6535	4691	4189	2346
1901	6627	4726	4264	2363
1944	6704	4760	4324	2380
2002	6835	4833	4418	2417
2074	7018	4945	4546	2472
2131	7143	5011	4637	2506
2160	7154	4994	4657	2497
2218	7267	5050	4743	2525

STAGE 2 DATA

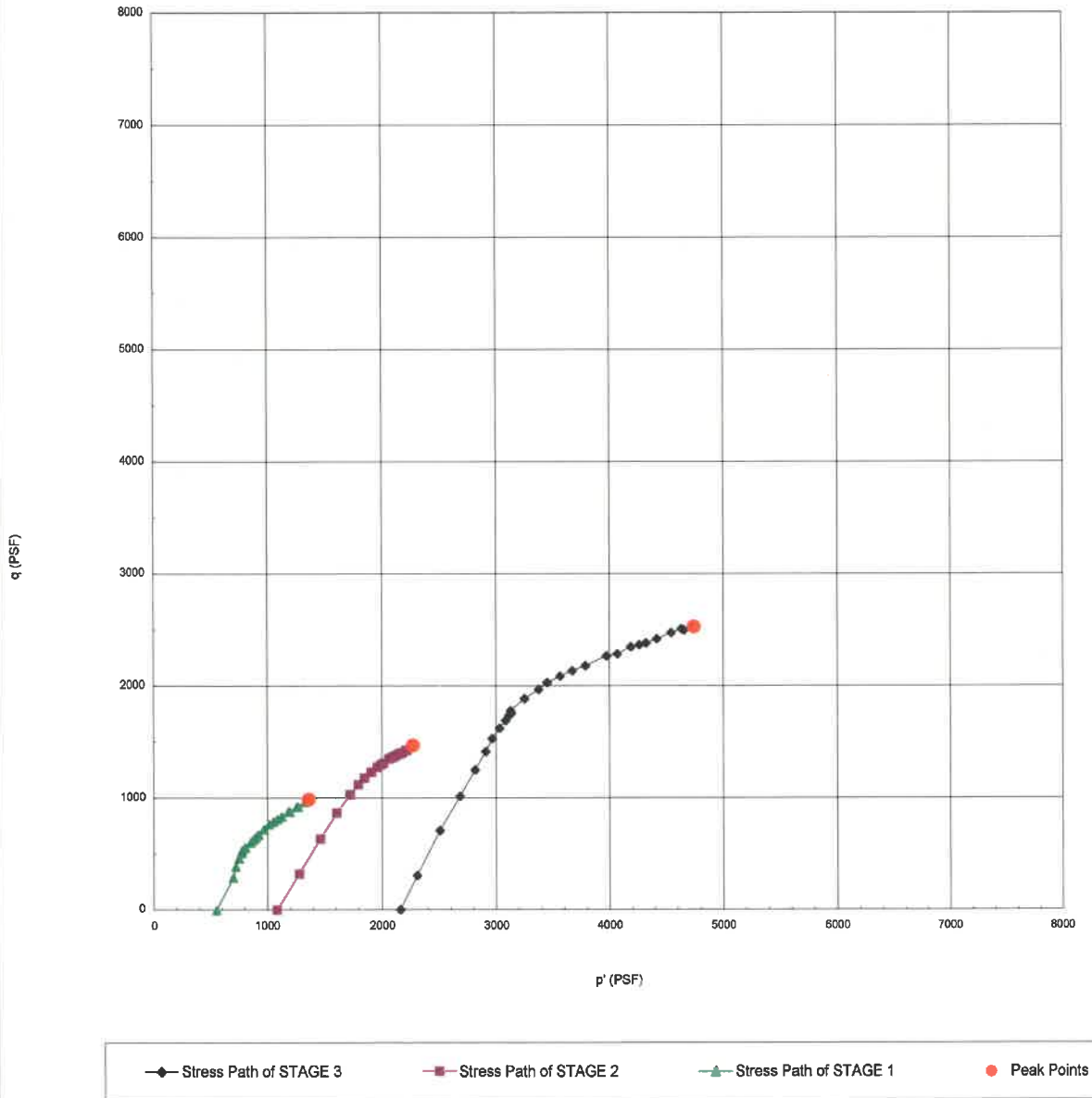
σ'_3 (psf)	σ'_1 (psf)	Deviator Stress ($\sigma_1 - \sigma_3$) (psf)	p' = ($\sigma'_1 + \sigma'_3$)/2 (psf)	q = ($\sigma_1 - \sigma_3$)/2 (psf)
1080	1080	0	1080	0
955	1599	645	1277	322
829	2093	1264	1461	632
738	2470	1732	1604	866
691	2750	2059	1721	1030
675	2913	2238	1794	1119
673	3026	2353	1849	1176
677	3137	2460	1907	1230
686	3235	2549	1961	1274
695	3285	2589	1990	1295
705	3322	2617	2013	1308
715	3409	2694	2062	1347
726	3444	2718	2085	1359
736	3464	2728	2100	1364
747	3499	2753	2123	1376
756	3538	2782	2147	1391
767	3556	2789	2162	1394
777	3585	2808	2181	1404
786	3638	2852	2212	1426
795	3638	2843	2217	1422
805	3739	2934	2272	1467

STAGE 1 DATA

σ'_3 (psf)	σ'_1 (psf)	Deviator Stress ($\sigma_1 - \sigma_3$) (psf)	p' = ($\sigma'_1 + \sigma'_3$)/2 (psf)	q = ($\sigma_1 - \sigma_3$)/2 (psf)
547	547	0	547	0
403	986	583	695	292
331	1108	777	720	388
288	1209	921	749	461
259	1277	1017	768	509
245	1310	1065	777	532
245	1357	1112	801	556
245	1452	1207	849	604
245	1499	1255	872	627
245	1547	1302	896	651
245	1545	1300	895	650
245	1591	1346	918	673
245	1684	1439	964	720
245	1777	1532	1011	766
259	1836	1577	1047	788
274	1895	1621	1084	811
288	1953	1665	1121	833
302	2059	1757	1181	878
317	2070	1753	1193	877
331	2175	1844	1253	922
346	2186	1840	1266	920
360	2291	1931	1325	965
374	2346	1972	1360	986

Effective Stress Path Analysis - p' q Plots

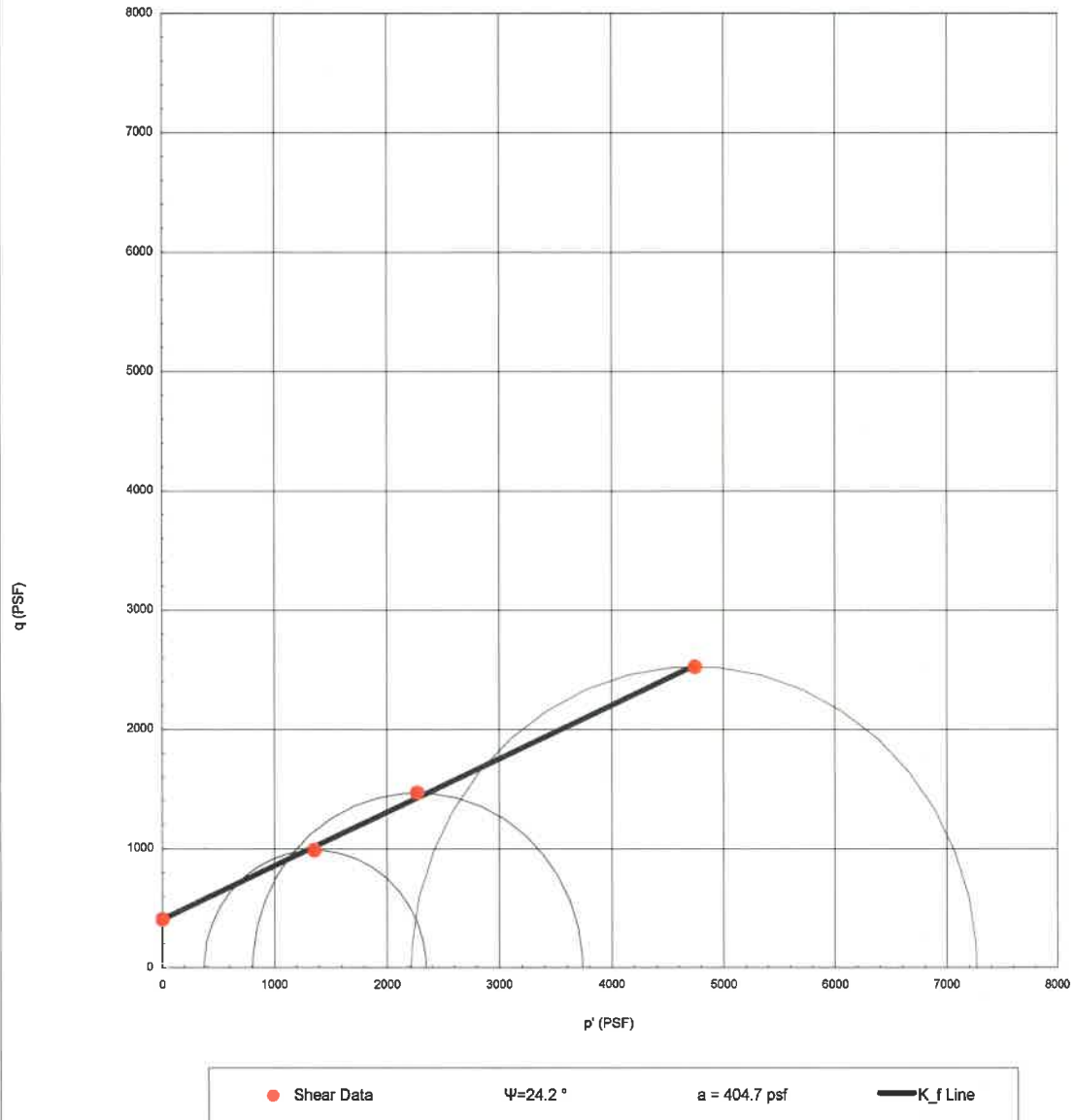
W-1 ,W-1-17.5A , 18.5-19' , Stages 1, 2 & 3



NOTE 1: The peak points shown in the plot represent maximum values of q $[(\sigma_1 - \sigma_3)/2]$.

Effective Stress Path Analysis - p'-q Regression Plot at Maximum q

W-1 ,W-1-17.5A ,18.5-19' ,Stages 1, 2 & 3



NOTE 2: The line presented in the graph is the K_f line taken at Peak q values defined by the equation $q=a+p' \tan(\Psi)$ where a = the intercept on the q-axis in stress units and Ψ = the angle of the K_f line with respect to the horizontal in degrees.

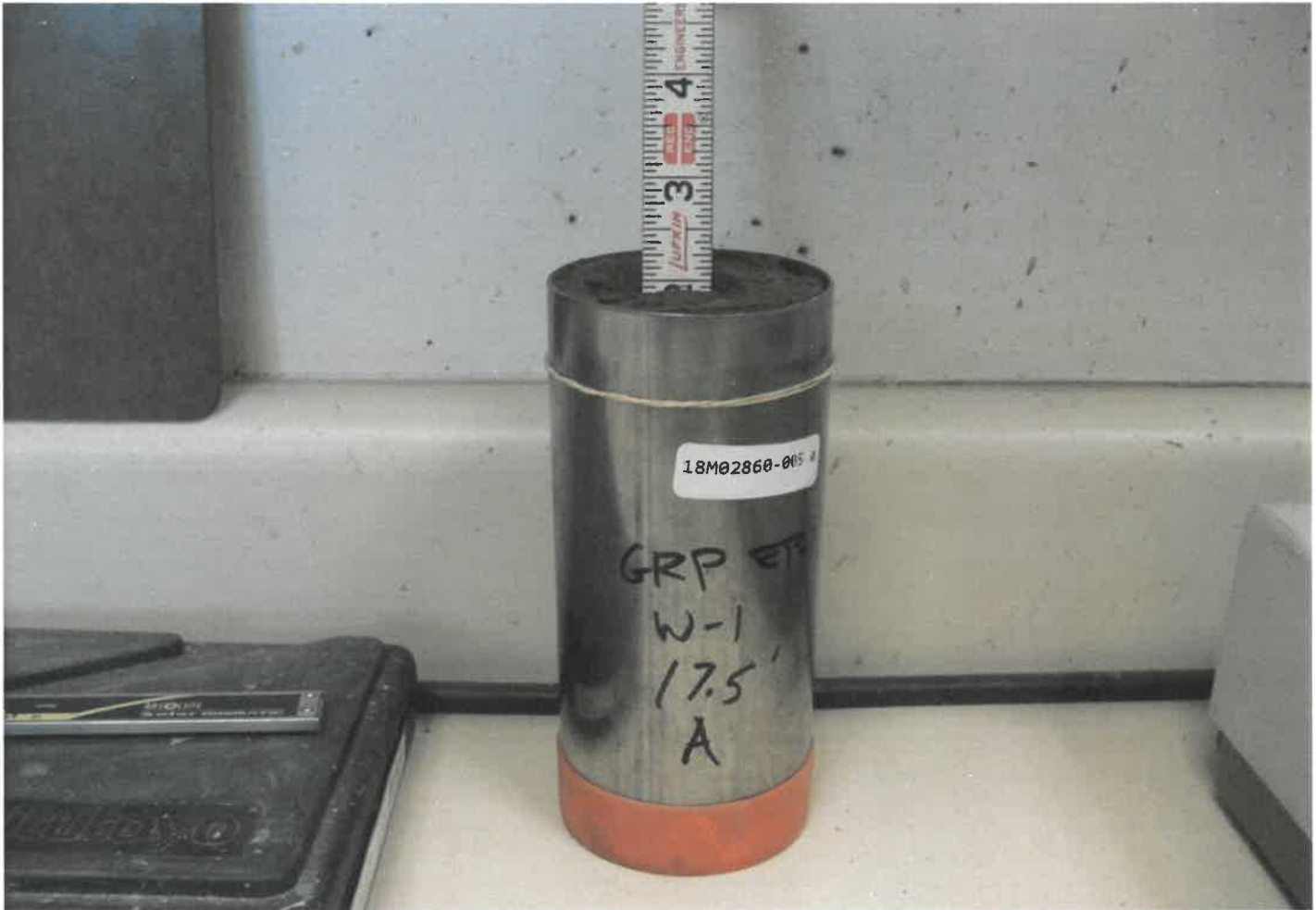
NOTE 3: The K_f is NOT the Mohr-Coulomb failure envelope defined by the equation $\tau=c+\sigma \tan(\Phi)$. The equations $\sin(\Phi)=\tan(\Psi)$ and $c=a/\cos(\Phi)$ may be used to approximate values for Φ and c at the effective stress condition described in NOTE 1.



ADVANCED TERRA TESTING

Image Attachment

CLIENT	Stantec	--
JOB NO.	2868-024	--
PROJECT	GRP EP-1 Relining	--
PROJECT NO.	233001304	--
LOCATION	--	--



NOTES

Sample had 2" deep hole in the center. Subsampled with a california liner to obtain correct L/D ratio of 2:1.

File name: 2868024__Image_18_11_27_07_34_39

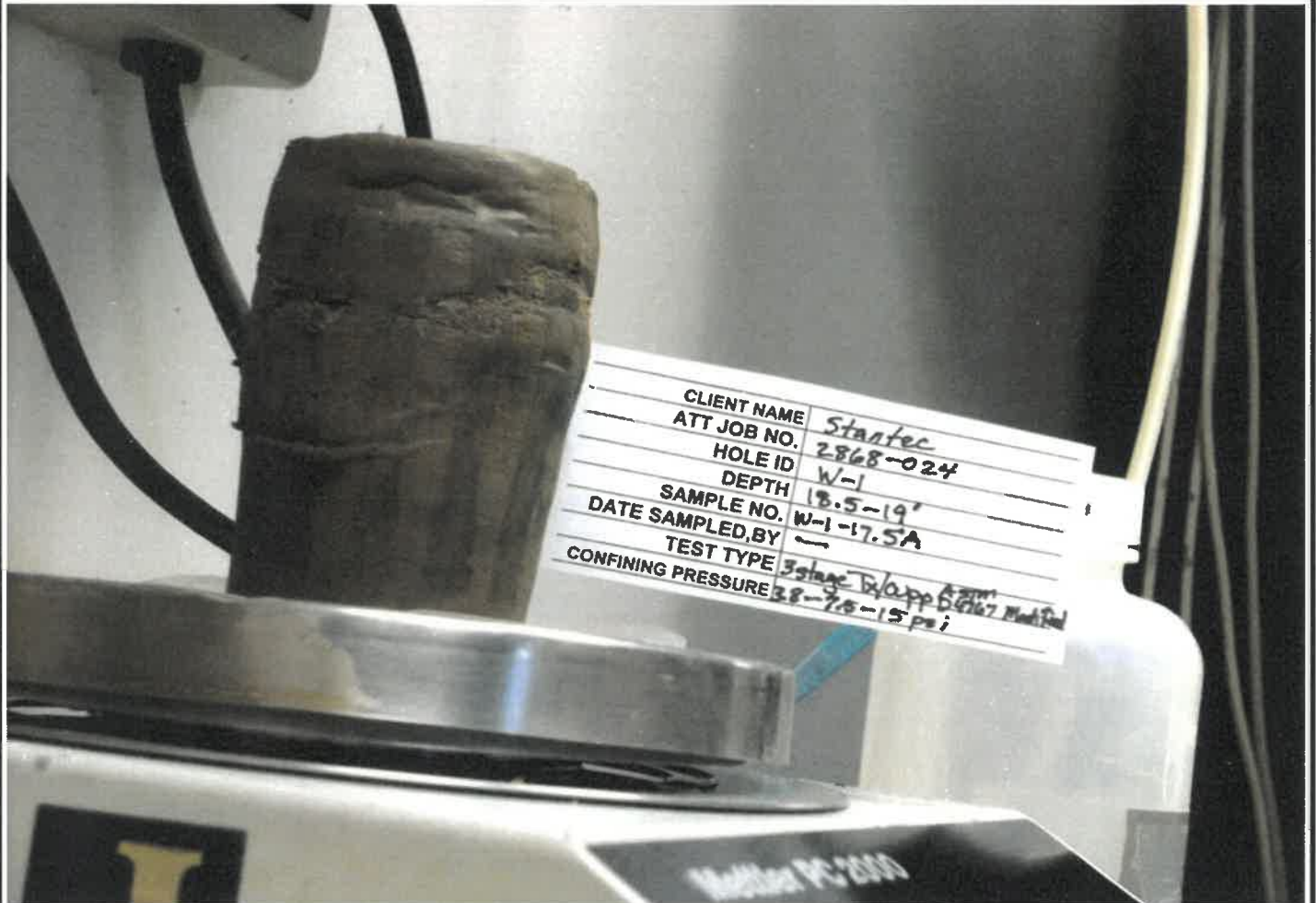


ADVANCED TERRA TESTING

Image Attachment

CLIENT Stantec
JOB NO. 2868-024
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
LOCATION --

--
--
--
--
--



NOTES

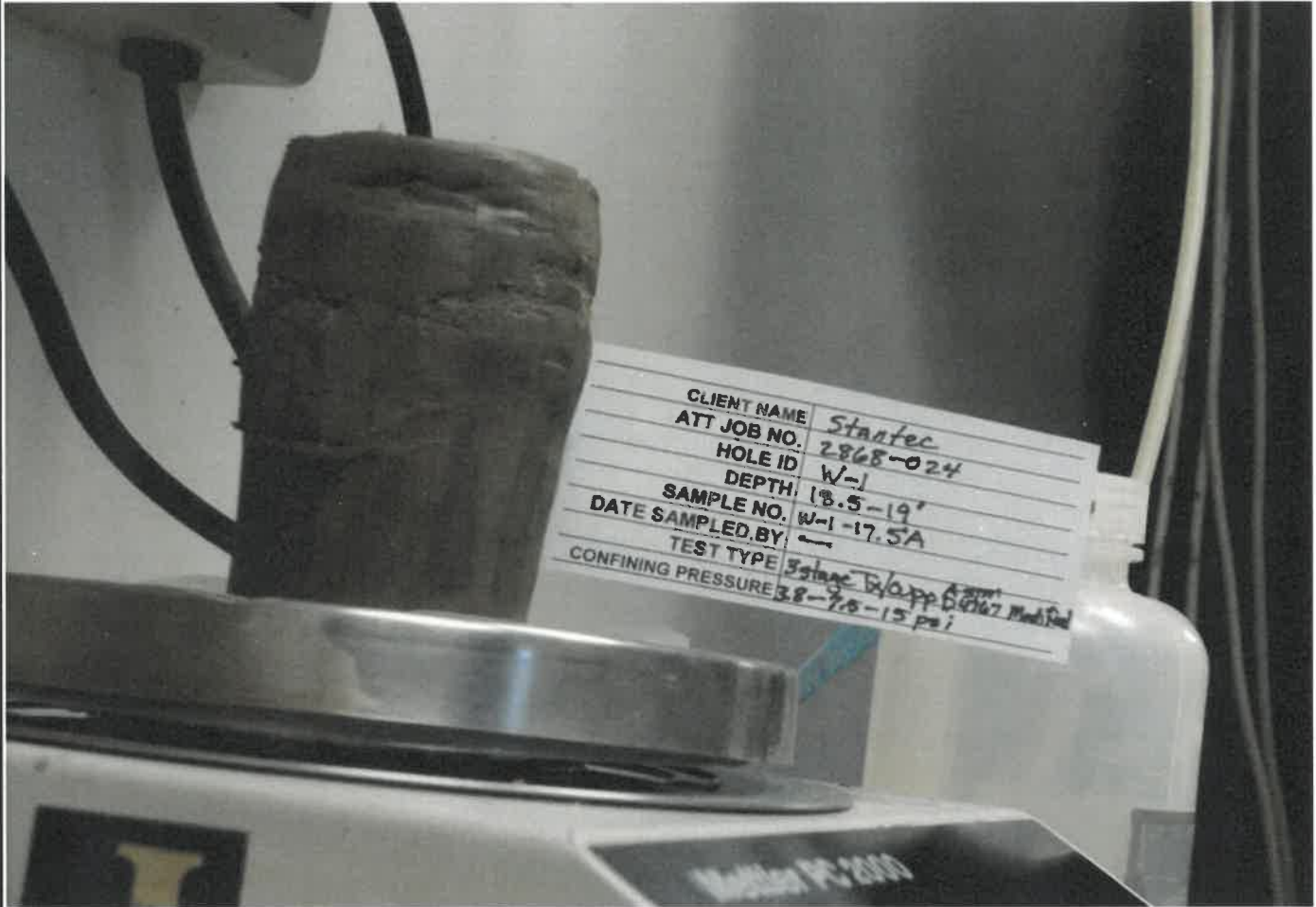
File name: 2868024__Image_18_12_11_09_08_43



ADVANCED TERRA TESTING

Image Attachment

CLIENT	Stantec	--
JOB NO.	2868-024	--
PROJECT	GRP EP-1 Relining	--
PROJECT NO.	233001304	--
LOCATION	--	--



CLIENT NAME	Stantec
ATT JOB NO.	2868-024
HOLE ID	W-1
DEPTH	18.5-19'
SAMPLE NO.	W-1-17.5A
DATE SAMPLED BY	---
TEST TYPE	3 stage triaxial
CONFINING PRESSURE	3.8-7.6-15 psi

NOTES

File name: 2868024__Image_18_12_07_10_12_00

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS

ASTM D4767 Modified for Multiple Stages

Stage 1

CLIENT	Stantec	JOB NO.	2868-24
PROJECT	GRP EP-1 Relining	DATE SAMPLED	--
PROJECT NO.	233001304	DATE STARTED	11/26/2018
BORING NO.	S-1	DATE FINISHED	12/7/2018
DEPTH	15.5-16'	CELL NUMBER	14S
SAMPLE NO.	S-1-15B	SATURATED TEST	Yes
LOCATION	Homestake Mining Co.	CONF. PRES. (psf)	475
SAMPLE TYPE	Silty Sand		

MOISTURE/DENSITY DATA	BEFORE TEST	AFTER TEST	
Wt. Soil + Moisture (g)	694.03	746.43	
Wt. Wet Soil & Pan (g)	708.96	761.36	
Wt. Dry Soil & Pan (g)	637.20	637.20	
Wt. Lost Moisture (g)	71.76	124.16	
Wt. of Pan Only (g)	14.93	14.93	
Wt. of Dry Soil (g)	622.27	622.27	
Moisture Content (%)	11.53	19.95	
Wet Density (pcf)	118.3	127.8	
Dry Density (pcf)	106.1	106.5	
Initial Diameter (in)	2.382		
Initial Area (sq in)	4.456		
Initial Height (in)	5.016		
Volume Before Consol. (cu ft)	0.01294		
Volume After Consol. (cu ft)	0.01288		

Notes & Comments: Did not correct for the filter paper or membrane strength.

Data entry by: CAL Date: 12/11/18 Technician CAL
Data checked by: SPH Date: 12-11-18

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS

ASTM D4767 Modified for Multiple Stages

Stage 1

CLIENT	Stantec	JOB NO.	2868-24
PROJECT	GRP EP-1 Relining	DATE SAMPLED	--
PROJECT NO.	233001304	DATE STARTED	11/26/2018
BORING NO.	S-1	DATE FINISHED	12/7/2018
DEPTH	15.5-16'	CELL NUMBER	14S
SAMPLE NO.	S-1-15B	SATURATED TEST	Yes
LOCATION	Homestake Mining Co.	CONF. PRES. (psf)	475
SAMPLE TYPE	Silty Sand		

SATURATION DATA

Cell Pressure (psi)	Back Pressure (psi)	Burette Reading (cc)		Pore Pressure (psi)		Change	B
		Close	Open	Close	Open		
40	38	4.0	12.0				
50	48	12.4	13.5	38.4	44.2	5.8	0.58
60	58	13.5	14.7	48.4	54.8	6.4	0.64
70	68	15.0	15.7	58.0	65.4	7.4	0.74
80	78	15.6	16.8	67.9	76.4	8.5	0.85
90	88	16.5	17.0	77.7	86.8	9.1	0.91
100		17.3	17.3	87.7	97.2	9.5	0.95

CONSOLIDATION DATA

	Elapsed Time (min)	SQRT Time (min)	Burette Reading (cc)	Volume Deflection (cc)
	0.00	0.0	17.30	0.00
	0.25	0.5	17.70	-0.40
	0.5	0.7	17.70	-0.40
	1	1.0	17.70	-0.40
	2	1.4	17.70	-0.40
	4	2.0	17.70	-0.40
	9	3.0	17.70	-0.40
	16	4.0	17.75	-0.45
	30	5.5	17.75	-0.45
	60	7.7	17.80	-0.50
	120	11.0	17.80	-0.50
	240	15.5	17.80	-0.50
	360	19.0	17.80	-0.50
	1440	37.9	17.90	-0.60

Initial Height (in)	5.016	Initial Volume (cc)	366.362
Height Change (in)	0.026	Volume Change (cc)	13.900
Height After Consol. (in)	4.990	Cell Expansion (cc)	12.255
Initial Area (sq in)	4.456	Net Volume Change (cc)	1.645
Area After Consol. (sq in)	4.459	Consol. Volume (cc)	364.717

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS

ASTM D4767 Modified for Multiple Stages

Stage 1

CLIENT	Stantec	JOB NO.	2868-24
PROJECT	GRP EP-1 Relining	DATE SAMPLED	—
PROJECT NO.	233001304	DATE STARTED	11/26/2018
BORING NO.	S-1	DATE FINISHED	12/7/2018
DEPTH	15.5-16'	CELL NUMBER	14S
SAMPLE NO.	S-1-15B	SATURATED TEST	Yes
LOCATION	Homestake Mining Co.	CONF. PRES. (psf)	475
SAMPLE TYPE	Silty Sand		

Initial Height (in)	5.016	Init. Area (sq in)	4.456
Consol. Height (in)	4.990	Consol. Area (sq in)	4.459
Back Pressure (psi)	88.4	Strain Rate (in/min)	0.0008

Axial Load (lbs)	Axial Load (psf)	Delta Ht. (in)	Axial Strain (%)	Area Final (sq in)	Deviator Stress (psf)	Pore Pres. (psi)	Delta Pres. (psf)	Sigma 3' (psf)	Sigma 1' (psf)	Prin. Stress Ratio
0	0	0.0000	0.00	4.459	0	88.4	0	475	475	1.00
8	271	0.0023	0.05	4.461	271	88.9	72	403	674	1.67
13	417	0.0051	0.10	4.464	416	89.2	115	360	776	2.16
15	497	0.0072	0.14	4.466	497	89.4	144	331	828	2.50
18	568	0.0095	0.19	4.468	567	89.5	158	317	884	2.79
21	672	0.0125	0.25	4.470	670	89.6	173	302	972	3.22
23	736	0.0147	0.29	4.472	734	89.6	173	302	1037	3.43
26	846	0.0179	0.36	4.475	843	89.6	173	302	1145	3.79
27	885	0.0204	0.41	4.478	881	89.6	173	302	1184	3.91
29	949	0.0231	0.46	4.480	945	89.6	173	302	1247	4.13
33	1050	0.0253	0.51	4.482	1044	89.6	173	302	1347	4.45
36	1163	0.0306	0.61	4.487	1155	89.5	158	317	1472	4.65
40	1301	0.0351	0.70	4.491	1292	89.4	144	331	1623	4.90
43	1402	0.0401	0.80	4.495	1390	89.2	115	360	1750	4.86
48	1534	0.0459	0.92	4.501	1520	89.1	101	374	1894	5.06
52	1686	0.0508	1.02	4.505	1669	88.9	72	403	2072	5.14
60	1934	0.0611	1.22	4.514	1911	88.8	58	418	2328	5.58
68	2183	0.0707	1.42	4.523	2152	88.5	14	461	2613	5.67
76	2454	0.0806	1.62	4.532	2415	88.2	-29	504	2919	5.79
85	2729	0.0907	1.82	4.542	2679	87.8	-86	562	3241	5.77
93	3016	0.1002	2.01	4.5506	2956	87.3	-158	634	3589	5.66
102	3307	0.1099	2.20	4.5596	3234	86.9	-216	691	3925	5.68
112	3617	0.1212	2.43	4.5702	3529	86.6	-259	734	4263	5.81

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS

ASTM D4767 Modified for Multiple Stages

Stage 2 of 3

CLIENT	Stantec	JOB NO.	2868-24
PROJECT	GRP EP-1 Relining	DATE SAMPLED	—
PROJECT NO.	233001304	DATE STARTED	11/26/2018
BORING NO.	S-1	DATE FINISHED	12/7/2018
DEPTH	15.5-16'	CELL NUMBER	14S
SAMPLE NO.	S-1-15B	SATURATED TEST	Yes
LOCATION	Homestake Mining Co.	CONF. PRES. (psf)	936
SAMPLE TYPE	Silty Sand		

MOISTURE/DENSITY DATA

**BEFORE
TEST**

**AFTER
TEST**

Wt. Soil + Moisture (g)	694.03	746.43
Wt. Wet Soil & Pan (g)	708.96	761.36
Wt. Dry Soil & Pan (g)	637.20	637.20
Wt. Lost Moisture (g)	71.76	124.16
Wt. of Pan Only (g)	14.93	14.93
Wt. of Dry Soil (g)	622.27	622.27
Moisture Content %	11.53	19.95
Wet Density (pcf)	118.8	128.0
Dry Density (pcf)	106.5	106.7

Initial Diameter (in)	2.412
Initial Area (sq in)	4.570
Initial Height (in)	4.869
Volume Before Consol. (cu ft)	0.01288
Volume After Consol. (cu ft)	0.01286

Notes & Comments:

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS

ASTM D4767 Modified for Multiple Stages

Stage 2 of 3

CLIENT	Stantec	JOB NO.	2868-24
PROJECT	GRP EP-1 Relining	DATE SAMPLED	--
PROJECT NO.	233001304	DATE STARTED	11/26/2018
BORING NO.	S-1	DATE FINISHED	12/7/2018
DEPTH	15.5-16'	CELL NUMBER	14S
SAMPLE NO.	S-1-15B	SATURATED TEST	Yes
LOCATION	Homestake Mining Co.	CONF. PRES. (psf)	936
SAMPLE TYPE	Silty Sand		

CONSOLIDATION DATA

Elapsed Time (min)	SQRT Time (min)	Burette Reading (cc)	Volume Deflection (cc)
0.00	0.0	18.20	0.00
0.25	0.5	18.60	-0.40
0.5	0.7	18.60	-0.40
1	1.0	18.60	-0.40
2	1.4	18.65	-0.45
4	2.0	18.70	-0.50
9	3.0	18.70	-0.50
16	4.0	18.70	-0.50
30	5.5	18.70	-0.50
60	7.7	18.80	-0.60
120	11.0	18.80	-0.60
240	15.5	18.85	-0.65
360	19.0	18.90	-0.70
1472	38.4	19.00	-0.80

Initial Height (in)	4.869	Initial Volume (cc)	364.717
Height Change (in)	-0.026	Volume Change (cc)	0.800
Ht. After Consol. (in)	4.895	Cell Expansion (cc)	0.300
Initial Area (sq in)	4.570	Net Change (cc)	0.500
Area After Consol. (sq in)	4.540	Consol. Volume (cc)	364.217

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS

ASTM D4767 Modified for Multiple Stages

Stage 2 of 3

CLIENT	Stantec	JOB NO.	2868-24
PROJECT	GRP EP-1 Relining	DATE SAMPLED	--
PROJECT NO.	233001304	DATE STARTED	11/26/2018
BORING NO.	S-1	DATE FINISHED	12/7/2018
DEPTH	15.5-16'	CELL NUMBER	14S
SAMPLE NO.	S-1-15B	SATURATED TEST	Yes
LOCATION	Homestake Mining Co.	CONF. PRES. (psf)	936
SAMPLE TYPE	Silty Sand		

Initial Height (in)	4.869	Init. Area (sq in)	4.570
Consol. Height (in)	4.895	Consol. Area (sq in)	4.540
Back Pressure (psi)	88.3	Strain Rate (in/min)	0.0008

Axial Load (lbs)	Axial Load (psf)	Delta Ht. (in)	Axial Strain (%)	Area Final (sq in)	Deviator Stress (psf)	Pore Pres. (psi)	Delta Pres. (psf)	Sigma 3' (psf)	Sigma 1' (psf)	Prin. Stress Ratio
0	0	0.000	0.00	4.540	0	88.3	0	936	936	1.00
4	127	0.003	0.06	4.542	127	88.5	29	907	1034	1.14
13	412	0.005	0.10	4.544	412	89.0	101	835	1247	1.49
20	634	0.008	0.16	4.547	633	89.4	158	778	1411	1.81
27	856	0.010	0.20	4.549	855	89.5	173	763	1618	2.12
33	1047	0.012	0.25	4.551	1044	89.6	187	749	1793	2.39
43	1364	0.015	0.31	4.554	1360	89.5	173	763	2123	2.78
50	1586	0.017	0.35	4.556	1580	89.3	144	792	2372	3.00
57	1808	0.019	0.39	4.557	1801	89.2	130	806	2607	3.23
64	2030	0.022	0.45	4.560	2021	89.0	101	835	2856	3.42
75	2379	0.025	0.51	4.563	2367	88.8	72	864	3231	3.74
90	2855	0.030	0.61	4.568	2837	88.4	14	922	3759	4.08
105	3331	0.034	0.69	4.571	3307	88.1	-29	965	4272	4.43
118	3743	0.039	0.80	4.576	3713	87.8	-72	1008	4721	4.68
131	4155	0.045	0.92	4.582	4117	87.5	-115	1051	5168	4.92
143	4536	0.051	1.04	4.588	4489	87.1	-173	1109	5598	5.05
151	4790	0.055	1.12	4.591	4736	86.8	-216	1152	5888	5.11
159	5043	0.061	1.25	4.597	4981	86.5	-259	1195	6176	5.17
166	5266	0.066	1.35	4.6018	5195	86.2	-302	1238	6433	5.19
174	5519	0.070	1.43	4.6056	5440	85.8	-360	1296	6736	5.20
181	5741	0.075	1.53	4.6103	5653	85.5	-403	1339	6993	5.22
188	5963	0.080	1.63	4.6151	5866	85.2	-446	1382	7248	5.24
195	6185	0.085	1.74	4.6199	6078	84.9	-490	1426	7504	5.26
202	6407	0.089	1.82	4.6238	6291	84.7	-518	1454	7745	5.33
209	6629	0.095	1.94	4.6296	6501	84.4	-562	1498	7998	5.34

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS

ASTM D4767 Modified for Multiple Stages

Stage 3 of 3

CLIENT	Stantec	JOB NO.	2868-24
PROJECT	GRP EP-1 Relining	DATE SAMPLED	--
PROJECT NO.	233001304	DATE STARTED	11/26/2018
BORING NO.	S-1	DATE FINISHED	12/7/2018
DEPTH	15.5-16'	CELL NUMBER	14S
SAMPLE NO.	S-1-15B	SATURATED TEST	Yes
LOCATION	Homestake Mining Co.	CONF. PRES. (psf)	1872
SAMPLE TYPE	Silty Sand		

MOISTURE/DENSITY DATA

	BEFORE TEST	AFTER TEST	
Wt. Soil + Moisture (g)	694.03	746.43	
Wt. Wet Soil & Pan (g)	708.96	761.36	
Wt. Dry Soil & Pan (g)	637.20	637.20	
Wt. Lost Moisture (g)	71.76	124.16	
Wt. of Pan Only (g)	14.93	14.93	
Wt. of Dry Soil (g)	622.27	622.27	
Moisture Content %	11.53	19.95	
Wet Density (pcf)	119.0	128.4	
Dry Density (pcf)	106.7	107.0	
Initial Diameter (in)	2.428		
Initial Area (sq in)	4.630		
Initial Height (in)	4.800		
Volume Before Consol. (cu ft)	0.01286		
Volume After Consol. (cu ft)	0.01282		

Notes & Comments:

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS				
ASTM D4767 Modified for Multiple Stages				
Stage 3 of 3				
CLIENT	Stantec	JOB NO.	2868-24	
PROJECT	GRP EP-1 Relining	DATE SAMPLED	—	
PROJECT NO.	233001304	DATE STARTED	11/26/2018	
BORING NO.	S-1	DATE FINISHED	12/7/2018	
DEPTH	15.5-16'	CELL NUMBER	14S	
SAMPLE NO.	S-1-15B	SATURATED TEST	Yes	
LOCATION	Homestake Mining Co.	CONF. PRES. (psf)	1872	
SAMPLE TYPE	Silty Sand			
CONSOLIDATION DATA				
	Elapsed Time (min)	SQRT Time (min)	Burette Reading (cc)	Volume Deflection (cc)
	0.00	0.0	20.60	0.00
	0.25	0.5	21.60	-1.00
	0.5	0.7	21.65	-1.05
	1	1.0	21.70	-1.10
	2	1.4	21.75	-1.15
	4	2.0	21.80	-1.20
	9	3.0	21.80	-1.20
	16	4.0	21.90	-1.30
	30	5.5	21.90	-1.30
	60	7.7	22.00	-1.40
	120	11.0	22.05	-1.45
	240	15.5	22.15	-1.55
	360	19.0	22.15	-1.55
	1320	36.3	22.40	-1.80
Initial Height (in)	4.800		Initial Volume (cc)	364.217
Height Change (in)	0.019		Volume Change (cc)	1.800
Ht. After Consol. (in)	4.781		Cell Expansion (cc)	0.609
Initial Area (sq in)	4.630		Net Change (cc)	1.191
Area After Consol. (sq in)	4.633		Consol. Volume (cc)	363.026

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS

ASTM D4767

Stage 3 of 3

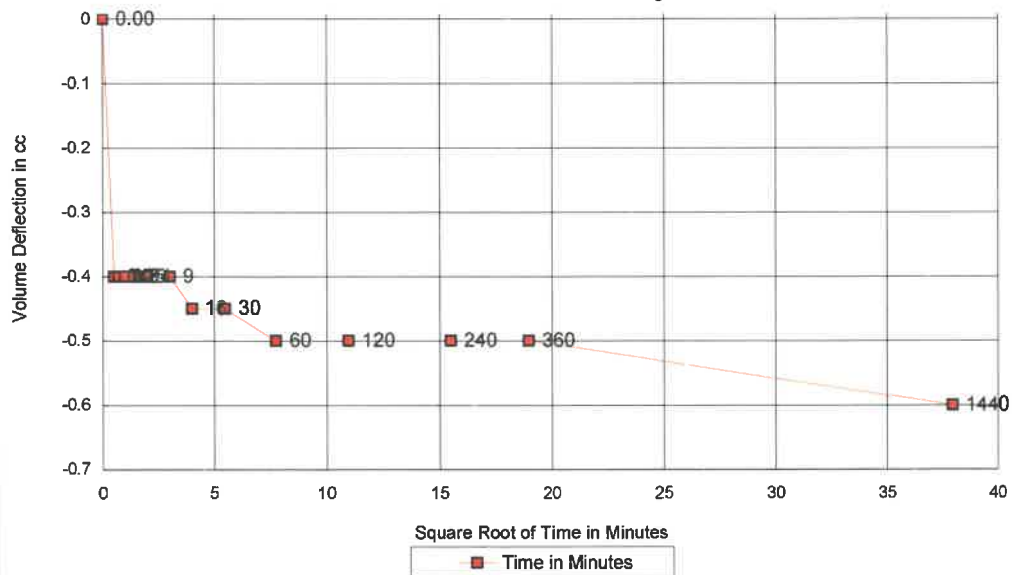
CLIENT	Stantec	JOB NO.	2868-24
PROJECT	GRP EP-1 Relining	DATE SAMPLED	—
PROJECT NO.	233001304	DATE STARTED	11/26/2018
BORING NO.	S-1	DATE FINISHED	12/7/2018
DEPTH	15.5-16'	CELL NUMBER	14S
SAMPLE NO.	S-1-15B	SATURATED TEST	Yes
LOCATION	Homestake Mining Co.	CONF. PRES. (psf)	1872
SAMPLE TYPE	Silty Sand		

Initial Height (in)	4.800	Init. Area (sq in)	4.630
Consol. Height (in)	4.781	Consol. Area (sq in)	4.633
Back Pressure (psi)	88.2	Strain Rate (in/min)	0.0008

Axial Load (lbs)	Axial Load (psf)	Delta Ht. (in)	Axial Strain (%)	Area Final (sq in)	Deviator Stress (psf)	Pore Pres. (psi)	Delta Pres. (psf)	Sigma 3' (psf)	Sigma 1' (psf)	Prin. Stress Ratio
0	0	0.000	0.00	4.633	0	88.2	0	1872	1872	1.00
22	684	0.003	0.06	4.636	683	89.7	216	1656	2339	1.41
73	2269	0.012	0.25	4.644	2263	90.8	374	1498	3761	2.51
98	3046	0.017	0.36	4.649	3035	90.5	331	1541	4576	2.97
124	3854	0.021	0.44	4.653	3837	89.9	245	1627	5465	3.36
151	4694	0.026	0.54	4.658	4668	89.4	173	1699	6367	3.75
176	5471	0.030	0.63	4.662	5436	88.8	86	1786	7222	4.04
199	6186	0.035	0.73	4.667	6140	88.4	29	1843	7983	4.33
219	6807	0.039	0.82	4.671	6752	87.9	-43	1915	8667	4.53
235	7305	0.044	0.92	4.676	7237	87.5	-101	1973	9210	4.67
249	7740	0.049	1.02	4.681	7660	87.1	-158	2030	9691	4.77
302	9387	0.071	1.49	4.703	9248	85.2	-432	2304	11552	5.01
345	10724	0.095	1.99	4.727	10511	83.1	-729	2601	13111	5.04
387	12029	0.119	2.49	4.751	11730	81.1	-1022	2894	14624	5.05
426	13241	0.143	2.99	4.776	12845	79.0	-1325	3197	16042	5.02
505	15697	0.189	3.95	4.823	15076	74.6	-1958	3830	18907	4.94
583	18121	0.241	5.04	4.879	17208	69.7	-2664	4536	21744	4.79
629	19551	0.288	6.02	4.930	18373	65.7	-3240	5112	23485	4.59
679	21105	0.336	7.03	4.983	19622	62.2	-3744	5616	25238	4.49
724	22504	0.384	8.03	5.037	20697	59.1	-4190	6062	26759	4.41
759	23592	0.431	9.01	5.092	21465	56.2	-4608	6480	27945	4.31
792	24618	0.478	10.00	5.147	22156	53.7	-4968	6840	28996	4.24
818	25426	0.526	11.00	5.205	22629	51.4	-5299	7171	29800	4.16
829	25768	0.574	12.01	5.265	22674	50.0	-5501	7373	30047	4.08
831	25830	0.622	13.01	5.326	22470	49.0	-5645	7517	29986	3.99
816	25364	0.670	14.01	5.388	21809	49.2	-5616	7488	29297	3.91
823	25581	0.722	15.10	5.457	21718	49.1	-5630	7502	29221	3.89

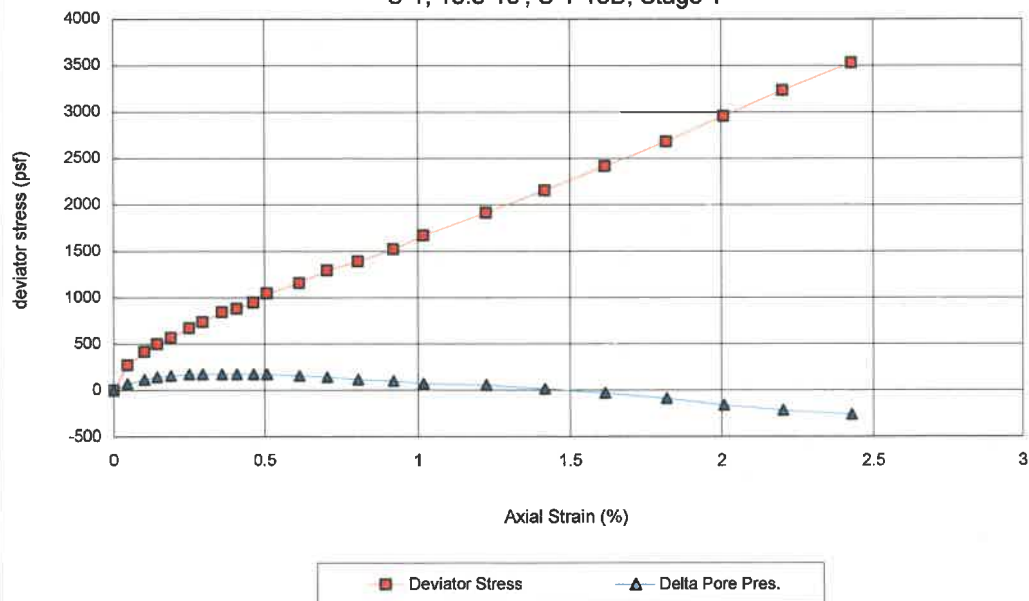
CONSOLIDATION DATA

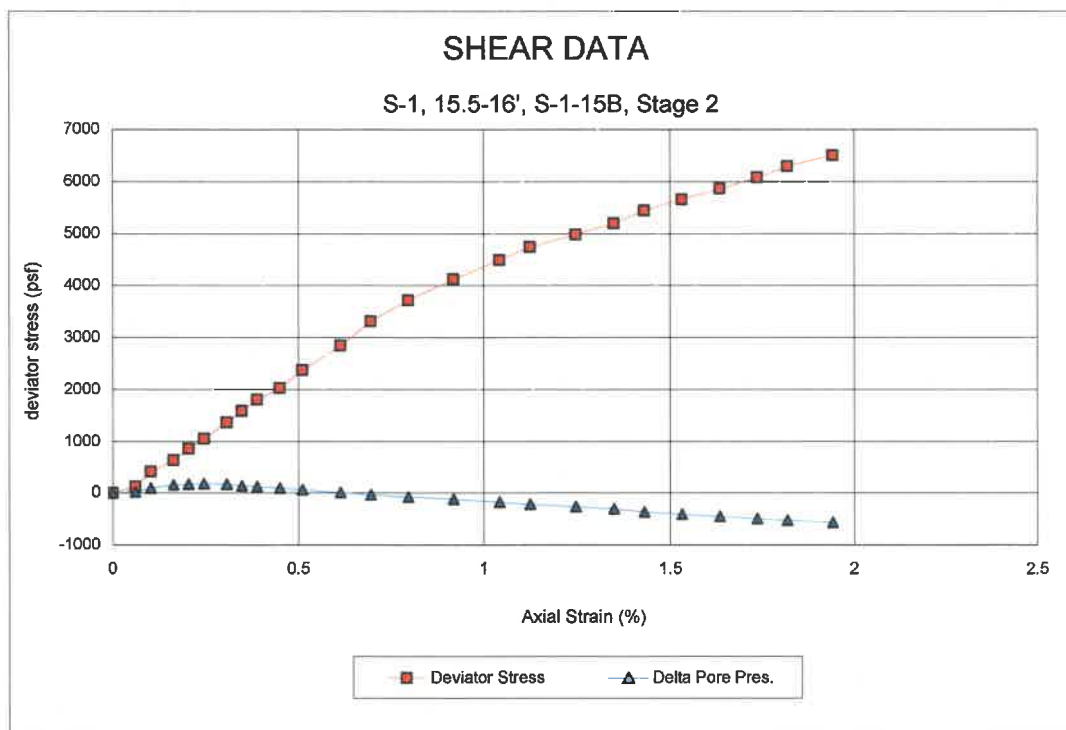
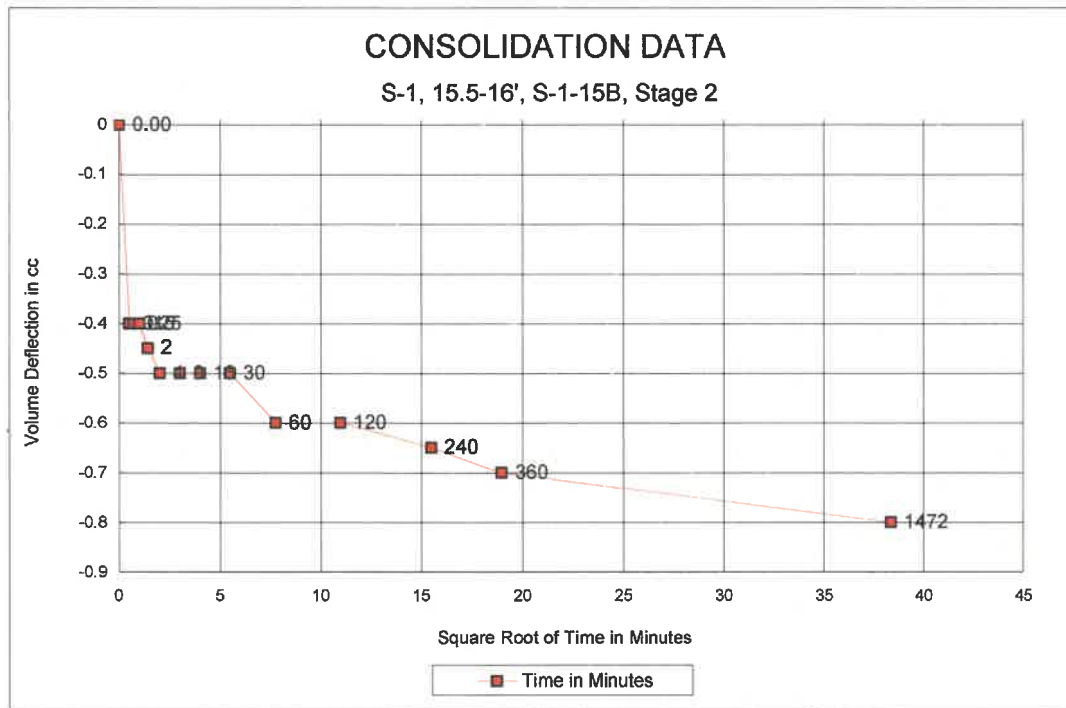
S-1, 15.5-16', S-1-15B, Stage 1

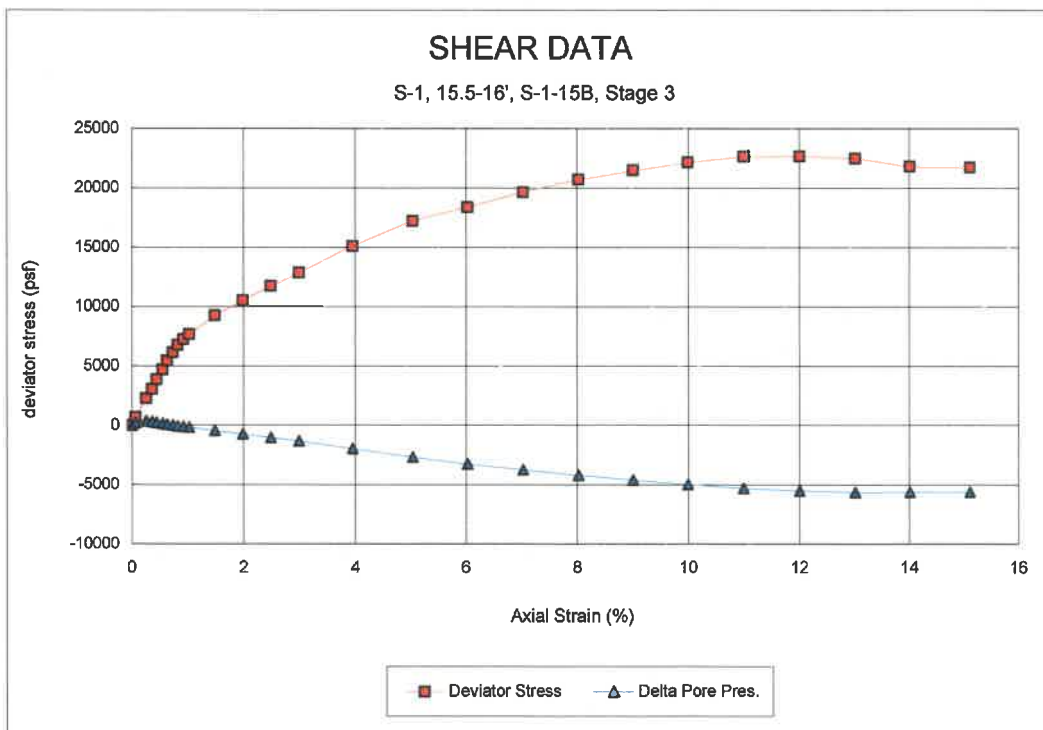
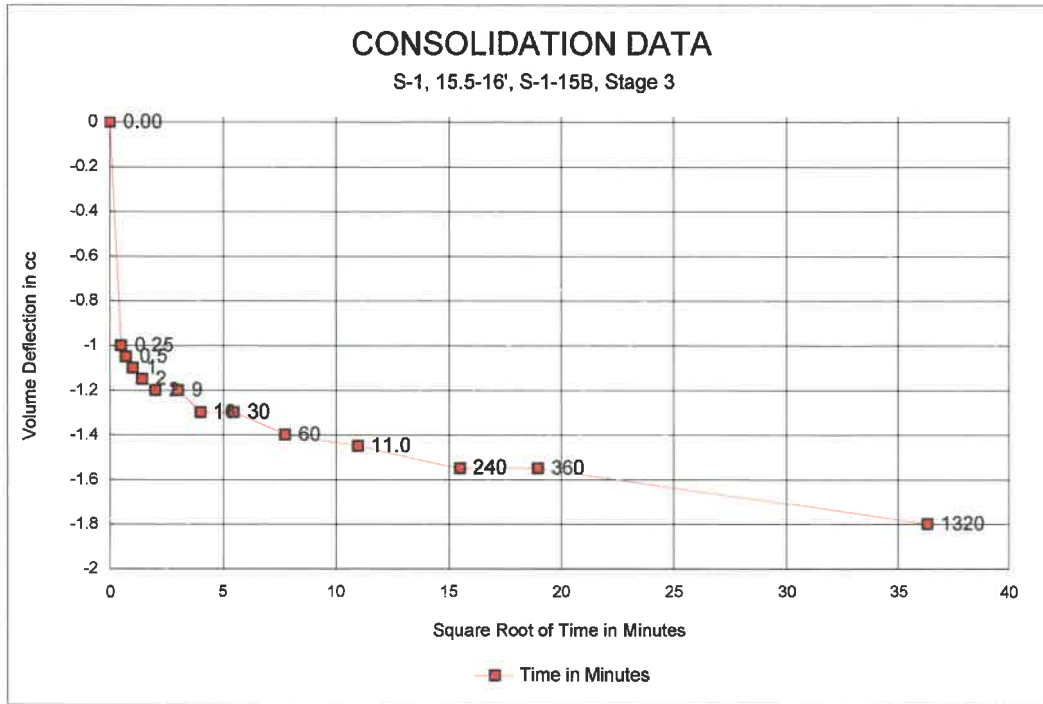


SHEAR DATA

S-1, 15.5-16', S-1-15B, Stage 1







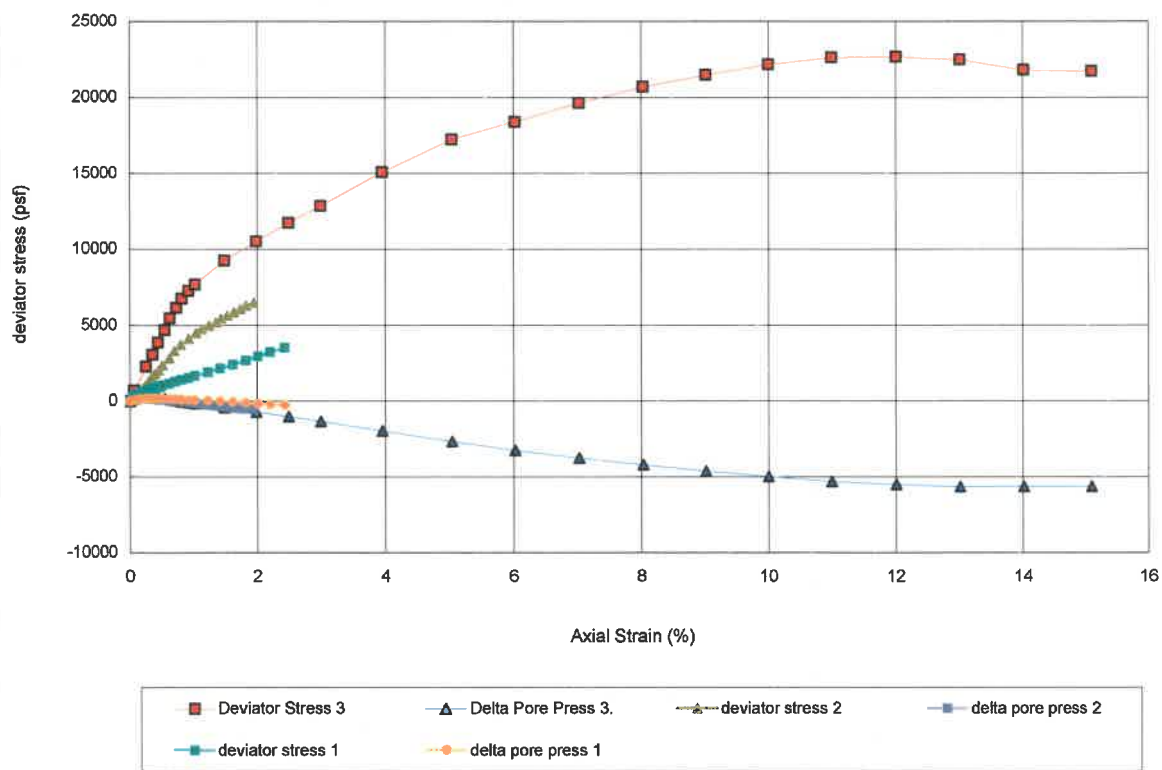
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS
ASTM D4767 Modified for Multiple Stages

CLIENT Stantec
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
BORING NO. S-1
DEPTH 15.5-16'
SAMPLE NO. S-1-15B
LOCATION Homestake Mining Co.
SAMPLE TYPE Silty Sand

JOB NO. 2868-24
DATE SAMPLED —
DATE STARTED 11/26/2018
DATE FINISHED 12/7/2018
CELL NUMBER 14S
SATURATED TEST Yes

SHEAR DATA

Stages 1, 2 and 3



Client: Stantec
Job Number: 2868-24
Project: GRP EP-1 Relining
Location: Homestake Mining Co.
Project Number: 233001304

Boring Number: S-1
Depth: 15.5-16'
Sample Number: S-1-15B
Sampled Date: —
Sampled By: —

Tested By: CAL

TEST TYPE: TX/CUPP

σ ₃ Confining Stresses (psf)	
STAGE 3	1872
STAGE 2	936
STAGE 1	475.2

Peak Points	p' (psf)	q (psf)
STAGE 3	18710	11337
STAGE 2	4748	3250
STAGE 1	2499	1764

Stress Condition at Maximum Deviator Stress (PSF)				
	σ ₃	σ ₁	σ' ₃	σ' ₁
STAGE 3	1872	24546	7373	30047
STAGE 2	936	7437	1498	7998
STAGE 1	475	4004	734	4263

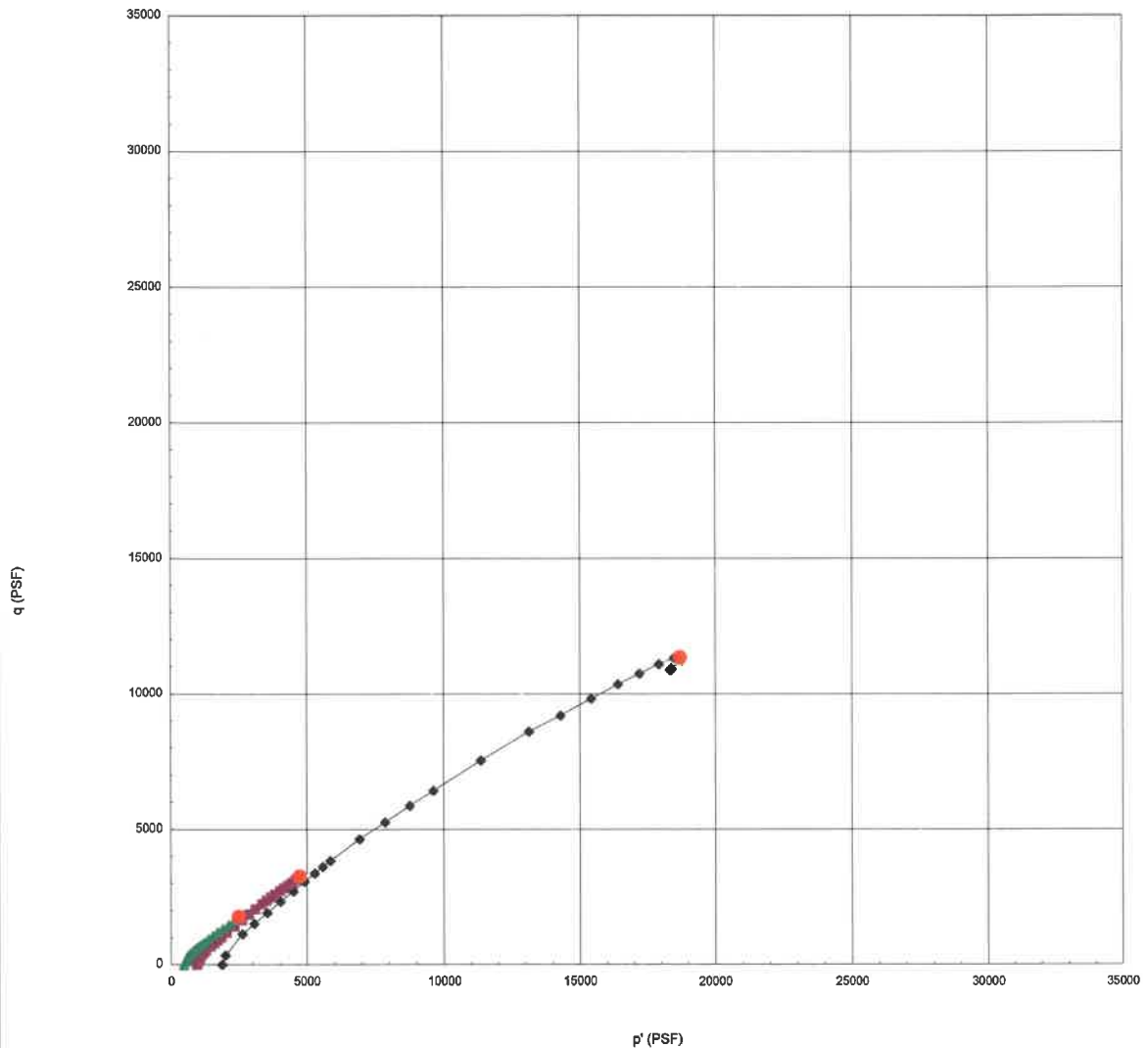
STAGE 3 DATA				
σ ₃ '	σ ₁ '	Deviator Stress (σ ₁ -σ ₃)	p' = (σ ₁ ' + σ ₃ ')/2	q = (σ ₁ ' - σ ₃ ')/2
1872	1872	0	1872	0
1656	2339	683	1998	342
1498	3761	2263	2629	1132
1541	4576	3035	3058	1518
1627	5465	3837	3546	1919
1699	6367	4668	4033	2334
1786	7222	5436	4504	2718
1843	7983	6140	4913	3070
1915	8667	6752	5291	3376
1973	9210	7237	5591	3619
2030	9691	7660	5861	3830
2304	11552	9248	6928	4624
2601	13111	10511	7856	5255
2894	14624	11730	8759	5865
3197	16042	12845	9619	6423
3830	18907	15076	11369	7538
4536	21744	17208	13140	8604
5112	23485	18373	14299	9187
5616	25238	19622	15427	9811
6062	26759	20697	16411	10348
6480	27945	21465	17213	10733
6840	28996	22156	17918	11078
7171	29800	22629	18485	11314
7373	30047	22674	18710	11337
7517	29986	22470	18752	11235
7488	29297	21809	18393	10905
7502	29221	21718	18361	10859

STAGE 2 DATA				
σ ₃ '	σ ₁ '	Deviator Stress (σ ₁ -σ ₃)	p' = (σ ₁ ' + σ ₃ ')/2	q = (σ ₁ ' - σ ₃ ')/2
936	936	0	936	0
907	1034	127	971	63
835	1247	412	1041	206
778	1411	633	1094	317
763	1618	855	1191	427
749	1793	1044	1271	522
763	2123	1360	1443	680
792	2372	1580	1582	790
806	2607	1801	1707	901
835	2856	2021	1846	1010
864	3231	2367	2047	1183
922	3759	2837	2340	1419
965	4272	3307	2619	1654
1008	4721	3713	2865	1857
1051	5168	4117	3110	2059
1109	5598	4489	3353	2244
1152	5888	4736	3520	2388
1195	6176	4981	3686	2490
1238	6433	5195	3836	2597
1296	6736	5440	4016	2720
1339	6993	5653	4166	2827
1362	7248	5866	4315	2933
1426	7504	6078	4465	3039
1454	7745	6291	4600	3145
1498	7998	6501	4748	3250

STAGE 1 DATA				
σ ₃ '	σ ₁ '	Deviator Stress (σ ₁ -σ ₃)	p' = (σ ₁ ' + σ ₃ ')/2	q = (σ ₁ ' - σ ₃ ')/2
475	475	0	475	0
403	674	271	539	136
360	776	416	568	208
331	828	497	579	248
317	884	567	600	284
302	972	670	637	335
302	1037	734	669	367
302	1145	843	724	422
302	1184	881	743	441
302	1247	945	775	473
302	1347	1044	824	522
317	1472	1155	895	578
331	1623	1292	977	646
360	1750	1390	1055	695
374	1894	1520	1134	760
403	2072	1669	1237	834
418	2328	1911	1373	955
461	2613	2152	1537	1076
504	2919	2415	1711	1207
562	3241	2679	1901	1340
634	3589	2956	2111	1478
691	3925	3234	2308	1617
734	4263	3529	2499	1764

Effective Stress Path Analysis - p' q Plots

S-1, S-1-15B, 15.5-16', Stages 1, 2 & 3

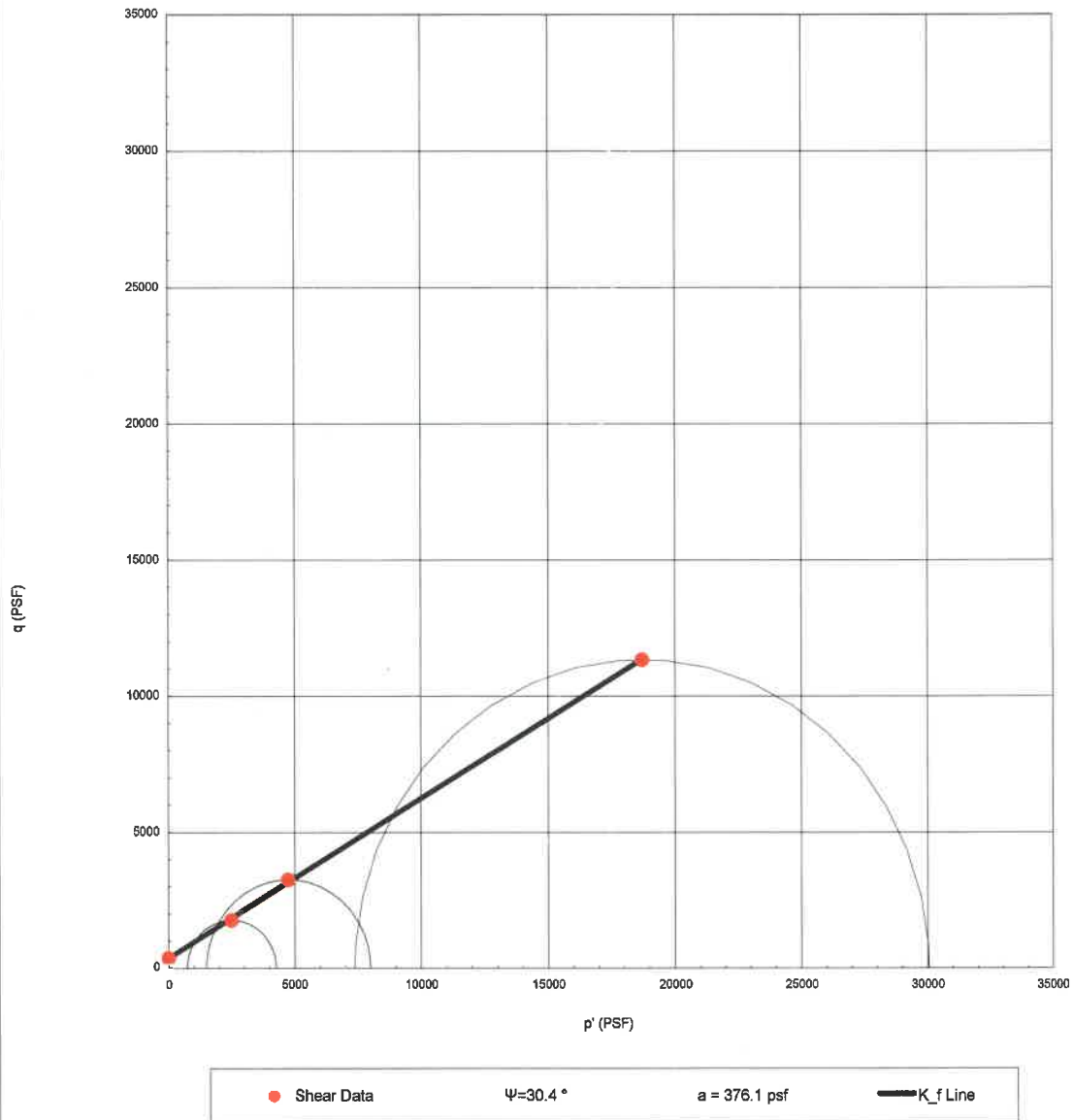


— Stress Path of STAGE 3 — Stress Path of STAGE 2 — Stress Path of STAGE 1 ● Peak Points

NOTE 1: The peak points shown in the plot represent maximum values of $q [(\sigma_1 - \sigma_3)/2]$.

Effective Stress Path Analysis - p'-q Regression Plot at Maximum q

S-1, S-1-15B, 15.5-16', Stages 1, 2 & 3



NOTE 2: The line presented in the graph is the K_f line taken at Peak q values defined by the equation $q = a + p' \tan(\Psi)$ where a = the intercept on the q-axis in stress units and Ψ = the angle of the K_f line with respect to the horizontal in degrees.

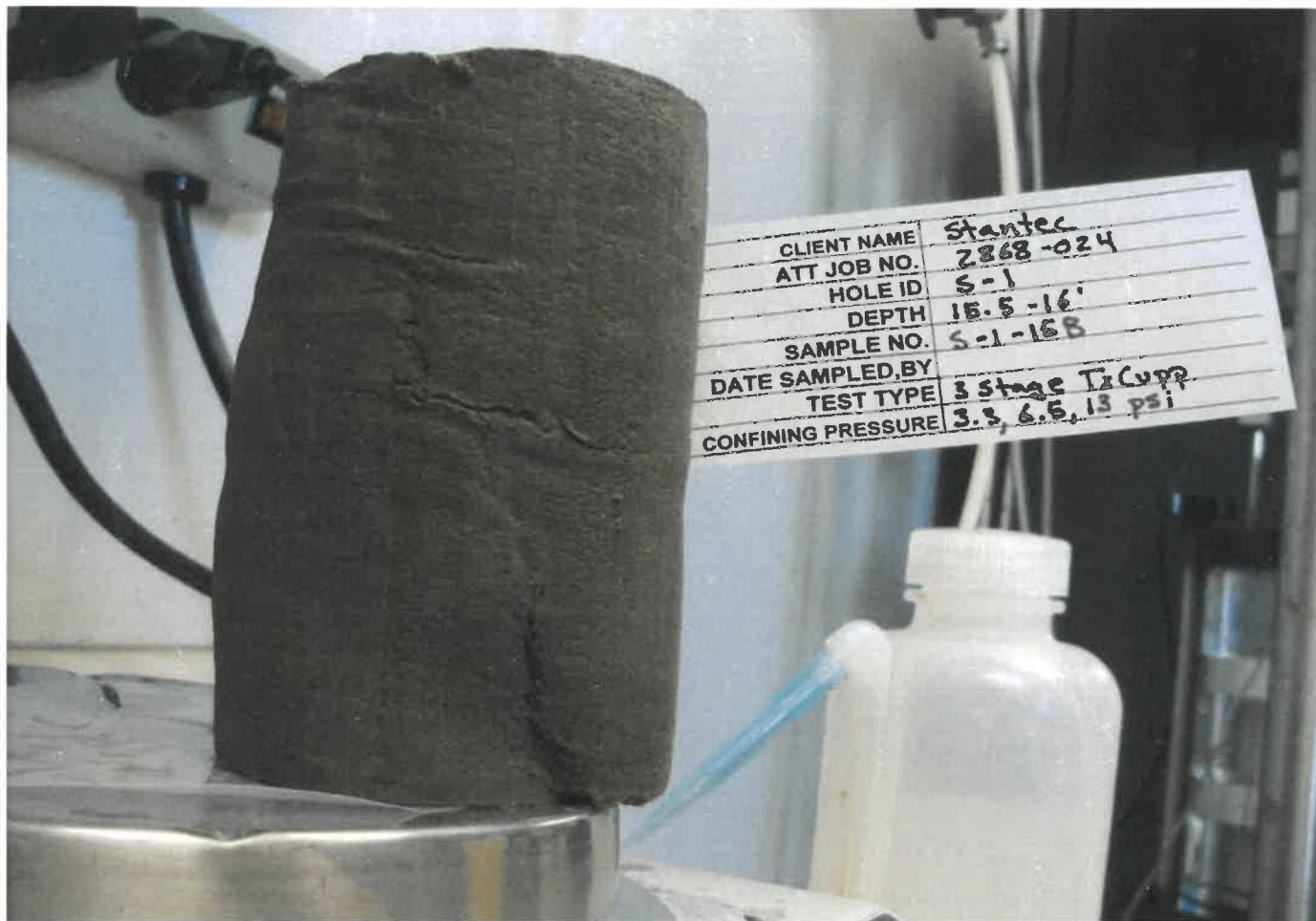
NOTE 3: The K_f is NOT the Mohr-Coulomb failure envelope defined by the equation $\tau = c + \sigma \tan(\Phi)$. The equations $\sin(\Phi) = \tan(\Psi)$ and $c = a / \cos(\Phi)$ may be used to approximate values for Φ and c at the effective stress condition described in NOTE 1.



ADVANCED TERRA TESTING

Image Attachment

CLIENT Stantec
JOB NO. 2868-024
PROJECT GRP EP-1 Relining
PROJECT NO. 233001304
LOCATION --



NOTES

File name: 2868024__Image_18_12_11_09_09_23